Handbook of Research on Human Performance and Instructional Technology

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Section 1
Instructional and Learning Design Foundations

This section presents the concepts and applications of instructional design to the real classroom. In addition, this section discusses key features in designing learning environments and strategies to incorporate effective instructional design models into designing a technology rich learning environment.

Chapter 1
An Ontological Approach to Online Instructional Design.......................................................................................... 1

Robert Z. Zheng, University of Utah, USA
Laura B. Dahl, University of Utah, USA

This chapter introduces the ontological instructional design as an alternative to the traditional instructional design in teaching and learning. By comparing the differences between traditional instructional design and e-Learning, the authors suggest that instructional design in e-Learning require a different model than the existing traditional models due to the idiosyncratic nature of e-Learning in terms of population, environment, and resources.

Chapter 2
Constructivist Instructional Design: A Blueprint for Online Course Design................................................................. 24

Carlos R. Morales, Lock Haven University, USA

With the continuous growth of online learning in higher education, the need to design course materials that capitalize and leverage on the richness of the Internet and learning technologies has taken on new dimensions. This chapter explores constructivist theory paired with instructional design models to design learning environments that apply content to real-life situations.
Chapter 3
Classroom-in-a-Box: Rethinking Learning Community Classroom Environment
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*Caroline M. Crawford, University of Houston – Clear Lake, USA*
*Virginia Dickenson, (the famed Xenon Darrow in Second Life)eLumenata, USA*
*Marion S. Smith, Texas Southern University, USA*

This discussion focuses upon a theoretical understanding of the instructional architecture that supports learning communities within three-dimensional virtual world environments; specifically, within the Second Life world environment. This theoretical understanding provides the essential link between instructional imperatives, performance improvement and a community of learning within an instructional technology framework. Motivated by the shift from the Information Age known for the availability of information towards the Cognitive Age which emphasizes the ability to access, evaluate, organize, comprehend, apply, analyze, synthesize and innovatively represent information into an enhanced understanding and novel use, this discussion offers the opportunity to directly address the learner’s needs within the three-dimensional virtual learning environment, such as Second Life, through the design of a virtual learning environment classroom-in-a-box.

Chapter 4
Three Contexts Methodology: Strategies to Bring Reality to the Classroom .............................. 63

*Antonio Santos, Universidad de las Américas Puebla, México*

The main objective of this manuscript is to propose a methodology called the Three Contexts Methodology based in the situated learning paradigm. It attempts to integrate three contexts related to the process of learning: 1) the context of the community of professional practice that created the content; 2) the school classroom; and 3) the context in which what is learned is going to be applied. Through this the 3CM strives to improve learning transfer and the integration of technology.

Chapter 5
Creating Supportive Multimedia Learning Environments ............................................................. 88

*Bobbe Gaines Baggio, La Salle University, USA*

This chapter explores strategies for developing effective multimedia instruction should be based on evidence presented by cognitive science and backed by research. Unless guided by instructional design principles, multimedia learning products run the risk of being unusual and entertaining but not effective.

Chapter 6
Using CPS to Promote Active Learning .................................................................................... 106

*Youmei Liu, University of Houston, USA*
*Shari Mauthner, University of Houston, USA*
*Lindsay Schwarz, University of Houston, USA*
This chapter discusses the integration of the Classroom Performance System (CPS), and will cover three aspects: 1) incorporating CPS based on active learning theory, 2) discussing student positive feedback on CPS use experiences, and 3) sharing CPS best practice with other educators to promote active learning from teaching, design and administration perspectives.

Section 2
Instructional Technology Applications

This section includes contributions that address innovative technology interventions to solve educational related problems in curriculum and in instruction. Not only does this section speak toward how to use technology in the teaching and learning process, it also address key issues in implementation, project management, and diffusion. Also present in this section are examples and strategies on how to use certain technologies to promote active learning. This collection of articles should be required reading for anyone planning to infuse technology into their teaching and learning practices.

Chapter 7
Wired for Learning—Web 2.0 for Teaching and Learning: Trends, Challenges, and Opportunities for Education

Irene Chen, University of Houston-Downtown, USA
Terry T. Kidd, Texas A&M University, USA

Web 2.0 refers to the recent expansion of the Web. This expansion can be thought of as a new layer on top of the Web and refers to the ways the platform, the Web, is used. Previously, World Wide Web sites were relatively static sites and provided the user information. This chapter will focus on the second generation of Web tools that allow for communication tools, interaction with media and humans, and collaboration and sharing. Web 2.0 tools allow users to create online content--they are writing to the Web.

Chapter 8
Revisit Planning Effective Multimedia Instructions

Chien Yu, Mississippi State University, USA
Angela Williams, Mississippi State University, USA
Chun Fu Lin, Minghsin University of Science & Technology, Taiwan
Wei-Chieh Yu, Chang Gung Institute of Technology, Taiwan

The effective use of pedagogical design principles with appropriate multimedia can permit greater individualization, which in turn fosters improved learning, greater learner satisfaction, and higher retention rates. This chapter reviews the trends and issues of today’s multimedia education, and attempts to provide strategies and guidelines for planning multimedia instruction.

Chapter 9
Applications of Second Life

Nicole Buzzetto-More, University of Maryland Eastern Shore, USA
The following chapter will provide readers with a better understanding of Second Life; the applications and implications of Second Life for teaching, learning, and professional development training; project examples; best practices; a model for the development of education and/or training projects in Second Life; pitfalls and potential problems; how Second Life can offer a linkage between education, professional development training, and organizational development; and future directions for Second Life.

Chapter 10
Using Concept Maps to Enhance Students’ Prior Knowledge in Complex Learning ......................... 163
Robert Z. Zheng, University of Utah, USA
Laura B. Dahl, University of Utah, USA

As an instructional tool, concept map has been widely used to teach complex subjects in schools. Research suggests that concept mapping can help bridge learners’ prior knowledge with new learning, reduce the cognitive load involved in learning and improve comprehension, content retention, and knowledge transfer. Existing literature focuses on cognitive features, cognitive styles and differences between instructor provided and student generated concepts. However, little is known about the effects of concept maps as a cognitive tool to influence learners’ learning, specifically before and after the learning takes place. This chapter offers a discussion of general research in concept mapping and theories that support such instruction.

Chapter 11
Interface Design, Positive Emotions and Multimedia Learning....................................................... 182
Chaoyan Dong, New York University, USA

Research in multimedia learning has not yet been sufficiently investigated. In this chapter, the author proposes that attractive interface design does indeed promote multimedia learning. This hypothesis is based on the review of the following theories and related empirical studies: 1) an interface impacts a user’s experience; 2) beautiful interfaces induce positive emotions; 3) positive emotions broaden cognitive resources; and 4) expanded cognitive resources promote learning. The Model of Emotional Design in Multimedia Learning is proposed to highlight how emotions regulate multimedia learning. Suggestions regarding designing attractive interfaces are provided.

Chapter 12
Blogging Minds on Web-Based Educational Projects ................................................................. 195
Harrison Hao Yang, State University of New York at Oswego, USA

This chapter examines issues and problems of typical Web-based educational projects as gleaned from the literature. It then reveals the potentials and advantages of the Weblog for enhancing those existing Web-based educational projects. It also proposes a new framework which integrates the Weblog as a means for Web-based educational project design, development, and implementation. Finally, a case study is presented which incorporated Weblogs in a specific Web-based educational project - the development of a professional portfolio.
Chapter 13
Language Simulations for Fostering Language Acquisition and Communicative Competence in Adult Second-Language Learners

Angelene McLaren, Wayne State University, USA

This change requires finding effective ways to facilitate this paradigm shift. This chapter will try to answer question: Can language simulations foster language acquisition and communicative competence in adult second-language learners? It will also explore: what language acquisition is and how it is obtained; theoretical foundations of language acquisition; learning simulations and what makes them effective; language simulations – how and why they work; what simulations can do to promote communicative competence; a practical example; future applications and importance of language simulations; and what future research is necessary to fulfill this promise.

Chapter 14
Amateur Radio in Education

Miroslav Skoric, University of Novi Sad, Serbia

The intention of this chapter is to increase capacities in educators for using computer and communication technologies; to help them to acquire systematic knowledge in basic computer networking and communicating with their peers, other teachers, students and parents. In form of introducing “packet radio”, one of the most popular amateur radio computer-related communication modes, the mission of this chapter is to motivate teachers and students to use amateur radio for experimenting with AMUNETs – the Amateur Radio University computer Networks – within their school buildings and university campuses. The chapter describes experiments with networking simulations in local area networks which aim is to gain basic experience with the amateur radio software.

Section 3
E-Learning

The online distance education, web based instruction, and eLearning application section discusses major issues and themes dealing with online web based instruction or what has been widely accepted as eLearning. Chapters presented in this section discuss designing effective applications for online learning, including articles on how to over issues problems in corporate eLearning, as well as a discussion on web based instructional design.

Chapter 15
My Experience Tells the Story: Exploring Technology Adoption from a Qualitative Perspective - A Pilot Study

Terry T. Kidd, Texas A&M University, USA

This chapter, focuses on the first hand experiences of faculty involved in implementing innovative technology solutions aimed at meeting the needs for quality teaching and active student learning. Respondents represented a wide range of academic and professional positions. They identified themselves as
Assistant, Associate, and Professor as well as, Assistant Department Chair, and Associate Vice President of Academic Affairs. Finally, this chapter reports on the predominate themes of the narratives shared by these professions: organizational support, leadership, training and development, and resources as well as suggestions and recommendations for training and development as well as implication for technology leadership.

Chapter 16
Framing Pedagogy, Diminishing Technology: Teachers Experience of Online Learning Software

Julia Thornton, RMIT University, Australia

Literature on teaching online emphasizes the differences between online and face-to-face teaching over the similarities between them. This idea of differences is conceptualized as a discrepancy in expectation between face-to-face and online teaching that requires a remodeling of approach to overcome it. This chapter explores frames and sense making as a means of understanding the experiences of teachers who are slow adopters of technology in settings where technology is also inflexible.

Chapter 17
Online Studio Design Pedagogy: Community, Personality, Graphic Design, Usability

Bridget Zalewski Sullivan, Towson University, USA

The pedagogical and design strategies used to create art design courses for the World Wide Web include: creating a sense of community and personality, course content that considers the needs of the online learner, graphic design, information architecture, web usability, appropriate multimedia methods, Web 2.0 technology and MUVE’s, and the Quality Matters™ peer review. This chapter focuses on the strategies used to unify the online teaching and learning environment for all four of the online Interactive Media Design courses.

Chapter 18
Using Ontology for Personalized E-Learning in K-12 Education

Petek Askar, Hacettepe University, Turkey
Arif Altun, Hacettepe University, Turkey
Kaan Kalunyazgan, Yuce Schools, Turkey
S. Serkan Pekince, Yuce Information Systems, Turkey

E-learning environments incorporate the notion of semantic Web-based ontologies into their future directions. Ontologies by using the capabilities of semantic Web approach, relate information about data (i.e., metadata) with documents in hyperspace. This chapter introduces the development of a K-12 education ontology for e-learning environments. It presents design and implementation processes, followed by several recommendations for future directions for ontology development.
Chapter 19
A Framework for Developing and Implementing u-Learning Models ................................................. 310
Des Casey, Monash University, Australia
Janet Fraser, Monash University, Australia

The advent of networked mobile devices has made the deployment of online learning environments to such devices technically feasible. E-learning environments can be utilised by multiple devices: desktops, laptops, tablets, PDAs, Pocket PCs and mobile/cell phones. Extending traditional desktop e-learning environments to mobile learning (m-learning) environments has created ubiquitous learning (u-learning) environments. This chapter focuses on the appropriate u-learning model needed to proceed with the development and deployment of any u-learning environment.

Chapter 20
A Practical Guide to Evaluate Quality of Online Courses ................................................................. 324
Yungwei Hao, National Taiwan Normal University, Taiwan
Gary Borich, University of Texas at Austin, USA

This chapter introduces a graphic approach to define quality in online courses. The Decomposition Model (Borich & Jemelka, 1982) is used to illustrate course structure and the salient characteristics of an effective online course. The constraints that influence the success of online courses are discussed. Salient transactions (activities) that occur in online courses are described. And the means-end continuum in the process of online learning is illustrated graphically. The chapter is expected to provide readers with a full picture of a quality online course through an architectural framework.

Chapter 21
Web Accessibility Essentials for Online Course Developers ......................................................... 344
Jozenia Torres Colorado, Emporia State University, USA
Jane H. Eberle, Emporia State University, USA

As institutions of higher education (IHE) put more services and resources online, formatting pages so they are accessible to users with disabilities is essential. Although IHEs are attempting to comply with Web Accessibility Standards with their public web pages, full compliance has been difficult. In addition, the growth of online courses has only complicated the issue. Although learning management systems (LMS) may claim to be web accessible, accessibility of individual content items at the course level, is set by the course developer. This chapter will discuss essential information necessary for online course developers to develop web accessible content.

Chapter 22
Web Accessibility Policy for Students with Disabilities in U.S. Postsecondary Distance Education ......................................................... 357
Heidi L. Wilkes, Northeastern University, USA

Satisfying the burgeoning demand for distance education and incorporating the requisite technological changes will provide educational opportunities for many more—often non-traditional—students, includ-
ing those with disabilities. Institutions that choose to offer distance education must assess the environment within which disabled students will work, as well as the legal context, possible risks, importance to the institution’s mission, and the appropriate level of commitment and resources that will contribute to reducing the barriers faced by students with disabilities. This chapter presents a discussion on Web accessibility and the concerns of the ability of students with disabilities to access information on the Internet for distance learning opportunities.

Chapter 23
Pulse!!: Designing Medical Learning in Virtual Reality ................................................................. 374
Claudia L. McDonald, Texas A&M University-Corpus Christi, USA
Jan Cannon-Bowers, University of Central Florida, Orlando, USA
Clint Bowers, University of Central Florida, Orlando, USA

Pulse!! The Virtual Clinical Learning Lab is a federally-funded research project designed to transfer and further develop state-of-the-art game design and technology to create subject matter for clinical medical learning in virtual reality. The underlying design principles of Pulse!! includes immediate feedback, repetitive practice, controlled environment, individualized learning, defined outcomes and educational validity. This chapter focuses on whether the apparatus and conventions of this new paradigm in medical education can be made into an effective tool that is generally acceptable to those who undergo medical training.

Section 4
Sociocultural Aspects of Instructional Technology

This section is dedicated to the exploration and discussion of socio-cultural aspects of instructional systems and technology. Chapters in this section speak to multicultural education issues, issues in ethics and professional responsibility, cultural psychological issues as well as issues in computer mediated communication. This section is a must read for those interested in implementing instructional systems & technology. This section will also help on become knowledgeable and aware of the cultural dynamics that affect the use of technology in the teaching and learning process.

Chapter 24
Multicultural e-Education: Student Learning Style, Culture and Performance ................................ 392
Kenneth David Strang, Central Queensland University, Australia

Academic performance of international university students was predicted using an interdisciplinary model, built by integrating theories from educational psychology and cultural anthropology. Approximately 2,500 online undergraduate business degree students from 21 countries were sampled from an Australian university. An a priori learning style instrument was used to assess their study strategies, which was integrated to an a priori global culture taxonomy using ethnic demographic data. This chapter will focus on the results of the study.
Chapter 25  
Adaptation-Oriented Culturally-Aware Tutoring Systems: When Adaptive Instructional Technologies Meet Intercultural Education .......................................................... 413  
Emmanuel G. Blanchard, ATLAS Laboratory, Canada

With improvements in network technologies and systems’ scalability, more and more globally-distributed applications are increasingly. Opportunities for people from varying societies to play, exchange, confront, cooperate or learn synchronously have multiplied, resulting in many technology-mediated intercultural interactions. Furthermore, with globalization, software creation and distribution is no longer confined within borders; it can be developed anywhere and distributed everywhere around the world. This chapter focuses on research on cultural awareness in e-Learning systems, especially in the sub-domain of Intelligent Tutoring Systems and the generic modular architecture for designing culturally-adaptive e-Learning system.

Chapter 26  
Asian American Perspectives on Education and Technology .......................................................... 431  
Deepak Prem Subramony, Grand Valley State University, USA

This chapter, based on fieldwork conducted in 2007 at a large public university in Hawaii, explores Asian-American college students’ relationships with education and technology, and the role of educational and technological factors in their process of negotiating professional and cultural self-identities as contemporary Americans of Asian descent. The chapter elaborates upon key factors in this regard emerging from the study, viz. (a) Education; (b) Access; (c) Prestige; (d) Survival; (e) Avoidance; and (f) Transnationalism. The chapter subsequently outlines a theoretical framework – based on Willis’ (1977) reformulation of the Marxian concept of “praxis” –characterizing the informants’ educational and technological endeavors as proactive attempts to create an empowered self-identity in response to their socio-cultural environment.

Section 5  
Human Performance

Human Performance is focused behavior or purposeful work (Rudman, 1998, p. 205). That is, jobs exist to achieve specific and defined results (outputs) and people are employed so that organizations can achieve those results. This is performed by accomplishing tasks. Managing performance has the dual purpose of 1) arranging situations (environment) so that employees can do their best and 2) growing the employees by educating, enlightening, and appreciating them. To that end the purpose of human performance is to achieve specific and defined results from people so that the organization can achieve its goals and objectives. This section focuses on strategies, models, and techniques for improving human performance in educational and learning settings.
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For many faculty the integration of technology and learner-centered teaching strategies or the adoption of instructional “best practices” represents innovation and change. The author visited fifteen research intensive university faculty development centers, looking at what they considered best practices with regard to improving instruction. The practices and programs described had one or more of the following components: Motivation, Opportunity, Resources and Evaluation, what I am calling here the MORE model. This paper discusses these four factors important to instructional change agents. The paper ends with a list of implications, based on the model, for that would enable faculty development centers to have more control over the factors that are important to faculty success and systemic change.
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University 2.0 is a collaborative way of constructing and sharing knowledge, based on epistemological and social technologies to amplify the effect of interaction and participation at higher education settings. This chapter will focus on a case study and how Web 2.0 social technologies were implemented to improve teaching and learning performances by integrating user-centered interactive platform, offline support strategies, and evaluation systems.

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The technology revolution is for all practical purposes a major revolution in the history of modern society, impacting every facet of education, business, and industry with a speed beyond one's imagination. Now in the 21st century, technology has taken a higher place in the context of learning and development.

With new information technologies born, with a strong focus on the dissemination of information for both producers and consumers, the focus has now shifted to how technology best be used to harness and develop one's own learning potential. This learning potential has been largely due to the expansion of the World Wide Web and new innovative techniques to learning and development.

In this current decade, the Internet and its associated communication technologies have become a driving force in education, allowing people worldwide to communicate and exchange information in ways that have created a new dimension and taxonomy of learning. In recent years, through the use of Web-enabled technologies, educational institutions and businesses of all types have developed and expanded their traditional learning programs in order to meet the diverse needs of a global population. These technologies now allow for readily available learning and training opportunities for everyone regardless of their geographic location, bringing the true meaning of the education across the seas to its full realization. This is modality of learning is made possible through advances in human performance and instructional technology.

With advances in human performance and instruction technology come advances in teaching and learning and methods for rethinking the teaching and learning paradigm all together. These advances — advances in hardware, software, internet capabilities, and applications have lead to an every widening, yet condense form of interaction, networking, learning, and personal development. With this new understanding of the new aim of human performance and instructional technology is to integrate the three foundational areas into improving the teaching and learning process. These three foundational areas include:

1. **Design**: The systematic identification of educational needs and the subsequent design, development, implementation and evaluation of materials for use in classrooms and at distant sites.
2. **Development**: The production of materials to meet specific educational objectives including multimedia programs, graphics, and video.
3. **Research/Evaluation**: The planning, design, and implementation of research and/or development projects that apply educational technology principles to any aspect of education or training in a variety of settings, including schools, industry, medicine, and the military.

By integrating each of the three foundations, instructional technology paves way to new educational and learning experiences. Looking into this new era of possibilities, instructional technology is considered to be much broader than hardware and software. It is considered a new way of reflection and rethinking one's learning potential.
Instructional Technology includes analysis, design, development, evaluation, and implementation and management of instructional systems and other learning environments that contribute to learning and the development of the mind, body, and spirit. Within this discipline, the theoretical research explored in the field is interdisciplinary, encompassing instructional design theories and models; learning and cognition; instructional strategies and tactics; visual design, media design, and interaction design; usability testing and evaluation; educational systems design; production and management systems; and human performance improvement. These contexts include adult learning in business, industry, government, health institutions, and the like.

As we look at this field in depth, we can see the influences impacting the quality and levels of engagement between the instruction, the learner, and content materials within any given learning environment. This has caused some to reconsider the value of using instructional technology and differentiated instruction. Moreover, aspects of social interaction like mentoring, role modeling, and community are by products of instructional technology and human performance. More often, when forced to use instructional technology in teaching, instructors will default to a technology enhance lecture mode, rather than taking advantage of the variety of instructional technology solutions that can expand the teaching and learning process and the educational experience of the learner. While instructional technology and human performances promises solutions to many educational problems of today, resistance from faculty and administrators to the use of instructional technology and human performance is not unusual. This reaction can arise from the belief - or fear - that the ultimate aim of instructional technology is to reduce or even remove the human element of instruction. Most instructional professionals however, would counter with this claim that education will always require human intervention from instructors or facilitators. With this key idea in mind, the aim of this publication is not to persuade an individual to use instructional technology and human performance techniques; however, the aim is to present strategies and applications of instructional technology and human performance that can benefit learners in the business or educational context. The idea is to inform both educational and business practices.

Because instructional technology and human performance has profoundly impacted every aspect of life of our lives, many researchers around the world have focused on accumulating knowledge on this discipline in order to advance the field forward. The volume of research in the field of human performance instructional technology has by far exceeded many other fields. The sheer impact of research discoveries in this area has become the driving force for many emerging technologies and applications for improving teaching and learning. No longer is this discipline limited to a few areas such as education, but, similar to the field of medicine, business and industry, government and the military. Today, the field of human performance and instructional technology is a collection of many disciplines researchers have created. This collection has been accomplished by producing research to understand the potential, problems, and challenges of each individual discipline, while trying to expand the body of literature related to instructional technology.

To access the latest trends in research in instructional technology and human performance, the decision was made to assemble a handbook where researchers from a global perspective could assist in providing the necessary coverage of human performance and instructional technology. This has lead to the Handbook of Research on Human Performance and Instructional Technology. The primary objective of the book is to highlight current research by defining the most relevant aspects of human performance and instructional technology, terms, strategies, models, and acronyms related to each discipline, and to provide the most comprehensive listing of references related to this field of research.

This book addresses the connection between human performance and instructional technology with teaching and learning, but more importantly learning and development. Using sound instructional and learning design principles, innovative ideas for instructional technology applications, e-Learning, the
socio-cultural aspect of instructional technology and human performance, the authors in this book guide the reader from focusing on the technology as a tool, to focusing on instructional technology as a change agent – changing the way we look at learning.

In order to provide the best balanced coverage of concepts, strategies and trends related to the topics of this handbook, current researchers from around the world were asked to submit their chapter describing their unique coverage of human performance and instructional technology. Each chapter submission began with the proposal phase. Following the authors submission, each proposal was submitted for blind reviewed by a team of reviewers who indicated an acceptance or rejection of the proposed chapter. Following the proposal review process, each author was then given permission to complete their own chapters for the handbook. After completing their respective chapter, the chapter was then submitted once again for blind peer review. After a two round rigorous referred process of two reviewers, the chapters that were strong and favorable from the reviewers were chosen as entries for this handbook. The idea was to assemble the best minds in the instructional technology field to contribute entries into the handbook. As a result of the double blind submission process, this handbook includes more than thirty entries highlighting current concepts, issues and emerging trends, frameworks, and strategies relating to instructional technology and human performance. All entries have been written by leading scholars from many prominent research institutions around the world.

The Handbook of Research on Human Performance and Instructional Technology will provide great valuable to wide range of audiences. These audiences include members from higher education, primary and secondary education, business, industry, as well as federal, state, and local governments and the military. Specifically, this handbook will provide higher education faculty and administrators, educators, researchers, trainers, instructional designer, students, and anyone else interested strategies and frameworks in how to implement effective instructional technology applications to promote high quality active learning. Further, this book will provide a valuable resource to corporate executives and human resources administrators seeking examples of how to blend instructional technology with their training and performance improvement initiatives, as well as insights into where such blending might be financially attractive, efficient and strategically beneficial. Training managers might take advantage of examples from this book to help justify eLearning initiatives and strategic plans. This book also appeals to higher education administrators struggling with issues on where to place value and resources as it relates to online and distance education. Clarification of the range of blended learning models can help administrators and staff members from learning and teaching center on college campuses to training faculty member for a wealth of online and face to face teaching possibilities with instructional technology and human performance techniques. Teaching with instructional technologies is a new experience for most college faculty, so having a range of examples of how to utilize concepts of instructional technology and human performance in the teaching and learning process will become extremely vital. Whether one is designing, developing, implementing or management an online course or designing a technology rich student centered learning environment, instructional designers, teachers, and practitioners alike will need information concerning instructional technology and human performance. Those in the field conducting research in will benefit from reading chapters on the current research and applications both from the corporate perspective, but also from the education perspective. Finally, policy makers reading or accessing this book will discover the value and power in using instructional technology and human performance to promote excellence in quality and in learning and development. Hence governmental funding for these types of initiatives and projects needs to reflect this fact. Increasingly, instructional technology and human performance is playing a vital and significant role in such educational activities.

The chapters authored were selected based on their expertise and leadership roles within the field as well as their unique perspective on the subject matter. With the combination of corporate and military training, non profit organizations, primary and secondary schools, higher education institution, and the
medical industry, a wide range of perspectives were covered in this handbook. Further, this handbook highlights instructional technology and human performance as a growing field of study which uses technological innovation as a means to solving educational, learning, and development challenges.

The chapters presented are not organized by industry. Instead, they are divided into five sections. These themes include instructional and learning design foundations, instructional technology applications, e-Learning, the sociocultural aspects of instructional technology, and human performance technology. This way, the *Handbook of Research on Human Performance and Instructional Technology* will present different approaches to promoting quality learning and development strategies through technology. Moreover, this handbook will provide a sure foundation on different types of instructional design methodologies, tips and strategies on how to use technology to facilitate active learning, a discussion on the sociocultural aspect of instructional technology and trends in human performance technology. In addition, this will provide related a platform and discussion to help faculty, trainers, instructional designers, and teachers to develop online instructional and teaching materials. This handbook also shows instructors how to create authentic and active learning environments with instructional technology complete with an assessment and evaluation guide. Lastly, the handbook provides a platform to assist college and university faculty, trainers, and research to manage and develop eLearning applications with updated strategies that facilitate learning and human capital development in a business context.

For all practical purposes, this handbook discusses various methods and tools for assessment, testing and evaluating of effective instructional technology and human performance strategies for the educational opportunities and learning development challenges. For the future development of instructional technology and human performance, this book gives a discussion on the trends and issues facing the field as well as progression as to where the field may be headed. In the end, this book contains a wide range of ideas, examples, guidelines, stories, models, and solution for anyone interested in the field instructional technology and human performance.

With a diverse and comprehensive coverage of multiple perspectives presented in this authoritative guide, the *Handbook of Research on Human Performance and Instructional Technology* will contribute to a better understanding all topics, research, and discoveries in this evolving, significant field of study. Further, the contributions included in this handbook will be instrumental in expanding the body of knowledge to a wider audience. The coverage will provide a strong reference source for both instructional technology and human performance researchers and also decision makers seeking to obtain a greater understanding of the concepts, issues, trends, challenges and opportunities within human performance and instructional technology.

It is our sincere hope that the *Handbook of Research on Human Performance and Instructional Technology* will assist colleagues, faculty, students, teachers, and business decision makers in enhancing their understanding of this discipline and to effectively integrate instructional technology and human performance to meet the needs of all learning populations. Perhaps this publication will inspire its readers to contribute to the current body of research in this immense field, tapping into possibilities to create, facilitate, and sustain change in educational institutions by making learning and development opportunities open and engaging to participants.

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As I endeavored to edit the handbook of research, I realized how essential the help, encouragement, and support of those with whom we work together. Indeed, this edition could not have come into existence without their tremendous works. I would like to thank all of authors for their continued work and patience and tolerance during the creation of this book. I am surely blessed to have been accompanied by so many distinguished people like you and I am very much indebted to you.

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Holim Song
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Completing a project of this magnitude is a great challenge and an opportunity many chose never to undertake. It is with the help of many individuals who have inspired and motivated me to complete the journey that lie ahead.

I would first like to take this opportunity to acknowledge the considerable time and effort the authors have invested in their respective publications in this book. The authors presented within this book are intelligence and well seasoned in their practice and respective areas. Without the hard work, dedication, and in some cases sacrifice, this book would not be made into reality without the assistance of the authors. Thank you for being so gracious and patient under fire and accepting to my comments and ideas on your chapters. I would like to send a special acknowledge and thanks to my good friend and co-collaborator on this project, Dr. Holim Song from the Texas Southern University.

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Further, I would like to pay a special tribute to my nephew, who shows me it’s a good thing to be a kid sometimes and to my dear sister who works hard to reach the limits in the sky.

And lastly, to my ancestors who were silenced and never saw freedom, this book is dedicated to them.

_Terry T. Kidd (PhD Candidate)_
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Section 1

Instructional and Learning Design Foundations
Chapter 1
An Ontological Approach to Online Instructional Design

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ABSTRACT
This chapter introduces the ontological instructional design as an alternative to the traditional instructional design in teaching and learning. By comparing the differences between traditional instructional design and e-Learning, the authors suggest that instructional design in e-Learning require a different model than the existing traditional models due to the idiosyncratic nature of e-Learning in terms of population, environment, and resources. An ontological instructional design model is proposed with a focus on the sharability, reusability and interoperability of ontological entities and design components within the ontological entities, which provides a holistic approach to online instructional design compared to the segmented, linear design approach in traditional instructional design models. A case study is included to illustrate the use and application of the ontological instructional design model in an online business course. Finally, guidelines for implementing the model are made with suggestions for future research.

INTRODUCTION
The proliferation of web technology in education, particularly with the introduction and implementation of semantic web, has called for the need of re-examining the traditional instructional design in online learning (Snelbecker, Miller, & Zheng, 2007; Zheng & Ferris, 2007). The traditional instructional design models focus primarily on epistemological approach in design by examining the experiential process related to knowledge representation as well as the means related to the production of knowledge based on various principles in instructional design (Han & Park, 2008; Spector, 2001). Although the epistemological approach contributes to a general understanding of the relationship between the knowledge representation and the knowledge production, the implementation of epistemological approach in terms of shared conceptualization of domains in online learning remains an area that
warrants further exploration and validation. In other words, how to implement instruction, particularly online instruction from an ontological perspective has been the focus of many online instructional designers and researchers (Abel et al., 2004; Berners-Lee, Hendler, & Lassila, 2001). The present chapter offers a discussion on (1) issues in applying traditional instructional design models to online learning; (2) differences between epistemological design and ontological design in instruction; (3) the need to apply ontological design to e-learning with respect to recent development in semantic web; finally (4) a conceptual framework for ontological instructional design in online teaching and learning.

ISSUES OF APPLYING TRADITIONAL INSTRUCTIONAL DESIGN MODELS TO ONLINE LEARNING

Studies over the last decade have focused on the issues related to the applicability of traditional instructional design models to e-Learning (Akbulut, 2007; Rutherford & Kerr, 2008). Research in this field has so far produced mixed results. Some believe that traditional instructional design models can be universally applied to any instruction, online or offline (Anglada, 2008; Bi, 2000). Others argue that traditional instructional design models may not fit e-Learning due to their rigidity and lack of flexibility in design (DeSchryver & Spiro, 2008; Gunawardena, Ortegano-Layne, & Carabajal, 2006; Koh & Branch, 2004). Crawford (2004) explored online learning and traditional instructional design and found that there were apparent discrepancies between the two models. According to Crawford, the e-Learning model allows for exploratory, constructivist concept building whereas the traditional instructional design model is procedure-centric which allows little room for creative learning. Consistent with Crawford’s finding, Barron, Orwig, Ivers, and Lilavois (2002) found mismatches between traditional design models and e-Learning models in terms of individualized learning, collaboration, instructional delivery, and instructional design.

Individualized Learning

There are significant differences regarding the theoretical assumptions of individualized learning between traditional design models and e-Learning models (Barron et al., 2002; Harris, 1998). Traditional design models assume that all learners must learn at exactly the same pace and at the same level of content mastery. As such, instructional goals and learning objectives in traditional instructional design are routinely set to fit the normal curve, with little concern for the individual outliers (Moller, Foshay, & Huett, 2008). The above theoretical assumptions and their resultant approaches in traditional instructional design can be problematic because it is difficult to fit online learners into this traditional normal curve. An online learning community is characterized by its diversity in terms of prior knowledge, learner characteristics, motivation, social and economic status, and so forth (Moller et al., 2008; Proske, Narciss, & Korndle, 2007). Therefore, designing online instruction based on normal curve practice and the assumptions of traditional design theory would adversely affect the online learning community where individualized support at various levels is needed.

Collaborative Learning

Although both traditional instructional design and online learning emphasize the importance of collaboration in learning, there are fundamental differences between the two due to the distinct learning mode that each takes in learning. In the traditional classroom, collaborative learning occurs in a face-to-face environment where students concurrently interact with each other in the same place (Topper, 2007). The physical and time constraints thus restrict the mode of
collaboration in instructional design. Typically, instructional designers would maneuver factors related to physical environment such as seating arrangement, student grouping, and so on in order to maximize learners’ learning (Lim, Kim, Chen, & Ryder, 2008; Rutherford & Kerr, 2008). Contrary to traditional collaborative learning, collaboration in online learning is defined as virtual collaboration, meaning the physical interaction that is present in traditional learning environment is not available in online learning. As a result, synchronous and asynchronous communication, virtual grouping, as well as transactional distance (e.g., the interaction among the students, between the students and the instructor, etc.) in online learning become the foci in online instructional design (Giguere, Formica, Harding, & Cummins, 2007; Murphy & Rodriguez-Manzanares, 2008).

**Instructional Delivery**

What makes online learning idiosyncratic and different from traditional learning is the unique way that the online instruction is delivered. Traditional teaching relies heavily on the instructor, texts, and classroom media to deliver the content (Rutherford & Kerr, 2008; Solimeno, Mebane, & Tomai, 2008). An instructor would typically resort to texts, handouts, worksheets, and sometimes classroom media like Smartboard, video, or PowerPoint to deliver the content. Solimeno et al. (2008) point out that in a traditional classroom environment the instructor simply coordinates what is available to make the content delivery successful. They argue that the traditional teacher-centered approach impedes learners’ self-initiation in learning. Learners have little control over the content delivery and learning process. Conversely, in an online learning environment, learners have much control over the content delivery and are able to make decisions during the learning process (DeSchryver & Spiro, 2008). For example, e-Learning is characterized by multiple nodes and nonlinear presentation of information. Learners can thus choose the information appropriate at their level of learning. Moreover, since the content in e-Learning is delivered digitally, there is an opportunity for the instructional designer to incorporate various media including multimedia and hypermedia and various communication tools like email, blogs, threaded discussion, synchronous and asynchronous learning, and so on to deliver the content in the way that promotes learner self-initiation and constructivist learning (Papastergiou, 2006). Papastergiou noted that the traditional instructional design that capitalizes on teacher-centered approach in content delivery appears to be ill-fitted for e-Learning environment where learner-centered information access and delivery are emphasized.

**Instructional Design**

Most of traditional instructional design models were derived from behavioral models (Gustafson & Branch, 1997). This behavioral origin underscores the philosophical differences between the traditional learning and e-Learning, which result in differences in design between the two camps. Crawford (2004) observed several differences between traditional instructional design and e-Learning design. First, the traditional instructional design follows a hierarchical, linear approach in which the design components are disconnected and segmented whereas the e-Learning design is characterized by a non-linear approach in which instructional information is presented in a form of web or network. Second, in traditional instructional design, goals and objectives are always defined by quantifiable behavioral indicators, whereas in e-Learning design the focus is on open-ended learning process. Crawford argued that because of the differences between e-Learning and traditional learning, the instructional design related to each type of learning has been distinctly different: the instructional design in e-Learning accentuates developing a learning environment where learners are able to share and construct
new knowledge whereas the design of traditional learning focuses on achievement of a set of specific goals or objectives (see also Shoop, Nordstrom, & Clariana, 2007; Rutherford & Kerr, 2008).

As was mentioned, there are significant differences between traditional and e-Learning design. Such differences derive primarily from the underlying design philosophy of the two schools. Research indicates that simply migrating traditional instructional design to online instructional design without considering the unique characteristics of e-Learning would cause more harm than doing good (Wuensch, Aziz, & Özan, 2008). Instructional designers should therefore be cautious about applying traditional instructional design models to e-Learning. Researchers (e.g., Abel et al., 2004; Gasevic & Hatala, 2006) suggest that the current study on e-Learning should go beyond the superficial differences such as learning environments to explore the epistemological and ontological aspects in design, particularly by examining the design consequences of each in teaching and learning.

**EPISTEMOLOGICAL AND ONTOLOGICAL INSTRUCTIONAL DESIGN**

Epistemology and ontology are related and at the same time are distinct from each other. They differ in the approaches toward the nature of knowledge which consequently result in different learning outcomes. The following is a discussion of the differences between epistemological and ontological instructional design.

**Ontology**

The term ontology essentially refers to the study of being or existing. It seeks to describe or posit the basic categories and relationships of being or existing to define entities and types of entities within its framework. In modern era the theory of ontology has been mapped to a new discipline -- computer science and has thus assumed a new meaning different from its philosophical origin.

**Ontology in Philosophy**

In Greek philosophy, ontology means understanding the eternal reality (Reginald, 1985; Spector, 2001). Plato defined the reality as primary and the perception and experience of reality as secondary. Socrates held the similar view that the purpose of learning was to recognize eternal truth and therefore the instruction was to remind someone of something already known and accepted as true (Spector, 2001). This classical view of ontology has changed due to a realization that the explanation and uncovering of external reality involves human as perceiver and that human judgment, with respect to such uncovering, is subject to error.

One of the assumptions of modern ontology is that instruction should focus on bodies of knowledge rather than individual knowledge (Merricks, 2007). Instead of relying on one-to-one correspondence between individual beliefs and external reality, the modern ontology proposes a coherence theory of truth in which acceptance or rejection of new beliefs should be based on how well new beliefs fit with and how coherent they are with the established beliefs (Merricks, 2007; Quine & Ullian, 1978; Spector, 2001). This assumption is important in that it influences the formation of ontology in computer science in which the shared conceptualization of reality across knowledge domains is emphasized.

**Ontology in Computer Science**

Derived from its philosophical origin, the ontology in computer science is a data model that represents a set of concepts within a domain and the relationships among those concepts. For example, in artificial intelligence, software engineering, biomedical informatics and information architecture, the ontology is defined as a form of knowledge.
An Ontological Approach to Online Instructional Design

representation about the world. Ontologies in computer science generally describe:

- Individuals: the basic or “ground level” objects
- Classes: sets, collections, or types of objects
- Attributes: properties, features, characteristics, or parameters that objects can have and share
- Relations: ways that objects can be related to one another
- Events: the changing of attributes or relations

The advent of web technology, particularly the semantic web, necessitates educators, instructional designers, and other educational professionals to re-examine the existing practice in web-based instructional design by putting in perspective the ontological design as they develop their web-based instruction. Henze, Dolog, and Nejdl (2004) point out that the challenge of web-based learning is to provide distributed information with well-defined meaning, understandable for different parties. They assert that one solution to such challenge is to develop an ontological approach so that applications will be used to “provide individually optimized access to information by taking the individual needs and requirements of the users into account” (p. 82). Sampson, Lytras, Wagner, and Diaz (2004) concurred that ontology, which is a major component of semantic web, should play a key role in enabling the representation and dynamic construction of shared and reusable learning content (see also Yang, Chen, & Shao, 2004).

The Semantic Web is an evolving extension of the World Wide Web in which the semantics of information and services on the web are defined, making it possible for networked computers to understand the requests of people and machines to use the online content. Berners-Lee et al. (2001) posit that the Web as a universal medium for data, information, and knowledge exchange ought to comprise a set of machine-readable content using design principles, collaborative working groups, and a variety of enabling technologies. Some elements of the semantic web are expressed as prospective future possibilities that are yet to be implemented or realized. Other elements of the semantic web have been defined and are expressed in formal specifications. They include eXtensible Markup Language (XML), database connections (SQL), Resource Description Framework (RDF), and notations such as RDF Schema (RDFS) and the Web Ontology Language (WOL), all of which are intended to provide a formal description of concepts, terms, and relationships within a given knowledge domain (Antoniou & van Harmelen, 2004). In addition, people-readable specifications using notations such as Cascading Style Sheets (CSS) and eXtensible Stylesheet Language (XSL) have been widely accepted as standard forms for machine-readable documents to enhance sharability and reusability.

Epistemology

Epistemology or theory of knowledge is the branch of philosophy that studies the nature, methods, limitations, and validity of knowledge and belief. Much of the debate in this field has been focused on analyzing the nature of knowledge and how it relates to similar notions such as truth, belief, and justification (Spector, 2001). The early epistemology such as Descartian philosophy emphasized the first truths as a foundation to construct a picture of reality (Fuller, 1955; Williams, 2001). Differing from the classical ontology as represented by Plato and Socrates, Descarte’s epistemology challenged the established truths by questioning every belief that one holds about external reality. This view of beliefs was associated with the rise of science and the success associated with the scientific method, which Descartes helped codify (Spector, 2001). Descarte’s work laid the foundation for epistemological study which centers on
the experience of reality through perception and persuasion, the very “enemies” which Socrates and Plato attacked with such vigor.

One approach that epistemology tries to reach truth is through empiricism - what we can know through our senses - which we can summarize as “we believe what we see”. Another approach is skepticism which asks “how can we believe what we see?” Fisher and Nicholas-Everitt (1994) point out that empiricism and skepticism are two ways of approaching our experience of life and the subjectivity of our minds. By relating this philosophical view to the educational practices, we saw the boom of behaviorism which taps into in the empirical aspect in learning (Bloom, 1956; Skinner, 1953), and the rise of cognitive information process theory which explores the unknown of the mind pertaining to learning processes (Baddeley, 1986; Klahr & Wallace, 1976).

Differences between Epistemological and Ontological Views on Knowledge

Epistemology and ontology differ significantly on the views of knowledge with former focusing on the nature and production of knowledge, and the latter on the concept of knowledge. For example, epistemology primarily addresses the following questions: “What is knowledge?”, “How is knowledge acquired?”, and “What do people know?” whereas ontology searches for answers to the question “How do you know it?” So far, there has been a great emphasis on epistemology in instruction. For example, most instructional design models and strategies are based on epistemology to answer the questions of how knowledge is acquired and what people know. Little attention has been given to the ontological aspect in the design of instruction.

THE NEED TO APPLY ONTOLOGICAL DESIGN TO E-LEARNING

As was mentioned elsewhere, the current status of instructional design has been characterized by the epistemological approach which focuses primarily on single knowledge domain in design. With the increasing use of World Wide Web in teaching and learning, particularly the use of semantic web, it is important to consider the ontological aspect of knowledge in design by answering the question “How do you know it?” We believe that there is an imminent need to develop a framework for ontological instructional design in e-Learning. However, before we proceed to an indepth discussion of the issue, let us first examine the existing ontological models in computing.

A Review of Computational Ontological Models

To date, research on ontological design has been primarily focused on computational perspective with an emphasis on instances and classes, objects and property attributes associated with domains. Several computational models of ontological design have been proposed that include Hendler’s (2001) ontological design model, Henze, Dolog, and Nejdl’s (2004) domain ontology model, and Abel et al.’s (2004) ontology-based organizational memory model. The first two are generic ontological models whereas the latter one deals with organizational memory work in ontological design. For the purpose of this chapter our discussion will center on generic models in computational ontological design.

Hendler’s Ontological Design Model

Hendler’s (2001) model represents a data model that describes the relationship between domains. The model defines the domains in terms of dimensions and values. For example, a weather service
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Domain may be represented by dimensions containing advertisement, description, and logic, as well as values that include format, service type, and service logic. The values corresponding to their respective dimensions can be expressed as follows:

advertisement.format:=[multimedia];
description.description:=[service type];
logic.transfer:=[TransferOccurs(#cost, service):= Reached (ServState), ServiceCost(#cost)].

The logic.transfer notation describes the information about services associated with a transfer action during severe weather (Figure 1). In Hendler’s model, different domains (e.g., weather service and transfer service) are connected based on semantic rules of dimensions, values, and universal resource indicators (URIs). The model describes objects that act as binding glue between different systems and services and serve as a basis for interoperability among various ontological entities (Ullrich, 2004). Hendler (2001) points out that the model enables computer program constructor to “use ontologies to ensure that everyone agrees on terms, types, constraints, and so forth” (p. 32).

Domain Ontology Model

While Hendler’s model defines domains in terms of dimensions and values, the domain ontology model proposed by Henze et al. (2004) focuses on classes and object properties. The model uses computational notation to define class type and object properties. In the example of weather service mentioned above, the weather service domain is related to other domains in terms of class type and object property. For example, weather service can be defined as a service class type which includes the properties of information, guidelines and resources. The weather service class is related to the transfer service class through the activation of emergency object property. Thus, the above relationship can be expressed by following computational notations.

type:weatherService[
    type:class ->weatherService:
        object_oriented
    weatherService:information
        ->type:web_doc
    weatherService:guidelines->type:web_doc
    weatherService:resources->type:web_doc]
type:transferService[
    type:class->transferService:
        object_oriented
    transferService:cost->type:web_doc]
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The above computational notations indicate that weather service and transfer service are two reusable objects, each of which is defined by its properties. The object properties in the notations are web document type that is subsumed under the relevant domains. Figure 1 shows the differences between two models discussed above.

Limitations of Computational Models in Ontological Design

Although computational models of ontological design provide a blueprint for e-Learning by examining the components across domains in a web environment, they are limited by their micro-level analysis that deals exclusively with computational objects and pertinent semantic relationships. In addition, the models are marked by such high level technicality that renders little applicability to general educational community. To conclude, the models are effective tools for designing computational semantic web, but are insufficient in terms of serving the purpose of general educational community.

A MODEL FOR ONTOLOGICAL DESIGN IN E-LEARNING

As indicated, the epistemological instructional design is limited by its narrow focus on single knowledge domain and can be problematic when applying to the design of e-Learning, partly because most traditional models were developed well before online learning becomes a reality in education, and partly due to the fact that online learning is characterized by interoperation among multi-domains that form a new knowledge representation in learning (Lundin, 2000; Snelbecker et al., 2007). On the other hand, the computational model of ontological design demonstrates little relevancy for general educational purposes because of its high technicality. Having discussed the limitations of both models in e-Learning, we would like to offer a different perspective on e-Learning by proposing an ontological approach toward online instructional design.

A Model of Ontological Instructional Design in E-Learning

One of the key issues that frequently surfaces in the study of e-Learning is learners’ self-initiation in learning (Allen, 2005; Berge et al., 2000). Allen (2005) examined the variables that affect learners’ self-initiation in e-Learning and concluded that self-initiation is critically related to (a) the presence of constructivist learning environment in learning, (b) levels of content challenge and learners’ prior knowledge, and (c) the connection between the target domain and germane domains of knowledge. According to Allen (2005), learners become more active in learning if they are given the opportunity to construct their own knowledge by relating the new content to their prior knowledge and to make meaningful connections among various domains of knowledge. Berge et al. (2000) point out that active online learning entails collaboration in learning where knowledge collaborators share knowledge and new ideas through various social negotiation processes. Research shows that quality collaboration can influence the quantity and quality of knowledge that flow into the virtual learning community (Chapman, Ramondt, & Smiley, 2005) and that effective collaboration is characterized by positive interdependence, individual and group accountability, and interpersonal and small group skills in learning (Johnson & Johnson, 1994; Zheng, 2009).

Recently, efforts have been made to incorporate the above factors in the design of learning (Morrison, Ross, & Kemp, 2007; Yang et al., 2004). Morrison et al. propose a model that focuses on fostering active learning and collaborative experience for students. Instead of presenting the instruction with a linear, segmented design, Morrison et al.’s model takes a holistic approach by examining the critical role of each design compo-
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Figure 2. A model of ontological instructional design for e-learning
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relationship, the design principle derived from this relationship would define a linear, hierarchical approach as its design strategy. The following discussions focus on relationship among different ontological entities that include design entities (e.g., knowledge repository, media repository, and design component repository) and interaction entities (e.g., knowledge representation and media), followed by a presentation of the ontological design principles related to the ontological instructional design.

Knowledge Repository and Knowledge Representation

The interaction entity of knowledge representation is directly interfaced with the knowledge repository, a design entity, and indirectly related to the media repository via the media entity. According to Yang et al. (2004), knowledge representation in e-Learning is composed of content structure and format. For the knowledge representation to be functionally meaningful, it must draw on and interact with the knowledge repository and be shaped by the design principles and strategies in the design repository. In other words, the content structure of knowledge representation is formulated based on the inputs from the knowledge repository and the design component repository.

The knowledge representation has two formats: carriers and shells. The carriers are knowledge representation tools to deliver the concepts and skills to learners whereas the shells represent the space for knowledge construction and creation (for details on the discussion of knowledge representation as carriers and shells, see Kyzylkaya, Torun, & Askar, 2007). In the event of e-Learning, the selection of the format is dependent on the purpose of the instruction. For example, if the instruction is to deliver the content for learners to learn the basic concepts and skills, the carrier presentation will be used to deliver the content. If the purpose of the instruction is to develop skills in knowledge construction, the shell presentation will be used for learners to construct new knowledge.

In short, the shells enable learners to create new knowledge and share it with other learners. The carriers store the knowledge which is presented to the learner.

Media Repository and Modality Concerns

Media are interfaced with the media repository to support the knowledge representation in e-Learning. They can be integrated with the carrier to present the content. Examples include using multimedia or hypermedia to present the content. They can also be used with the shell to support knowledge construction. For example, learners can use multimedia tools to create a learning object that contains the new knowledge created by the learner and post it to the web to share with others.

A related issue concerning the use of media is modality effect on learning (Mayer, 2001; Zheng, 2007). Although there is an overlap between media and modality, they are distinct from each other in terms of the role they play in e-Learning. Media refers to the use of one medium (e.g., video) or a combination of several media (e.g., video, audio, textbook, etc) in instruction. Modality means the presentation of information that is cognitively processed in a certain way by the working memory. For example, information can be presented through either auditory or visual channels. Positive modality effect occurs when the information presented through auditory or visual or both formats assists in knowledge acquisition. Negative modality effect is observed when the information presented through visual or auditory channels competes with limited cognitive resources in working memory, thus impeding learning (Mayer, 2001; Mayer & Johnson, 2008; Sweller & Chandler, 1991). Presenting knowledge with multiple media does not necessarily produce positive modality effect. Selecting media or determining instructional modes often depends on the nature of, and structure of knowledge to be
presented (Zheng, Miller, Snelbecker, & Cohen, 2006). When learning simple declarative knowledge such as the name of a place, the text mode would suffice. However, when learning complex procedural knowledge such as advanced geometry, images, text, even auditory modes become essential for understanding the content (Butcher, 2006). In an ontological design environment, selection and design of media should be considered in conjunction with modality effects.

**Design Component Repository**

The design component repository consists of rules, strategies, principles, and procedures of instructional design (Dick, Carey, & Carey, 2005; Gustafson & Branch, 1997; Smith & Ragan, 2005). It interacts with other design entities (e.g., knowledge repository and media repository) to provide support to knowledge representation. Its primary roles are to package an instructional material based on the instructional design principles and to deliver it to learners in a more effective manner. Because of its organizational and delivery functions, design component repository is included in this model as one of the key functions for e-Learning.

Taken together, the above ontological entities demonstrate a high level of sharability and interoperability across domains. Figure 3 shows the relationship among knowledge repository, design component repository, and knowledge representation.

As was demonstrated, the outer circle in Figure 3 is the knowledge repository that contains domains operating on semantic rules. The middle circle shows the design component repository that consists of design components operating on the shared knowledge rules. Distinct from traditional design models, the proposed ontological instructional design model emphasizes sharability and interoperability of knowledge domains and design components. The ontological design underscores a holistic approach in which the analyses of goals, learners, instructional strategies, and so forth are interdependent on one another. For example, the determination of an instructional goal is affected by variables in both design entities and representation entities. That is, considerations should be given simultaneously to such factors as the task, the content, and so forth (knowledge repository) and mode of presentation, instructional strategies, etc. (media and design repositories). The interoper-
ability between ontological entities characterizes what is called dynamic ontological instructional design in this model. Further discussion on the component interoperability will be presented later in a case study in the chapter.

**Ontological Design Principles**

By definition, ontology means to query “how do people know it” in the process of knowledge acquisition. Following this fundamental philosophical view, we propose three basic ontological instructional design principles based on which we design and develop the instruction.

**Principle One:** Ontological design is most effective when it promotes “how do people know it” rather than “what do people know.” This principle is based on the coherence theory of ontology that emphasizes the coherence between new knowledge and an established body of knowledge (Spector, 2001). New knowledge is gained through successful social negotiation with a larger social group to reach a harmony between new beliefs and established beliefs. This principle reflects the basic tenets of social constructivist learning in which self-initiation and social collaboration are at the core of knowledge construction (Bi, 2000; Bird, 2007; Brooks & Brooks, 1993).

**Principle Two.** Ontological design is most effective when ontologies are interfaced with each other to form a network of knowledge domains.

This principle is based on recent research on computational ontological design and studies on semantic web (Hendler, 2001; Henze et al., 2004). Research on semantic web reveals that learning becomes more effective when instructional resources are organized in a meaningful network that facilitates knowledge association and creation (Gasevic & Hatala, 2006; Yang et al., 2004).

**Principle Three.** Ontological design is most effective when a network of known knowledge exists to facilitate the construction of new knowledge. Based on the second principle, this principle focuses on constructing new knowledge by relying on an existing body of knowledge. It aligns with the schema learning theory which posits that meaningful learning occurs when new knowledge is integrated with the existing schemata (Piaget, 1952; Zheng, Yang, Garcia, & McCadden, 2008). An ontological design for learning becomes meaningful when learners’ learning experience, both as knowledge consumers and as knowledge constructors, is supported by a larger body of knowledge to which learners are able to relate themselves in the process of learning (Winberg & Hedman, 2008).

The ontological entities and design principles identified above provide a theoretical framework for designing and developing an ontological instruction in learning, particularly in online learning. To understand the application aspect of the principles, we introduce a case study in which the above principles are applied to teaching and learning in an online environment.

**APPLYING THE ONTOLOGICAL INSTRUCTIONAL DESIGN MODEL TO ONLINE LEARNING: A CASE STUDY**

This section focuses on the practical aspects of ontological design model, that is, the application of the ontological instructional design to online learning. Our discussion starts with a case study on a course design related to international leasing, followed by an analysis on the challenges pertaining to the course design and delivery. Finally, an ontological design approach is suggested with a focus on the application of identified design principles and the ontological design model.
The Case Study

Due to the fast growing economy in Asia, the international leasing business has blossomed, bringing an annual net revenue of 53 billion US-Dollars for the industry. Accompanied with this growing business are issues related to culture, business regulations and practices, international laws, and so forth. A recent study shows that litigations on international leasing are on the rise, partly due to a lack of understanding of different cultures, and partly because of unfamiliarity with the business regulations and practices in the partner countries. Therefore, there is an immediate need to train people to become familiar with the areas mentioned above.

S University decides to start a joint online program on international leasing with its partner university in Asia. The purpose is to bridge the gap between two countries by training people to become familiar with the cultures and business regulations of both countries and to independently problem solve complex situations in international leasing. Students enrolled in this program are expected to go beyond the minimum requirement of learners as consumers of knowledge but would be able to share and construct new knowledge in learning.

Challenges

There are several challenges pertinent to the design of the new program. First, there is a lack of adequate resources. Although general resources can be found in the library or other academic database, a well-organized resource on perspective culture related to leasing business is lacking. Secondly, due to a rapidly changing market economy in the partner country, the business regulations have been under constant revisions. This becomes a challenge to the program in keeping up with the changes so that the information does not become dated. Finally, there is a big challenge to the instructional design in terms of meeting the expectation that students go beyond knowledge consumers to become sharers and constructors of new knowledge.

Using Ontological Instructional Design Model to Meet the Challenges

The application of ontological instructional design model involves examining the relationships between ontological entities in a system and between ontological components within an ontological entity. As the ontological design model is used to organize and make connections between various ontological entities in the system, considerations must be given to whether the ontological entities facilitate learners’ experience in knowledge construction and sharing (principle one) and whether the ontological entities operate on the rule of interoperability and sharability so that a network of knowledge domains can be created (principle two). Further, it is important to have a mechanism within the established network of knowledge domains that supports the creation of new knowledge (principle three). Figure 4 displays the relationship between ontological entities in ontological instructional design.

The above ontological model enables the designer to clearly identify the functions and roles of the ontological entities in the system. For example, knowledge representation provides the learner with the access to the domain content which is connected to a larger ontological entity called knowledge repository. Both knowledge repository and design component repository provide the inputs in determining the content structure in knowledge representation. Finally, knowledge presentation is presented via media which draws resources from the media repository. Each ontological entity is defined by domain, method, and value. For example, knowledge representation consists of international leasing as its domain that is represented in modules. The quality of the modules is defined by the value of structural rules. A well organized and structured
module means it is well executed and highly efficient whereas a poorly organized and structured module means less efficiency. Besides, by looking at the diagram in Figure 4 we find that the modules in knowledge representation have two forms: carriers and shells. This means the learner can access the content either via carriers or shells. In the former, the learner plays the role of knowledge consumer. In the latter, the learner becomes a knowledge constructor.

As indicated, Figure 4 provides a map of the relationship among ontological entities. However, understanding such relationship requires a further examination of the components within an ontological entity as well as the association and connections among those components. In the following sections, we first describe the components in each entity (i.e., knowledge repository and design repository), then we present a discussion on the associative relationship among the components from each entity and how they are effected in the knowledge representation.

Knowledge Repository

Since international leasing is known as a multinational business, it encompasses several domains of knowledge. The domains may include cultures, business regulations, international leasing, international laws, history of international leasing, and so forth (Figure 4). A semantic web approach is used to organize the individual domains into an ontology of knowledge domain. For example, specific identifiers are used to define the domains in the metadata section of a HTML or XML so that they become searchable in the web. In a semantic web, learners are able to develop, as the webmaster does, sharable ontological content with many built-in tools in the Web. Thus, the domains are no longer a static repertoire of knowledge. Instead, they become active, dynamic resources powered by the learners who become actively involved in the learning process by creating ontological learning content which is further shared by a larger group of online learners.

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Figure 4. Relationship between ontological entities in the ontological design model
Design Component Repository

The design component repository consists of all the design components in instructional design. Not every instructional design needs to include all the design components. They can be selectively used based on the purpose of the instruction. However, when the components are used, they must be considered simultaneously in the design process. Table 1 shows a matrix that demonstrates the horizontal and vertical relationships between the components.

In this matrix, the horizontal relationship describes the interrelation between components whereas the vertical relationship delineates the dimensions of the component in relation to other components. For example, by examining the horizontal relationship between the instructional strategy and learner characteristics, the designer is able to determine the degree to which instructional strategy is related to learner characteristics, thus detect the level of interplay between two components. Likewise, by examining the vertical relationship of the instructional strategy with other components such as content and learner characteristics, the designer identifies the functional dimensions of instructional strategy. That is, instructional strategy can be functionally operated at the level of learner characteristics and content. Obviously, the matrix analysis enables the instructional designer to gain an understanding of the design components in considerable depth and breadth.

Knowledge Representation

Next, the components identified in both ontological entities, i.e., knowledge repository and design repository, are being considered in a larger context in terms of representing the knowledge to learners. For example, the design of semantic web for multiple knowledge domains is examined through the lens of design components. Specifically, the designer looks at the associative strength between the knowledge domains and the design components such as learner characteristics, instructional strategies, and so forth.

Based on the inputs from design component and domain knowledge analyses, the knowledge representation is formed. Various learning modules are formulated to represent the knowledge identified and at the same time the rules of reusability and sharability are applied to the design and development of instructional modules. Different from the traditional design, the ontological approach of representing knowledge enables learners to experience the construction and creation of knowledge through multiple venues, thus promoting a learning process that focuses on the understanding of “how do people know it” rather than “what do people know.”

In conclusion, the ontological design model is used in the case study to illustrate how an online instructional program can be created to facilitate dynamic knowledge acquisition and creation, as well as promote learners’ self-initiation and collaboration in learning. The model identifies the relationship among ontological entities in the design process. It reveals the interactive nature of components within an ontological entity and their connection with other ontological entities.

GUIDELINES FOR APPLYING ONTOLOGICAL DESIGN TO ONLINE LEARNING

As an alternative to traditional instructional design, the ontological instructional design has been increasingly adopted by instructional designers who perceive it as a promising approach to teaching and learning, especially in online learning (Kyzylkaya et al., 2007; Ullrich, 2004). With the advent of semantic web, knowledge is no longer considered to be individualized entities. Instead, they are ontologies of domains that can be constructed, reused, and shared. This change of knowledge representation demands a paral-
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Table 1. Component matrix of ontological instructional design

<table>
<thead>
<tr>
<th>Components</th>
<th>Content</th>
<th>Learner Characteristics</th>
<th>Instructional Strategy</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>Understanding the concepts and principles in international leasing, cultural factors, local business regulations, international laws that influence the business operation</td>
<td>Determining the relationship between content and learner characteristics</td>
<td>Identifying instructional media and strategies for content delivery</td>
<td>Determining assessment strategies to measure the delivery of content</td>
</tr>
<tr>
<td>Learner Characteristics</td>
<td>Identifying the range of learner characteristics</td>
<td>Developing instruction that gears toward individual needs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructional Strategy</td>
<td>Developing instructional strategies that support knowledge sharing and construction</td>
<td>Developing the assessment to measure the effects of media and instructional strategies in content delivery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessment</td>
<td></td>
<td></td>
<td></td>
<td>Developing the assessment that measures students’ basic knowledge, creativity, and constructivist thinking</td>
</tr>
</tbody>
</table>

Table 1. Component matrix of ontological instructional design

An ontological approach in instructional design. Rather than following a sequential, segmented approach in traditional instructional design, the ontological instructional design takes a nonlinear, interactive design approach in which resources become globally sharable and learning is regarded as a process of knowledge construction and creation (DeSchryver & Spiro, 2008).

Although ontological instructional design has shown its presence in teaching and learning, the complexity and evolving nature of the design requires instructional designers to take careful consideration of the factors that may affect the application and implementation of the design. It should be noted that the model could not be expected to address all aspects of the issues in ontological instructional design. However, it can help designers to identify the critical elements in design by examining the knowledge domains, knowledge representation, and relationship between ontological design components. Here are some general guidelines to consider:

1. The ontological instructional design should take in perspective the differences between ontological and epistemology approaches toward instructional design by distinguishing the epistemological view of what-do-people-know from the ontological view of how-do-people-know-it in learning.

2. The ontological instructional design should take into consideration the interoperability and sharability of ontologies and use a design approach that examines simultaneously various ontological entities as well as the components within an ontological entity.

3. The implementation of the ontological instructional design should take into consideration the design principles so that effective learning occurs in an ontological learning environment.

4. A balanced approached should be taken toward ontological instructional design which draws strengths from different research and practices including computational ontological design, instructional design in epistemological approach, pedagogies and best practices related to everyday classroom teaching and learning.
SUMMARY

The traditional design approach that focuses on linear, single domain design has become inadequate to address the increasing challenges faced by online learners, especially when the growth of knowledge has outpaced human’s processing capacity (Andrade, Ares, & Garcia, 2008; Dede, 2004). A new mode of learning that emphasizes knowledge interoperability, reusability, and sharability should be instated to meet the challenges of new learning. The ontological instructional design model proposed in this chapter is to provide an alternative perspective to the traditional design by introducing a methodology that will affect an ontological approach in learning.

By identifying the ontological entities which include knowledge representation, knowledge repository, design component repository, and so on, the model presents a holistic view of the functions and roles of ontological entities in design. Rather than presenting segmented instructional units, the ontological entities are related and interfaced with each other to promote knowledge sharing and construction. For example, knowledge representation is interfaced with knowledge repository so that domain knowledge in the knowledge representation is not segmented or isolated pieces of information. Instead, knowledge that flows from knowledge repository enriches the domain content in knowledge representation.

Related to knowledge repository and knowledge presentation is the design component repository. As an ontological entity, design component repository contains all the design components essential to the instructional design. In traditional design, the design components are sequenced in a hierarchical manner. The drawback for such design is that the designer typically focuses on one component at a time. There is a lack of holistic approach to the design. The proposed model provides a holistic approach by coordinating different design components in a single design platform called design matrix so that the designer will be able to simultaneously consider multiple factors in terms of their horizontal and vertical relationship.

To summarize, the proposed model presents an ontological approach to instructional design. The model can be applied in various online instructional design and learning. Taking an ontological approach, the design zeros in on knowledge sharability and reusability which have been commonly accepted as a design rule in semantic web. Drawn from its philosophical origin as well as major tenets from constructivist learning theory, the model promotes the experience of knowledge construction as the way of knowing. A case study is provided to illustrate how the model can be applied to the design and development of an online curriculum. As has been pointed out, the model cannot be expected to address all aspects of the issues in ontological instructional design. Future research is needed to test the model and its design principles in variety of online learning environments.

FUTURE RESEARCH

Online instructional design can be challenging to educators who are accustomed to traditional models of teaching. The proposed ontological instructional design model suggests a different way to traditional instructional design by drawing attention to the interplay of various design components and the relationship between ontological entities in a learning system. Instead of examining the roles of individual design component as does the traditional design model, the ontological model proposed in this chapter underscores the functions and roles of ontological entities in supporting various instructional goals and objectives. Future research is needed to test the generalizability of the model that can be applied to various online learning curricula and subject areas. Further empirical studies are needed to prove the validity and reliability of the principles, especially when
they are used to support online learning. Finally, research should be conducted to examine the correlation between the proposed model and other online models to further validate the usability and applicability of the model.

REFERENCES


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KEY TERMS AND DEFINITIONS

Design Component Repository: The design component repository consists of design components similar to those in traditional design models (Dick, Carey, & Carey, 2005; Gustafson & Branch, 1997; Smith & Ragan, 2005). It operates on the shared knowledge rule which determines the interactivity of the design components and the level of interfacing with the domains in knowledge repository.

Epistemology: Epistemology or theory of knowledge is the branch of philosophy that studies the nature, methods, limitations, and validity of knowledge and belief. The early epistemology such as Descarte emphasized the first truths as a foundation to construct a picture of reality (Fuller, 1955). Differing from the classical ontology as represented by Plato and Socrates, Descarte’s epistemology challenged the established truths by questioning every belief that one holds about
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external reality. This view of beliefs was associated with the rise of science and the successes associated with the scientific method, which Descartes helped codify (Spector, 2001). An important focus in epistemology is to try to reach truth through empiricism - what we can know through our senses - which we can summarize as “we believe what we see”.

**Knowledge Repository:** Knowledge repository refers to a wide range of knowledge domains across various subject areas including math, physics, biology, social science, language, etc. Domains within the knowledge depository are connected by semantic rules and can be accessed through domain identifiers and classes. Knowledge repository primarily interfaces with the design component depository in which the design components like goal analysis, task analysis, learner characteristics, and so forth interact with the knowledge domains to provide inputs for the design of knowledge representation. Since knowledge repository operates on semantic rules, the domains become sharable within the knowledge repository as well as with ontological entities outside the knowledge repository such as design component repository.

**Knowledge Representation:** Knowledge representation in ontological design consists of content structure and format. The content structure of knowledge representation is formulated based on the inputs from knowledge repository and design component repository. The format often takes the form of modules which have two different presentations, shells and carriers, the selection of which is dependent on the purpose of the instruction. For example, if the instruction is to deliver the content for learners to learn the basic concepts and skills, the carrier presentation will be used to deliver the content. If the purpose of the instruction is to develop skills in knowledge construction, the shell presentation will be used for learners to construct new knowledge. In short, the shells enable learners to create new knowledge and share it with other learners. The carriers store the knowledge which is presented to the learner.

**Ontology:** The term ontology essentially refers to the study of being or existence. It seeks to describe or posit the basic categories and relationships of being or existence to define entities and types of entities within its frame work. In Greek philosophy, ontology means understanding the eternal reality (Reginald, 1985). Plato defined the reality as primary and the perception and experience of reality as secondary. Socrates held the similar view that the purpose of learning was to recognize eternal truth and therefore the instruction was to remind someone of something already known and accepted as true (Spector, 2001). This classical view of ontology has changed due to a realization that the explication and uncovering of external reality involve human perceiver and that human judgment with respect to such uncovering is subject to error. One of the assumptions of modern ontology is that instruction should focus on bodies of knowledge rather than individual knowledge. Instead of relying on one-to-one correspondence between individual beliefs and external reality, the modern ontology proposes a coherence theory of truth in which acceptance or rejection of new beliefs should be based on how well new beliefs fit with and how coherent they are with the established beliefs (Quine & Ullian, 1978; Spector, 2001). This assumption is important in that it influences the formation of ontology in computer science in which the shared conceptualization of reality across knowledge domains is emphasized.

**Ontology in Computer Science:** Derived from its philosophical origin, an ontology in computer science is a data model that represents a set of concepts within a domain and the relationships between those concepts. For example, in artificial intelligence, software engineering, biomedical informatics and information architecture, the ontology is defined as a form of knowledge representation about the world. Ontologies in computer science generally describe (1) Individuals: the basic or “ground level” objects; (2) Classes: sets, collections, or types of objects; (3)
Attributes properties, features, characteristics, or parameters that objects can have and share; (4) Relations: ways that objects can be related to one another; and (5) Events: the changing of attributes or relations

**Ontological Instructional Design:** Ontological instructional design involves examining the relationships between ontological entities in a system and between ontological components within an ontological entity. The ontological design model is used to organize and make connections between various ontological entities in the system. Considerations must be given to whether the ontological entities facilitate learners’ experience in knowledge construction and sharing and whether the ontological entities operate on the rule of interoperability and sharability so that a network of knowledge domains can be created.
Chapter 2

Constructivist Instructional Design: A Blueprint for Online Course Design

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ABSTRACT

With the continuous growth of online learning in higher education, the need to design course materials that capitalize and leverage on the richness of the Internet and learning technologies has taken on new dimensions. Constructivist theory paired with instructional design models is believed to have a positive influence on the design of learning environments that apply content to real-life situations. Constructivist instructional design for online learning challenges instructional designers regarding the philosophy and methodology to be used, while it provides the conditions for learner-centered instruction. Instructional design and learning theories have been separated into their own arenas. Developing online learning environments using constructivist instructional design addresses and serves the learning needs of students by providing opportunities for increased knowledge construction and participation.

INTRODUCTION

The growth experienced in distance education through the online learning delivery method has been steadily exponential, requiring the use of new instructional and design strategies. Vital to this growth is the course design process that, paired with an increased accountability and requirements by accrediting agencies and the public, has prompted the addition of new course design methodologies, adjoining significance and relevance to online education (Merisotis and Phipps, 2000; Middle States Commission on Higher Education [MSCHE], 2002; Oliver, 2000). Instructional designers have found that traditional instructional design theories alone have limited applicability when designing online learning environments from a constructivist approach (Reigeluth, 1999; Williams, 2002).

The aforementioned growth is validated by the increasing number of colleges and universities that offering certificates, courses and entire
programs through the Internet (Allen and Seaman, 2004; 2005; 2006, National Center for Education Statistics [NCES], 2003). The growth seen in online learning has prompted the application of structured methodologies to ensure that online courses are equivalent to or better in content, activities, and rigor than their face-to-face (FTF) counterparts (Brooks, 2004; Howell, 2001, Kassop, 2003). Instructional design theories and models have been adapted to the online learning environment in an effort to meet the needs of non-traditional students as well as the requirements of accrediting bodies (Reigeluth, 1999; 2005). At the same time, an increased emphasis on quality assurance in the design of the virtual classroom has been seen in recent years (Monterrey Institute for Technology and Education, 2008; Quality Matters, 2008; WCET, 2008).

The use of instructional design models paired with learning theories like constructivism might aid higher education institutions in addressing low student interaction by increasing the impact on student learning in online courses (Morales, 2007).

The use of constructivist principles in the design of online courses and online programs capitalizes on the ability of the learner to construct knowledge while accessing prior knowledge. This process not only fosters the construction of knowledge in the learner, but also builds expertise in the subject, procedures, and skills (Clark, 2003; Jonassen, 1999). Constructivism is in line with learning-centered environments, in which the control of learning shifts from the instructor to the learner. The focus of design is on learning and the learner Berge (2002). Constructivist grounded learning environments provide learners with greater opportunities for engagement by working on activities that are authentic, relevant and applicable beyond the classroom.

CHAPTER OBJECTIVES

The reader will be able to:

- Recognize the importance of incorporating instructional design for the design of online courses.
- Comprehend how the constructivist theory can be used in online course design.
- Understand the educational implications of constructivist instructional design in online learning.
- Be aware of what course activities leverage on the constructivist approach.

MAKING TECHNOLOGY WORK FOR LEARNING

With the continuous growth of online learning in higher education, the need to design course materials that capitalize and leverage on the richness of the Internet and learning technologies has taken on new dimensions. The design of content that appeals and captivates the attention of online learners while providing opportunities for its application beyond the online classroom has increased as well. Constructivist instructional design for online course design might provide assistance to instructional designers and faculty in addressing learning styles in online learning. Karagiorgi & Symeou (2005) asserted “pairing constructivist instructional design with technology plays an important role by allowing non-linear learning” (p.23). These practices stimulate authentic learning by fostering the development of instructional strategies that facilitate further active construction of knowledge. The information presented in this chapter might assist course developers, instructional designers and faculty as they rethink and retool the design and delivery of online courses. This approach of combining instructional design models with learning theories for the development of learning environments grounded in constructivist theory might be of
great use in improving student satisfaction and the outcome of educational programs.

Higher education institutions are at defining moment as they look into ways to increase educational offerings to the underserved, while keeping distance education as a viable and convenient way to accomplish that goal. This attempt requires that a new blueprint and rationalization for course design strategies be considered (Morales, 2006). Increased pressure from accrediting agencies, board of governors, the public and the learner have required institutions of higher education to improve the quality of their offerings and find new ways to increase student retention, completion rates and satisfaction (Allen, & Seaman, 2004; Kassop, 2003; Quality Matters, 2007). An approach that incorporates the use of constructivist instructional design for online learning might assist course development staff to rethink the way courses and its activities are designed for online delivery. Recommendations for practice for instructional design teams are included.

**DESIGNING INSTRUCTION FOR ONLINE LEARNING**

Instructional designers continue to be challenged to create meaningful learning activities in order to fulfill student learning needs in accord with the promise a technology–enriched delivery medium might bring. As documented in the literature, instructional designers have found that the current instructional design theories have limited applicability when the course goals and objectives are based on a constructivist approach (Bolan, 2003; Chen, 2007; Karagiori & Symeou, 2005; Williams, 2002). The iterative process of analysis, design, development and evaluation at times falls short in meeting instructional design needs for online learning these days (Williams, 2002). In recent years, instructional designers and faculty have identified the need for instructional design models that provide more flexibility during course design. In part, the challenge can be addressed by incorporating constructivist activities into the course design process. Most of the instructional design models such as ADDIE, Rapid Prototyping, 3PD and Dick and Carey, still in use are too rigid or require too many steps. Faculty and instructional designers continue to debate the best way of using constructivist learning environments for the design of online learning materials, which suggests the possibility of continuing the exploration and adoption of this type of learning environment. Students taking online courses might benefit from problem-based learning, situated learning, collaborative learning and goal setting. As documented in the literature, course design for online learning requires planning as well as the establishment of goals and objectives that result in the development of the best learning environment (Morales, 2006; 2007).

Instructional designers play an important role in helping faculty develop content and learning materials applicable to the online classroom (Morales, 2006). Courses developed using instructional design and a constructivist approach that adhere to superior design standards (Quality Matters, 2006) are believed to have a positive influence on whether students experience a successful completion or early withdrawal. Research has found that inserting constructivist activities into the course design process increases student motivation and adds pertinence and value to the course as the activities allow students to construct knowledge using real-life applications (Reigeluth, 2005; Rovai, 2004; Shank, 1999). This is an important characteristic as the instructor develops online presence techniques that empower students to find and construct knowledge themselves rather than relying on the instructor as the sole source of information. The development and utilization of presence strategies by online faculty has been documented in the literature as a procedure that increases student motivation and collaboration while infusing the course with pertinence (Morrison, 2002; Palloff & Pratt, 1999; Picciano, 2002; Schneider, Frête & Synteta, 2002; Swan, 2002).
The use of sound instructional design for online learning course development has increased during the last decade (Chen, 2007; Reigeluth, 1999; Williams, 2002). The increased importance attained was accompanied by additional accountability, relevance, and pertinence. From the perspective of accountability, the public and accrediting agencies have traditionally been the ones demanding high quality course offerings. With the advent of online education, such demands continue to be applied as equivalencies to the rigor, design and quality of course activities for online learning. There is an unresolved challenge that accompanied this aforementioned growth: during the last decade no new instructional design methodologies have been proposed or developed for online course design with the goal of adding value, pertinence and real-life application —principles grounded in constructivism—to a delivery method that in principle is isolated and devoid of social characteristics.

The use of constructivist theory paired with instructional design was sought as a strategy that instructional designers and faculty could use to impact student learning. Constructivist instructional design allows instructional designers to design learning environments in which students could integrate and maximize authentic learning experiences and activities with subject matter (Chen, 2007; Morrison, 2003; Tam, 2000; Willis, 1995). On the other hand, the theory of constructivism has not been given adequate attention as a design strategy in online course design, in part because of the separation existing between instructional design models and learning theories (Dick, 1992). Researchers have found that constructivism is an effective learning theory used in traditional course design (Jonassen, 1999; Oliver, 2000).

Bourdeau and Bates (1996) assert the existence of an intrinsic link between instructional design (ID) and distance learning (DL), stating:

The importance of instructional design for distance learning introduces three main characteristics of optimum learning: learner control, dialogue and thinking skills. Similarly constructivist instructional design provides the conditions for learner-centered instruction as well as for active instruction. Bourdeau and Bates (1996) asserted that the importance of instructional design for distance learning lies in the macro and micro aspects of instruction. The macro aspect includes understanding and knowing the market, having a student support system in place, media selection, diffusion modalities and the evaluation of learner outcomes. On the other hand, the micro aspect of this link between instructional design and distance learning is visible in the design of learning activities, instructor evaluations and student support systems (p. 271).

Williams (2002) conducted research about instructional design factors and the effectiveness of web-based instruction. The author reiterated the importance of instructional design by saying “instructional design is the foundation for effective teaching and learning in an online environment” (p. 142). Williams suggested that designing courses based on the behaviorist and constructivist learning theories paired with adult learning theory is important in shaping the success of a course or program. This approach addresses and serves adult learning needs in a learning environment providing learners with increased participation in how and what to learn. In the case of adult learning, a major benefit is the fact that the skills and knowledge gained in the course can be immediately applied to their workplace, adding value to the effort (Shank, 1999; Washabaugh, 2003). Authors have compiled lists regarding the principles considered critical for the design of online materials and added that “using sound instructional design methods and learning theories increases student motivation and persistence” (Shank, 1999; Williams, 2002, p. 140).

The popularity of instructional design models during the decade of the 1990’s made them usable and widely researched by many practitioners. On the other hand, several have raised their continued concern regarding the limitations of instructional
Design models in providing the conditions for the development of constructivist learning environments. For many years it was promoted that instructional design models could not be paired with learning theories. Authors like Dick (1992) and Willis 1995, have pointed to the limitations found in instructional design models, asserting: “instructional designers should reconsider the theories they use to design learning” (p. 91). Dick initially seems to be against the mix of constructivist learning theories and instructional design; one of those trends is the use of “constructivist learning environments for the transfer of skills and knowledge” (p. 98).

Instructional design, by the use of theories and models, provides the tools and strategies to address the challenge of interconnecting four aspects of course design for distance learning: content, learning activities, guidance, and student support. These four aspects comprise what various authors consider a “complete DL package” (Bourdeau and Bates, 1996, p. 271; Simpson, 2002). The authors’ advocacy for instructional design in distance learning includes the use of ID as the ideal approach to solving many of the problems associated with DL.

**Constructivist Theory and Online Learning**

In the following section we provide a review the basics of the constructivist theory. The constructivist theory proposes that learning is an active process in which learners construct rather than acquire knowledge (Vygotsky, 1978). Constructivism is a philosophical viewpoint, a psychological construct, and an epistemological approach from which educators have derived specific teaching techniques (Honebein, 1996; Vygotsky, 1978). The philosophical perspective of constructivism holds that the truth as such cannot be known. The understanding of truth has been always socially and historically rooted and therefore limited.

According to Piaget (1971), the key points of constructivism state that individuals construct an understanding of the world through their interaction with objects, information and people in their environment and that individuals pass through four stages of cognitive development: sensory motor period, preoperational period, period of concrete operations and period of formal operations. Constructivism is a dynamic theory in which learners interact with the knowledge and information in an interpretive way. This interaction provides ID with data that allows them to use the theories in various ways with a heterogeneous learner population. Constructivist theory also permits knowledge to be presented from various perspectives so that the learner’s cognition level develops flexibility. This approach provides for the most efficient way of transferring knowledge to learners. This is well documented in a number of articles (Brown, Collins, and Duguid, 1989; Honebein, 1996; Lefoe, 1998). The theory of constructivism indicates that knowledge will be acquired and constructed by interaction with course content, information, learning objects and the learning situation being discussed (Tam, 2000; Rovai, 2004; Vygotsky, 1978). These interactions later will become named experiences, which will allow the learner to solve problems while facing new challenges and situations founded upon the new knowledge. The content is not pre-specified because the learner is encouraged to pursue other knowledge domains. Examples of constructivism operate on the notion that every field has its unique ways of learning. The idea is that the learner is taught how to develop a particular mentality toward the field of study.

Many years later, Jonassen asserted that, “knowledge is individually constructed and socially re-constructed by learners based on their interpretations of experiences in the world” (Jonassen, 1999, p. 217). Several scholars (Chen, 2007; Howell 2000; Karagiorgi & Symeou, 2005; Williams, 2002) have asserted that the use of instructional design models as the foundation for
online course design is believed to have a positive impact on student learning and satisfaction Jonasen (1992). They asserted that the constructivist theory claims that reality “…is more in the mind of the knower. The knower constructs a reality or an interpretation of it based on his/her experiences.” (Jonassen, 1992, p.29). Constructivist environments engage learners in the construction of knowledge through collaboration in diverse activities that embed relevant acquaintance, though reflection on what has been studied though interaction with content and other learners. The construction of knowledge occurs while interacting and reflecting on other students’ experiences as well and comes accompanied by inquiry that it is based on the expectations that are meaningful and pertinent to the learner. Interactive learning is present in four types: learner-content, learner-learner, learner-instructor and learner – interface (Hillman, Willis and Gunawardena, 1994; Moore, 1989) and be supposed to include feedback in the form of evaluation, assessment and other related processes. Constructivist activities for online learning could be designed effectively around constructivist environments as a way to capitalize on the richness of content, communication venues and flexibility provided by the internet.

The development of constructivist activities that capitalizes on the four types of interaction requires a change in the paradigm of how we design instruction and will be discussed further in this chapter. Among those proposed changes, we include leveraging more learning theories in conjunction with instructional design models, designing for the student-centered model and for the instructional designer, continuing his/her role as one that prescribes processes and procedures that include advice and consultation that might yield a broader usage of constructivist activities for online course design (Morales, 2007).

Incorporating constructivist activities into the instructional design process for online course design provides instructional designers with an increased repertoire of real-life applications, activities and strategies. At the same time, the inclusion of constructivist activities provides learners with greater participation and control of their learning.

The central point for developing learning environments grounded in constructivist principles are: to provide students with real-life application of the subject under study beyond the classroom, to engage and motivate learners to build expertise while constructing their own knowledge and to infuse pertinence into the subject under study (Chen, 2007). Instructional designers should develop a fresh repertoire of strategies, tools and approaches towards course design. This includes the possibility of combining learning theories with design models to better achieve not only the learning goals, but also the design goals as well.

**Instructional Design and Constructivist Theory**

Instructional design and learning theories has been separated in their own arenas. The advent of distance education and more recently online learning, has prompted reviewing the options we as instructional designers have available to improve the design of instruction. Constructivist activities ought to be designed centered on the student and not on the instructor’s expertise (Bordeau & Bates, 1996; Taylor and Maor, 2000). Much has been discussed regarding the design of pre-learning activities, which provide information about the structure of a course, expectations, instructions and competencies (Huang, 2002; Karagiorgi & Symeou, 2005). One of those venues to develop activities focuses on the development of authentic projects and problem solving situations, which will impart relevance to the subject but also provide learners with scaffolding as he or she constructs knowledge. Constructivism paired with technology-supported learning environments provides a link between constructivist theory and distance learning (DL), allowing students to build knowledge and expertise. In reviewing ID
models, researchers had reached the conclusion that ID models could provide the conditions to foster the acquisition of knowledge that applies to specific as well as to new situations (Chen, 2007; Tam, 2000). Instructional design models are limited in their ability to develop rich learning environments or supporting knowledge acquisition that function in complex natural environments (Williams, 2002).

The application of constructivism to online course design may ensure that learning is provided in authentic and meaningful contexts, that higher order learning skills be engaged, and that asynchronous tools like email and discussion forums promote in students the development of communication skills (Tam, 2000). Redefining the role of the instructor from being the source of information to being a facilitator of knowledge construction as well as increasing student autonomy by allowing them to participate more in determining learning methods, goals and objectives is seen as an added strategy towards successful implementation of constructivist instructional design.

Instructional design and its connection with constructivism can be justified with the use of technology. Although it has been suggested that its use might foster in students the development of knowledge as a construction, hundreds of studies, conducted in the last 20 years showed that there is no significant difference in learning with or without the use of instructional technology (Russell, 2001). The combination of instructional design models with the constructivism theory aids students in the development of knowledge construction patterns in a malleable way.

The integration constructivist instructional design might require a change in the paradigm of teaching. Teaching strategies for constructivism learning environments rely on two commonalities: case-based reasoning—which uses prior problem-solving experiences to solve the current problem—and problem-based learning—in which learning is based on the solution of a defined problem. Learning environments grounded in constructivist principles provide the student with real-life application of the subject under study beyond the classroom. Instructional design for online courses ought to capitalize on the dynamism and richness of the Internet by engaging and motivating learners to build expertise while constructing their own knowledge (Clark and Mayer, 2003; Dick and Carey, 1996; Mayer and Moreno, 2002).

Bolan (2003) proposed the idea that the combination of instructional and experiential learning theories promotes active participation and learner control. The case is made regarding the importance of course design to student retention in online courses by indicating that, “scheduling specific milestones into courses is believed to reduce attrition in fully asynchronous courses” (Bolan, 2003; p. 12). In practice, this may be achieved best through asynchronous course design. Activities and milestones could be designed and incorporated into online learning in a way that facilitates learning and increases motivation. Another important aspect of the relationship between the works of the two authors is that they recognize that instructional design by itself cannot fulfill the challenges required by course design and that effective course design relies on social constructivism to increase student learning, motivation and satisfaction in online courses. The key aspect is how instructional designers schedule milestones that are pertinent to the learner. An example that justifies the rationale of developing specific milestones is experience-based courses, which are best for clinical components because they can provide “the conditions for engaging students and accommodating learning styles” (Karagiorgi & Symeou, 2005).

Course design can deliberately focus on student interaction (Touvinen, 2000) providing for the utilization of the four types of interaction: learner-learner, learner-content, learner instructor (Moore, 1989) and learner-interface (Hillman, Willis and Gunawardena, 1994) discussed later in this chapter. Of the four interactions learner-content is believed to be the most fundamental.
Instructional designers are responsible for designing content for online education. In that sense, Ascough (2002) asserted that instructional designers must have a clear understanding of the medium as well as the pedagogical principles that lead to deep learning. What Ascough (2002) indicated is consistent with other researchers (Bolan, 2003; Williams, 2002), who claim that online education is a different way of teaching that requires a different approach. Some of the differences lie in three areas: type and form of content, communication mediums and participation from the learner. Furthermore, the author emphasizes one difference called “social dynamics,” in which aspects of gender, class and race issues are present. Instructional designers as well as instructors might provide opportunities for these differences to be addressed during the learning process.

For years practitioners and researchers have been focusing on two important aspects of online course design: technological characteristics and the pedagogical structure of the course. Researchers have discussed those technical considerations taken into account during the design phase that may positively influence online learning. These include employing a variety of media objects such as audio and video, hyperlinks to other important resources, videoconferencing and PowerPoint slides, when appropriate. The pedagogical structure has gained increased attention via the introduction of quality assurance elements (Quality Matters, 2008).

The “usefulness of online learning technology” is used to imply that these strategies foster student learning (Arbaugh, 2002, p. 137). Consequently, his notion that the medium of delivery’s ease of use be consistent with the enhancement of student attitudes and the online learning experience itself is also presented. It is noteworthy to mention that the focus is on the importance that course and interface design have in facilitating and promoting student learning in online learning environments.

Instructional designers and online instructors are supposed to be aware of social interaction, as it is one of the characteristics embedded in the delivery medium that could be increased. The majority of interaction occurs using text as a medium, which some learners may find devoid of visual richness. The challenge continues to be to employ alternative techniques, which might include the use of audio and video communications when possible. Some of those techniques involve the use of inexpensive technology such as web cams and computer microphones. Asynchronous and synchronous technologies like desktop sharing applications, Web 2.0 (Blogs, Wikis), SMS, Instant Messaging, Voice over IP (VoIP), audio and video chat, and these technologies allow learners to engage in social interaction with other learners as well as with the instructor. These strategies implement layers of stimulus that can increase interaction between learners. The provision of these optional technologies supports learning goals and outcomes (Clark, 1983; 2003). As the learner participation increases the opportunities available to students to construct their knowledge increases as well.

Constructivist learning environments should integrate authentic learning experiences and activities, real-life knowledge applications, social collaboration, and the presentation of multiple perspectives through instructional media in order to provide the ideal conditions for students to develop self-awareness. This aspect of the constructivist model assigns more value to how a student develops knowledge than what and how much a student knows about the subject.

**CONSTRUCTIVIST INSTRUCTIONAL DESIGN FOR ONLINE LEARNING**

The unification of instructional design with constructivist learning environments for online learning is believed to promote student learning, motivation and satisfaction. While Tam (2000) justify the use of instructional design models, Bolan (2003) emphasizes the need for providing the best learning environment by designing with
learning styles in mind. Gardner’s learning styles theory continue to be a key aspect in designing instruction because they provide guidance to the teacher and instructional designer on what content style and type work best for students’ learning.

The design of constructivist learning environments requires strategies and models that provide clear and prescriptive guidelines. Picciano (2002) indicated that in order to foster learning communities with a strong social learning foundation, social and communicative interactions between student and student and also between student and teacher are to be present in online courses. In a similar line the author asserted that the utilization of course design methods that emphasize student interaction result in greater satisfaction, motivation and a higher number of students achieving learning. The author also mentions that highly interactive courses are “successful in making the student adjusts to the non-linear asynchronous nature of most online courses” (p. 23).

One of the major benefits of the constructivist theory is that it helps to infuse motivation into distance education while respecting the learning attributes of adults (Knowles, Holton & Swanson, 1998; Markel, 1999). Researchers and practitioners (Ascough, 2002; Chen, 2007; Huang 2002; Petraglia, 1998: Jonassen, 1995) proposed applying constructivist theory to distance education and consequently to online learning. Huang 2002, asserted, “Hypermedia and Web publishing are knowledge construction environments…” (p.30).

The increased utilization of instructional technology continues to play an important role in distance education. In online learning, a combination of delivery methods is believed to help learners achieve a more integrated learning process. Instructional Technologies as asserted by Jonassen (1999), are cognitive tools that aid learners in articulating their thoughts while engaging in meaningful learning experiences. Instructional technology also aids learners in articulating what they know and reflecting on what they have learned. It also supports the development of mental models and the construction of personal representations of meaning.

Much has been said about adult learners in distance education and their specific needs. The theory of andragogy, proposed by Knowles, Holton and Swanson (1998) states how adults learn and what is important to them. Constructivist learning in many ways addresses the needs of adult learners by providing scaffolding activities grounded in real-life application and case studies, aspects that allow adult learners to apply knowledge acquired in the classroom to their workplace and online learning is seen as a springboard to deliver content and activities suited for an adult audience (Brookfield, 1986).

On the other hand, Lefoe (1998) asserted “instructional design models developed in the 60’s provide clear information on how to design instruction but fail in serving Instructional designers well at the time of designing constructivism learning environments” (p. 454). The author emphasizes that “constructivist learning environments should focus on learning rather than on teaching” (p. 456), thus an increased attention must be given to the three elements found in constructivism learning: context, collaboration and construction. Lefoe (1998) noted that designing constructivist-learning environments for the web requires capitalizing on interaction and collaboration. Simulation and role-playing allow students to showcase how they learn. In addition, avatars in virtual worlds like Second Life are becoming increasingly popular and valuable in the quest for the development of social constructivist learning environments for the web. Web 2.0 technologies no longer promote passive learning, they are pivotal in helping students construct their knowledge as they communicate and publish blogs, documents and other objects around topics of importance to them and others in class. This is reinforced by the fact that “learning is mediated by tools and signs” (Lefoe, 1998, p. 461). The computer and the web mediate in student learning because they provide the condi-
tions for the student to consult various sources, perceive content applied to real-world situations, and integrate the sources and views into his or her own knowledge. This rationale supports the view that once constructivist-learning environments are implemented in conjunction with problem-based learning in collaborative learning conditions, students find pertinence in the subject while developing ownership of what they have constructed (Morales, 2007). A similar line of thinking was expressed by Lefoe in 1998 by concluding: “A comparison of the two learning environments described here indicate that it is the designers’ interpretation of the goals and the way they are translated into learning activities that provides the unique experience in each constructivist learning environment.” (p. 460).

The Blueprint: Constructivist Instructional Design for Online Learning

It is necessary to discuss the elements required to develop online learning courses with a constructivist approach. The recommendations are focused on “presentation of content, instructor-student and student-student interactions, individual and group activities and student performance” (Rovai, 2004, p. 84). Content presentation may include ancillary materials, readings, an orientation that includes what is expected in the course, and support for fostering a learning community. The author provides suggestions about how to combine constructivism with student interaction, a strategy identified by other researchers (Lefoe, 1998; Tam, 2002) as key to the process of constructing knowledge; more specifically, the value of discussions, role-playing, peer citations and online presence (Palloff, & Pratt, 1999; Picciano, 2002) as well as “reflective interaction” (Rovai, 2004, p. 85-86).

Individual and group activities can be designed in ways that appeal to students and allow the application as well as the construction of knowledge based on how the world is perceived. Successful strategies for individual and group activities may include regular group evaluation and individual accountability to provide the proper conditions for fostering interdependence among students. Finally, group work can act symbiotically to encourage the development of environments in which collaboration and participative learning are present, aspects that provide added value in constructivist learning environments.

Constructivist instructional design poses a challenge to faculty and instructional designers when it comes to assessment. This type of learning environment requires the use of authentic tasks related to the instruction as well as the goals and objectives assumed. These tasks promote the ownership of knowledge and may include a combination of assessment options: portfolios, exams, group projects, discussions and regular assignments (Rovai, 2004; Jonassen, 1992).

Instructional design for online learning requires new ways to present content while at the same time requiring an adaptation of teaching strategies used for delivering instruction. Instructional designers and faculty members seeking to provide their courses with constructivist learning environments can employ several of the seven goals of constructivist learning proposed by Peter Honebein (1998, pp. 11-12):

1. Provide experience with the knowledge.
2. Provide experience in and appreciation for multiple perspectives.
3. Embed learning in realistic and relevant contexts.
4. Encourage ownership and voice in the learning process.
5. Embed learning in social experience.
6. Encourage the use of multiple modes of representation.
7. Encourage self-awareness of the knowledge construction process.

The seven goals Honebein (1998) developed for constructivist learning are prescriptive by em-
phasizing how course design can provide students with ownership and real-life applications—two important aspects of constructivist learning environments. Honebein’s goals provide students with knowledge construction processes and experience in appreciating multiple perspectives. In online learning these goals can enhance student learning via discussion boards, email and synchronous communication tools. Honebein’s underlying principle provides Instructional designers and faculty with guidance on how to create constructivist-learning environments and realistic activities in which students see the pertinence of and develop a sense of ownership over the content, and learn in collaboration with peers Honebein (1998).

In conclusion, research continues to show that instructional designers and faculty have identified the need for instructional design models that provide more flexibility during course design, emphasizing that the traditional design phases at times fall short in meeting instructional design needs for online learning (Hobbs, 2002). It continues to be mentioned in the literature that Computer Assisted Instruction (CAI) allows educators to reach diverse learning styles in what is usually referred as active learning. Allowing learners to construct their knowledge based on providing guided content via an online course is the approach to follow.

The Practice of Constructivist Instructional Design

In 2007 a study on the perceptions of instructional designers regarding the use of constructivist theory for online courses design was conducted. The results showed that many IDs are aware of the theory but other factors affect the application of constructivist theory, the frequency of use, and how to best combine its theory with their design.

Research conducted recently indicated that the use of constructivist principles in online course design is more pervasive than initially thought and instructional designers were aware of the constructivist theory and its benefits as they are incorporated into online course design. The study found that 8 out of 10 instructional designers incorporate constructivist activities into course design more than half of the time. An interesting finding of the study was that when instructional designers were asked during what phase of the design process they incorporate constructivist activities, 4 out of 10 tend to do so at least 25% of the time during the conceptualization and design phases, the study indicated that “Constructivist environments aid in the promotion of active learning, collaborative learning and provides scaffolding for various types of learners and activities. The results of this study make a strong case for instructional designers to advocate for the incorporation of constructivist environments in online course design in ways that increase its use, scope, applicability, and the number of activities” (Morales, 2007, p.73).

CONSTRUCTIVIST ACTIVITIES FOR ONLINE LEARNING

To improve motivation, constructivist instructional design is believed to facilitate the creation of learning environments that encourage in learners’ free-flowing expression and sharing ideas. In a similar way, learners have a significant influence in what they want to learn and in what manner.

Authentic learning is one of the goals of constructivism, in that, learning is supposed to meet real-life/case-based experience, which in turn is meaningful to learners due to their applicability beyond the four-walls of the classroom or in this cease, beyond the virtual classroom (Chen, 2007; Jonassen, 1995; Petraglia, 1998; Vygotsky, 1978).

Authentic knowledge comes to the stage when learners participate in the process of designing instruction, in many cases, allowing them to influence the topics, activities and the emphasis given to certain aspects of instruction. In online learning, this is possible with activities that ask
students to provide and share resources they find while studying. Another way of accomplishing this is by using Web quests as well as providing clear directions for an assignment, while at the same time giving them the flexibility and freedom to select the direction in which they want to conduct the activity (Huang, 2002; Karagiorgi & Symeou, 2005).

The strategies outlined above fit together in what is known as learner centered processes and environments. Online education is about learner centeredness, in which the instructor mentors or facilitates the learning process. The goal of this strategy is to encourage learners to be active participants in designing learning, which comes into play following authentic learning, collaborative learning as well as interaction with peers.

The employment these strategies may result in minimizing the many obstacles some learners find in online learning. Technology plays an important role in fostering and maintaining learning environments that accommodate and fulfill the various needs and demands of students. Developing activities in which communication, collaboration, social interaction, experiential learning and reflection are present empowers learners to create “customized learning” that is meaningful, authentic and based on their particular interest, given the tools and guidance the instructor provides (Huang, 2000; 2002).

Activities grounded in constructivist theory should provide students with the means to construct their own knowledge, but also to develop an understanding that ultimately will lead to creating the mental models and valid processes required to confront the learning task. Washabaugh (2003) calls them constructivist learning objects, through which analytical and critical thinking skills are fostered by the creation of meaningful, interactive, engaging and student-centered activities (Washabaugh, 2003).

Further attempts to merge learning theories with instructional design models come from Australia, where a change in the curriculum at the national level asked for the development of teaching strategies that engaged students in social constructivist activities for science, math and technology (Taylor and Maor, 2000). Their research was based on the use of a survey named COLLES Constructivist On-Line Learning Environment Survey, designed to monitor the preferred student’s online learning environment and compare it with their own learning experiences (Taylor & Maor, 2000). Their findings showed that constructivist activities ought to be designed based on individual as well as collaborative reflections that aid them in co-constructing new understandings drawn on personal experiences (Jonassen, 1995, O’Connor, 1998). Research findings indicate that students could be engaged in more frequent and meaningful thinking, reflection and analysis (Taylor & Maor, 2000). Likewise the activities supporting these processes should also promote student-centered learning environments in which they control what they want to learn, how is that they want to learn and the pace at what they want to learn.

**Designing Constructivist Interaction**

Activities that promote interaction might be designed to provide ample opportunities for learners to engage the four possible types of interaction.

*Interaction with content:* Activities that leverage on this type of interaction should be included Just-in-time learning, for example, or the acquisition of knowledge skills immediately prior to a need for their use, (Berge, 2002) reduces the need for retraining often required because the original instruction occurred a long time ago before an opportunity for its use is encountered. Hands-on activities may not be the best choice, as they will require practice to avoid the fading away of the gained skill.

*Interaction with peers:* This aspect is grounded on a social context due to the fact that significant learning experiences are acquired in a social context and are ultimately enhanced by interacting with others. Some of these activities include
reflection, interaction with peers, speech and communication; all of which should be encouraged at all skill levels, thus having students immersed in conducting activities at higher levels of the Bloom’s Taxonomy.

*Interaction with the instructor:* In a constructivist grounded learning environment, the relationship between the instructor and the student should be one of mentoring. In other words, due to the emphasis in the construction of knowledge, the instructor’s role is to provide guidance in that process with minimal influence. This is commonly done by providing continuous feedback and assessing the learners’ activities in the online classroom (Berge, 2002; Karagiorgi & Symeou, 2005; Jonassen, 1992; Jonassen, Davidson, Collins, Campbell, & Bannan Haag, 1995).

*Interaction with the interface:* Hillman, Willis, and Gunawardena (1994), identified learner-interface interaction as the manner in which learners get involved in taking distance education courses. The researchers asserted that, “instructional methods influence media selection…the system selected may have an affect on the methods…” Hillman, et al., (1994, pp. 32). This fourth type of interaction is of importance to distance education practitioners and designers due to the impact the interface might have on student learning. The interface is envisioned to aid the learner in the process of learning, facilitate and promote student collaboration and communication and cause an inquiry about seeking new knowledge. It is at this stage when learners will benefit from developing mental models to master the use of the interface as they learn the subject.

Asynchronous learning allows students more time for reflection, and those tend to be more substantive and meaningful. Learning from intrapersonal reflections is a valued process that provides learners with the scaffolding and skills needed to succeed in the course (Berge, 2002; Brooks, 2003; Harman & Koohang, 2005, Palloff & Pratt, 2005; Swan, 2002).

Recent research findings indicate: “Instructional designers stated that constructivist activities foster a pro-active approach by students to what and how they want to learn and also assist students in the transfer and application of the upper level critical thinking skills: analysis, synthesis and evaluation. Incorporating constructivist principles in the design of online courses helps in the removal of isolation, increases its social characteristics, and shifts the balance of responsibility for independent learning” (Morales, 2007, p.73).

**EVALUATION IN CONSTRUCTIVIST LEARNING ENVIRONMENTS**

The evaluation of constructivist activities poses various challenges to faculty and instructional designers as well. Practitioners as well as researchers for many years proposed-goal-free activities that did not delineate goals beforehand (Scriven, 1973). This proposal was based on the practice that “knowing the goals could hinder the evaluation process” (Jonassen, 1992). The practice of goal-free evaluation in constructivist learning appears to be limited which could be attributed to the fact that evaluation methods are context driven, requiring an overhaul of the processes involved. Authentic tasks should always be the foundation of constructivist learning environments. These types of activities are the ones that have real-world application, value and utility for the learner. Its integration across the curriculum makes the educational process more dynamic and meaningful. Knowledge construction is another area that requires our attention when evaluating constructivist activities. Defending a position and the mental models developed used to accomplish that could be categorized as constructivist evaluation. Constructivism does not always have to mirror reality, but the goal is to construct meaningful interpretations of what occurs in reality. In online learning courses, the goal is to assess higher order thinking levels: synthesis, evaluation.
The evaluation of constructivist activities could accommodate multiple perspectives also be multimodal and use authentic assessments to evaluate authentic tasks (Jonassen, 1992, 1999; Taylor & Maor, 2000).

**CHALLENGES OF CONSTRUCTIVIST FOR ONLINE LEARNING**

Constructivist instructional design for online learning challenges instructional designers in terms of the philosophy and methodology to be used conducing to sound design. It also challenges professors, when implementing constructivist learning environments requires a shift in the paradigm of their teaching style. The following principles ought to be considered when developing constructivist environments for online learning:

*Collaborative learning*: in which interaction is crucial for learning. The instructor has a facilitating role and reflection and social negotiation are the norm in the process.

*Interactive learning*: learning does not occur in isolation and it benefits from the interaction with peers, content and interfaces (Vygotsky, 1978; Petraglia, 1998). Learners are motivated and actively engaged in the learning process and this is valid for individuals and groups as well (Chen, 2007; Palloff & Pratt, 1999, 2005; Shank, 1999). Sample activities that can be designed include: discussions, group work, student presentations and collaborative work.

**FUTURE TRENDS**

Constructivist instructional design provides a blueprint for online course design. Constructivist learning environments provide the learner with opportunities to control his or her learning by shaping and creating mental constructs of knowledge grounded on activities that the instructor could apply to almost any subject or course level. These opportunities also provide the learner with a venue to reflect on how learning occurs, taking advantage of the various types of interactions existing in an online course. These interactions, if well executed, impart meaningfulness, pertinence, applicability, and value to the content and the learning process.

There are two important aspects in online course design grounded in constructivist theory that we need to consider. The first is to emphasize that interaction continues to be a key aspect that allows students to learn from each other while providing them with an engaging atmosphere to master the course. Secondly, the inclusions of higher-level processes that use problem solving, creativity and invention best serve as the basis for the design and development of course materials (Ascough, 2002; Hobbs, 2002; Jonassen, 1999; Morales, 2006; Rovai, 2004).

**CONCLUSION**

Instructional designers in their prescriptive role of suggesting a design model or approach are also considered learning architects when they in conjunction with the subject matter expert design instruction (Morales, 2006). Instructional designers have merged instructional design models and learning theories with the intent of developing real-life, richer and pertinent learning environments that provide the learner with greater influence on their learning. What do I want to learn? How will this activity help me solve a new problem? In the case of adult learning, how can I apply this knowledge to my workplace? These are the questions that learners ask themselves when they find the activities of the course dull and not connected with the real world. Blending constructivist theory with instructional design models produces constructivist instructional design, which aids in providing instructors with opportunities to develop problem-based learning, case studies, collaborative learning and action research activ-
ties in which the learner, not only construct his/her knowledge, but also can see the application of knowledge beyond the classroom.

Constructivist instructional design additionally provides instructional designers and instructors with opportunities to redesign their online courses with up-to-date activities and teaching strategies that while not new, might infuse a course with a renewed approach in which the learning process is centered on the learner and no longer on the instructor.

Developing online learning environments grounded in constructivist theory addresses and serves their learning needs by providing students opportunities for increased participation in what, how and even the pace at which to learn. In the case of adults, online learning grounded in constructivism benefits them uniquely because the skills and knowledge gained in the course can be immediately applied to their workplace, providing satisfaction via a return on effort and investment.

REFERENCES


KEY TERMS AND DEFINITIONS

**Constructivist Theory:** A learning theory that states that learning is an active process in which learners construct rather than acquire knowledge (Jonassen, 1999).

**Constructivist Instructional Design:** Blending constructivist theory with instructional design models produces constructivist instructional design, which aids in providing instructors with opportunities to develop problem-based learning, case-studies, collaborative learning and action research activities where the learner can see the application of knowledge beyond the classroom (Morales, 2007).

**Design-Oriented Theories:** The instructional design models that are prescriptive in nature and have provoked the development of new strategies and procedures for interaction and the development of learning communities essential to fulfilling non-traditional learning needs (Reigeluth, 2005).

**Instructional Design:** The systematic process of translating a plan of instruction into a set of activities, materials, information and/or assessment procedures (Smith and Ragan, 2005, p. 4-6).

**Instructional Design Models:** The method(s) used for the design of instruction, which is usually comprised of three to five phases that prescribe the steps to take in the design of instruction (Reiser and Dempsey, 2002).

**Instructional Design Theory:** Descriptive statements that explain, predict, or control events related to instruction and learning (Reigeluth, 1999, p. 7; Smith and Ragan, 2005, pp. 23-25).

**Instructional Designer:** The professional responsible for the design of content, activities and modules of instruction using a specific sequence for presenting the content for both, traditional as well as online courses (Morales, 2006).

**Learning Communities:** The process where a group of people (community) with similar interests (learning interests) is active and engaged around learning materials: collaborative learning, discussion, and share other aspects than the ones related to education Palloff & Pratt, (1999, 2005)

**Online Learning:** The type of instruction that is mediated via the internet. Instruction may be synchronous or asynchronous and various technologies can be use to mediate the process. (Dabbagh and Bannan-Ritland, 2005).
Chapter 3

Classroom-in-a-Box: Rethinking Learning Community Classroom Environment Needs within Three-Dimensional Virtual Learning Environments

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ABSTRACT

This discussion focuses upon a theoretical understanding of the instructional architecture that supports learning communities within three-dimensional virtual world environments; specifically, within the Second Life world environment. This theoretical understanding provides the essential link between instructional imperatives, performance improvement and a community of learning within an instructional technology framework. Motivated by the shift from the Information Age known for the availability of information towards the Cognitive Age which emphasizes the ability to access, evaluate, organize, comprehend, apply, analyze, synthesize and innovatively represent information into an enhanced understanding and novel use, this discussion offers the opportunity to directly address the learner’s needs within the three-dimensional virtual learning environment, such as Second Life, through the design of a virtual learning environment classroom-in-a-box.

INTRODUCTION

The publication of The Blue Book: A Consumer Guide to Virtual Worlds (Association of Virtual Worlds, 2008a, 2008b) suggests that virtual worlds are a growing phenomenon. Another indication of this trend is the use of Second Life by several businesses as a viable environment through which to interview technology-minded professionals (Athavaley, 2007). It is not a significant leap to expect the
three-dimensional virtual world environment to become a more viable instructional environment that may further engage learners. As quoted by Martin and Crawford (2008), “Universities have also been testing the three-dimensional virtual learning environments as potentially successful learning communities that directly address the concerns related to the silo effect” (p. 546). Further indication of the acceptance of virtual worlds in education is The Activeworlds.com, Incorporated, description of their product The Active Worlds Educational Universe, which states, “The Educational Universe is an entire Active Worlds Universe dedicated to exploring the educational applications of the Active Worlds Technology” (The Activeworlds.com, Incorporated, 2008, paragraph 1).

Distance education and online learning has grown and shifted over the previous fifteen years. It is only recently that researchers and developers have focused upon instructional potentials related to three-dimensional virtual learning environments. In this environment the active engagement of the learner may offer significant potential towards the success of learning communities. Before the introduction of three-dimensional learning environments, the primary course environment was textual in nature, with opportunities for the integration of supportive audio, video and interactive multimedia components for exhibition. Shifting from this text-based environment to a primarily virtual environment that more closely reflects the opportunities inherent within a more traditional community learning environment offers the learners the opportunity for a more autonomous, dynamic community of learning. Therefore, the engagement of the learner within a three-dimensional virtual learning environment, such as Second Life (Linden Research, Inc., 2008c), is imperative.

This engagement occurs through the design of a virtual learning environment classroom that the instructor can easily manipulate so as to meet the instructional needs of the learners. The design of a three-dimensional virtual learning environment classroom that supports the needs of the learners while emphasizing the instructor’s focus upon learning objectives is difficult, at best. Thus, the ability to design and develop a manageable, transportable environment that offers the instructor an opportunity to designate different surroundings “on the fly” through the push of a button so as to meet the necessary instructional needs is a priority. The concept of a transportable learning environment architecture that can be obtained as a boxed product, opened within the previously designated building environment and then effortlessly set up by incorporating appropriate instructional elements is a timely and necessary product. This classroom-in-a-box articulation offers the instructor the ability to easily shift between different instructional tasks, such as classroom lecture, group work, research and study area, faculty office hours, casual discussions and advising. Further, the classroom-in-a-box allows for a more appropriate articulation of the different underlying philosophies of learning that most appropriately meet the subject matter’s learning objectives.

BACKGROUND

To appropriately perceive the significance of a three-dimensional virtual environment classroom-in-a-box product, it is integral to discuss the shift from primarily textual information with bits and pieces of multimedia sparkle for exhibition towards a more autonomous, dynamic community of learning. The opportunity to directly address the learner’s needs is integral towards the enhancement of learning environments. Embracing the structural architecture within the three-dimensional virtual world environments supports the Web 2.0 phenomenon that engages the learners within social engagement opportunities. Further, the natural progression towards designing appropriate and successful holistic virtual
classroom-focused instructional environments is related to learning communities that enhance and structurally arrange the available knowledge into comprehensible, conceptual frameworks of understanding (Vygotsky, 1935, 1962, 1978, 1981; Wertsch, 1985). As well, semiotic components are now growing in significance within learning environment communities due to the significant influence on long-overlooked underlying messages and conceptual knowledge that is transmitted through communicative technologies (Chomsky, 2004; Cook, 1985; Coblentz, 2003; Gannon-Cook & Crawford, 2006; Hamilton, 1969; McLuhan, 1964a, b; McLuhan & Fiore, 1967; Rothstein, 1995; Schlain, 1998).

As society shifted from the Information Age to the Cognitive Age (Brooks, 1999; Pink, 2005) the design of learning environments changed from a focus upon knowledge availability for the masses towards the realized importance of the aptitude and talent associated with the ability to access, evaluate, organize, comprehend, apply, analyze, synthesize and evaluate (Bloom, 1984; Bloom, Englhart, Furst, Hill & Krathwohl, 1956) the knowledge, as well as the ability of the learner to remember, understand, apply, analyze, evaluate and create (Anderson & Krathwohl, 2001, as quoted by Churches, 2008, paragraph 3) information that is understood and innovatively reorganized and represented so as to enhance the understanding of the information in novel ways. This is imperative within the three-dimensional virtual learning environment has not yet been realized.

Herein is cultivated the concept of a classroom-in-a-box. The idea behind a classroom-in-a-box is the ability of the instructor to set up a classroom environment that meets instructional needs. As an example, if the authors developed a textbook for course use, and the authors sought to teach the course in a virtual environment, the authors could purchase the already developed classroom with all the slideshows, movies, unit information, whiteboard, podcasts, and other elements already integrated. Essentially, the classroom-in-a-box is a prefabricated environment that can be set up and work anywhere within a virtual world. The classroom-in-a-box may be made available as a shell environment or may include the subject information for a course. The concept of a two room environment is the classroom-in-a-box architectural setup. The first room is available as a consistent interface through which the learners access the course information; rather like a course-specific library environment. The second room has the ability to shift its setup, to meet the appropriate instructional needs, such as a lecture hall, small group tables, lounge area, faculty office, or other instructional environments determined by the course instructor. Additionally, the course instructor can decide to allow password access to instructional assistants, or even have the possibility of allowing the learners to shift the room’s setup.

When discussing any virtual world, one is dealing with a “grid” – a series of virtual environments and the server or servers that make up the virtual environment(s). The richer and more interactive the 3-D virtual environment, the more likely it is that the grid is going to require an entire server or multiple servers. Grids may be hosted at a specific location or locations, and tied together. Such is the case with Second Life and Active Worlds. It is also possible that a grid may be an independent, stand-alone environment, that is not tied to other environments.

Second Life is an massive example of a hosted grid. More than 6000 servers make up the entire grid, and Linden Labs, Inc. owns and controls all servers. Some virtual environments may be isolated in some regard, however, all of the Second Life environments are hosted and administered to by Linden Labs, Inc.

It would be possible to have a virtual environment or series of virtual environments that reside on a server or series of servers that are kept in a proprietary environment, strictly for the use of the institution. This would be considered an un-hosted
solution, or rather, the solution is hosted internally. In this case, the institution would own, control, and administer the virtual environment(s).

It is important to keep in mind, in the exploration of the classroom-in-a-box concept as an application within Second Life, there is a larger scope classroom-in-a-box concept as separate from any “hosted” grid such as Second Life. In this regard, the classroom-in-a-box could be an internally hosted virtual grid, or even a USB drive with a grid, as the virtual world technology is driven forward. For instance, in the not-to-distant future, a 3rd grader may take home a universal serial bus (USB) drive, a “plug and play” drive, that contains an entire virtual environment that allows him or her to learn about space travel by having an avatar or virtual personal representation build a rocket ship and travel around the Milky Way galaxy.

SHIFT IN THEORETICAL AND PHILOSOPHICAL FRAMEWORKS OF LEARNING

An understanding of learning has changed as the culture has shifted its focus, or emphasis, as the centuries have passed. As a society, we are familiar with primarily four ages which had not only dawned, but indeed have flowed over society and changed the social community forever:

- Agrarian Age
- Industrial Age
- Information Age
- Conceptual Age (Pink, 2005)

Initially, the agricultural focus of the culture was based upon sustainability of the race, many times referred to as the Agrarian Age. The need for social understanding, storytelling skills that would pass down the important lessons and histories of the culture, and the sharing of skill sets was vital towards the communal good of the society. However, a shift occurred when larger industries brought together numerous people who needed to be able to focus upon their specific task that would fulfill a portion of a larger project. The Industrial Age consisted of both the written and unwritten curriculum; the written curriculum was based upon reading, writing, arithmetic and some history, while the unwritten curriculum was based upon the need for Industrial Age workers to follow orders, focus for periods of time upon a specific skill or task, understand the needs related to scheduling, and similar related skills. Yet when the Information Age dawned in the late 20th Century, there was the realization that knowledge should be freely available to everyone and the tool through which this would occur was named the Internet or the World Wide Web. The Information Age degraded the prior power structure, wherein controlling information was power, and fostered discussions related to the digital divide. An interesting aspect of the Information Age is that there is a perceived heightened velocity and momentum associated with the societal issues. Pink (2005) suggested that the appropriate next age would be the Conceptual Age in which the power would shift to those within our society who were able to gather and reframe the information into useful knowledge.

In light of the shifts in society and its impact on learning, there is a shift in the World Wide Web. Recently, there has been a discussion of “Web 2.0” which is characterized by web-based communities and hosted services that include social-networking sites, wikis and blogs designed to facilitate creativity, collaboration, and sharing between users. “Web 2.0” is a term that helps support and frame an understanding of what is going on today. We may ask, what will be the next age, but more so, how will the elusive and ethereal World Wide Web continue to impact social learning communities?
UNDERLYING PHILOSOPHY OF LEARNING

The design of a learning environment is influenced by the human experience within it. It is suggested by Neil (2005) that Dewey “believed that learning was active and schooling unnecessarily long and restrictive. His idea was that children came to school to do things and live in a community which gave them real, guided experiences which fostered their capacity to contribute to society” (paragraph 1, http://wilderdom.com/experiential/JohnDeweyPhilosophyEducation.html). Further, Neil (2005) states that:

Dewey’s theory is that experience arises from the interaction of two principles -- continuity and interaction. Continuity is that each experience a person has will influence his/her future, for better or for worse. Interaction refers to the situational influence on one’s experience. In other words, one’s present experience is a function of the interaction between one’s past experiences and the present situation. For example, my experience of a lesson, will depend on how the teacher arranges and facilitates the lesson, as well my past experience of similar lessons and teachers. (Neill, 2005, paragraph 8)

From this delineation of Dewey’s work, the next step is to reflect upon the underlying philosophy of learning that organizes and establishes not only the instructional design process, but also an understanding and realization that the instructor’s underlying philosophy of learning will directly impact the learning environment.

It does occur on a regular basis that the lead instructional designer and course instructor are one in the same person, but many times the instructional designer may be different than the course instructor. As a result, the potential for conflicting of learning philosophies between the designer and the instructor may occur. There is the potential that the instructor will experience impediments or limitations associated with the implementation of a distance learning environment designed by persons with different underlying philosophies of learning and understanding. There is the potential for future research associated with this focus, as well as opportunities for professional development. However, to support and engage the learner in the distance learning environment, a consideration towards the learner’s hierarchy of needs is appropriate.

According to Wikipedia (2008a), an MMO or MMOG is a Massively Multiplayer Online Game, which is simply “a video game that is capable of supporting hundreds or thousands of players simultaneously” (paragraph 1). MMOs are, by their nature, played over the Internet. While “MUVE (plural MUVEs) refers to online, multi-user virtual environments, sometimes called virtual worlds (Wikipedia, 2008b, paragraph 1). Typically, a MUVE refers to an environment that is “not necessarily game-specific” (Wikipedia, 2008b, paragraph 1). Often, these terms are used interchangeably.

It is every bit as critical to consider learner motivation in the 3-dimensional virtual world, Massively Multiplayer Online (MMO) learning environment with regard to learning and virtual life. There are phenomena that occur within the virtual world, particularly in a social networking environment, that can affect motivation for which an instructor or instructional designer may not be prepared. The virtual world allows for a freedom that is often unavailable in the real world. For instance, in many MMOs, learner avatars can fly, teleport (instantly move from one area to another, regardless of distance or location), shape shift, change minor appearances at will, create objects that are impossible to create in real life. Additionally, if the learner is allowed to personalize the avatar, the avatar becomes an expression of the learner’s personality.

Consider another factor – if the learner’s real life is not optimum for a variety of reasons that exist on Maslow’s hierarchy, the learner may actually pre-
fer to spend time in the virtual environment, where he or she can be anything or anyone they desire. This may begin to affect the learning in a variety of ways – including the potential for incidental, unintended learning. This may manifest in the learner acquiring skills outside of the original goals and objectives set by the instructional designer. Incidental learning presents many opportunities. Instructional designers within a technology driven environment are able to examine the common unintended learning outcomes and capture those outcomes with deliberation, forming them into secondary learning outcomes instead of incidental outcomes. This can result in driving the learning objectives into higher levels of learning.

Another aspect of a learner finding higher motivation levels within the MMO can be an escalation of dysfunctional behavior. As the learner disconnects from their real life, avoiding the undesirable or uncontrollable areas of the real world, it seems to potentially retard the ability to grow and cope within that environment of reality. The very behaviors that may be contributing to the real life issues become exaggerated in the MMO, as the learner never has to develop coping behaviors, and may even avoid negative consequences due to anonymity. This retardation of growth does not have to be an outcome; the MMO can create an environment for learning coping skills, if the acquisition of those skills is made deliberate through learning objectives and the learner is capable of acquiring said skills. It is important to consider the inherent learner characteristics as well. For instance, a particular type of person seems to be drawn to the MMO environment. While there is a great deal of diversity in the MMO, there does appear to be a plethora of common characteristics in the population at large, and those characteristics seem include a propensity for personal drama or a definitive emotional immaturity within relationships.

Additionally, there is a tremendous move within MMO environments (whether they be gaming, social networking, or learning) to create ego / social status hierarchies. This can definitely be an impediment to moving learners into the realm of self-actualization, particularly if the MMO society is “retarded” at the ego / social status level. Instructional designers and instructors may find that they are no longer only shaping and designing a learning environment. They may have to design a learning “society.”

DEVELOPING THE UNDERLYING FRAMEWORK: LEARNING HIERARCHY OF NEEDS

Maslow’s Hierarchy of Needs (Maslow, 1943, 1954, 1970, 1978; Maslow & Lowery, 1998) frames an integral structure that supports the underlying framework within any distance learning environment, including the three-dimensional virtual learning environment, as well as the hierarchical enhancements (Alderfer, 1972, 1977, 1980a, 1980b, 1987; Huitt, 2004; Norwood, 2004). These hierarchical enhancements lead to a reflective consideration towards the distance learner’s needs. A framework that supports the underlying needs of the learners within this basic distance learning environment is Crawford’s Distance Delivery Hierarchy of Needs (2005), within a primarily textual knowledge structuring environment that is supported by video, audio and interactive media products such as multimedia animation element. Crawford (2006) stated that “It is imperative to maintain a focus upon the appropriate and successful enhancement of the learning environment through technological means, in a suitably ubiquitous manner” (p. 11) yet still remain focused upon the learner’s success. Furthermore, “Crawford’s focus upon the learner’s needs within the online learning environment is necessary to represent the technological and instructional needs of the learner” (Crawford & Freeman, 2007, p. 6). With the focus on three-dimensional virtual learning environment Crawford (2007) elaborated upon and enhanced the Distance Delivery Hierarchy
of Needs (Crawford, 2005) to offer Crawford’s 3D Virtual World Hierarchy of Needs.

The MMO / 3-D learning environment has the potential to allow the learner a rich spectrum of realization, similar to that which Norwood (2004) describes, including the following factors:

- Be authentic.
- Transcend their cultural conditioning and become world citizens.
- Find their vocation and right mate.
- Know that life is precious.
- Be good and joyous in all kinds of situations.
- Learn from their inner nature.
- See that basic needs are satisfied.
- Refreshen their consciousness, appreciate beauty and other good things in life.
- Understand that controls are good, and complete abandon is bad.
- Transcend trifling problems
- Grapple with serious problems such as injustice, pain suffering and death
- Be good choosers
- Be given practice in making choices of goodies, then making choices in their religious beliefs. (Norwood, 2004, paragraph 10)

The dependent variable is the learning environment. A restrictive environment that is instructor- or content-centered will limit the learner’s level of growth. This may result in the learner being focused on their own lower need levels. In order to promote higher levels of learning and the ascendance beyond lower needs, the learning environment must be designed appropriately. A learner-centered environment promoting abstract thinking, problem solving, and learner creativity will work better to this end, as framed through Crawford’s 3D Virtual World Hierarchy of Needs (Crawford, 2007). The virtual three-dimensional learning environments engage audio, video and interactive animation components, but also engage the integrally interactive and participatory three-dimensional animatory world. The significance of the virtual worlds within the learning environment is that, “Theorists differ over whether the system precedes and determines usage (structural determinism) or whether usage precedes and determines the system (social determinism) (although note that most structuralists argue that the system constrains rather than completely determines usage)” (Chandler, 2001, paragraph 20). It is of primary importance to focus the three-dimensional virtual environment’s opportunities and emphasis upon the learner; meaning, the instructional architecture that is a classroom-in-a-box.

As the 3-D virtual environment evolves, it becomes clear that some of the needs originally identified in Social Interactive Needs will be distributed into the lower needs areas. For example, the need to feel “sheltered” in the virtual world can be a very real one. Some people do not function well or productively in a virtual world if their avatar does not have a “home.” Having a “virtual home” may become more important than in real life.

The same is true of the concept of “safety” in the 3-D world. It is amazing and amusing to hear people exhibiting fear of being “assaulted” in the 3-D world. Yet, it is a common issue in Second Life. It can be as though people forget there is an Exit function in the client software. Avatars cannot be tracked by others, unless the avatar gives permission to do so, and permission can be removed at any time. Understanding how to protect one’s avatar can be every bit as important as understanding basic movement and communication.

In light of the considerations of Crawford’s distance Delivery Hierarchy of needs some standards emerged for 3-D virtual learning and a true standard has yet to emerge. One question that is already being explored is: To what extent does a learner’s real life situation and dysfunctions affect their virtual world situations and dysfunctions? Is it possible that learners can actually be
empowered by working through affective issues in the virtual world, or are they crippled by those issues as they are in real life?

CLASSROOM-IN-A-BOX

When discussing a “classroom-in-a-box,” it is critical to remember that there are no limitations in the virtual world. If one can imagine it, one can find a way to build it. Therefore, there are infinite ways to create a learning environment within the MUVE. Imagine a place, where one can touch a series of buttons and literally change the setting, the furniture, the media, even the location to accommodate the next level of learning. This is the concept of a virtual classroom-in-a-box.

The concept of a classroom-in-a-box revolves around the integral importance of a viable learning environment that ensures that the primary elements of a learning environment are easily available for utilization, and the space allocation is easily conceptualized and structured so as to ensure the most appropriate environment towards meeting learning goals and objectives. Much as with a real-world face-to-face learning environment, there are times when a lecture setting is most appropriate towards meeting learning objectives, yet there is also the necessity for small group environments or a lounge for office hour discussions and guidance. At the same time, it is important to ensure that the learners consistently have access to all viable subject matter resources so that they can work and study in an anytime, anywhere manner. Within a bricks-and-mortar face-to-face world, one must schedule classroom space for each type of environment that is needed (allocating classroom space) which usually takes on a sense of chaotic turbulence due to the space allocation issues within busy or growing organizations (universities, business/industry, K-12, etc.). With these issues, how might a three-dimensional virtual learning environment meet the needs of the learners and instructor within a compartmentalized classroom area? The classroom-in-a-box idea is a better response to this problem because the mere click of a button allows the classroom architecture to shift “as needed” in order to meet instructionally appropriate tasks.

Issues, Controversies, Problems

The reality within the more traditional, text-intensive distance learning environments is a structured tutorial style learning situation. Just as correspondence courses, instructional radio and television courses are not common today so too will there be a shift away from the distance education as we know it towards more innovative real-world learning.

A timely consideration is the cost of attending a face-to-face environment. As quoted in a New York Times newspaper article:

Enrollments in online classes expanded rapidly early in this decade, but growth slowed in 2006 to less than 10 percent, according to statistics compiled last year by researchers at Babson College in Massachusetts. Some recent increases reported by college officials in interviews were much larger, which they attributed to the rising cost of gasoline. Pricing policies for online courses vary by campus, but most classes cost as much as, or more than, traditional ones. (Dillon, 2008, paragraph 7)

The reality of the situation is that, “Once an incidental expense, fuel for commuting to campus now costs some students half of what they pay for tuition, in some cases more” (Dillon, 2008, paragraph 11). As noted by Dillon (2008):

At Brevard Community College in Cocoa, Fla., online enrollment rose to 2,726 this summer from 2,190 last year, a 24.5 percent increase. “That is a dramatic increase we can only attribute to gas prices,” said Jim Drake, Brevard’s president.

Dr. Drake and officials at several other colleges expressed concern that mounting fuel costs could force some students to drop out of college altogether, especially since only a fraction of courses
Classroom-in-a-Box

at most colleges are offered online. Dr. Drake has put Brevard on a four-day week to help employees and students save gas. (paragraphs 8-9)

For many students there is no other option available within today’s market. Dillon (2008) offers one case that may reflect the decisions of innumerable students:

One student taking online coursework for the first time is Kameron Miller, a 30-year-old working mother who lives in Buffalo, Mo., 40 miles north of Springfield. Her commute to classes in her 1998 Chevy Venture during the spring semester cost her at least $200 a month for gas, Ms. Miller said. This summer, she is taking courses in health, humanities and world music — all online.

“I don’t feel I get as much out of an online class as a campus course,” Ms. Miller said. “But I couldn’t afford any other decision.” (paragraphs 13-14)

This suggests that a shift in distance education course environments is not only timely, but necessary so as to meet the fundamental academic needs of the learners. Of course, a serious issue revolves around Internet access speeds. Although urban environments and bricks-and-mortar institutions of higher education have high-speed Internet access, the rural communities have been much slower to obtain higher levels of Internet access speed. For this reason, there continue to be issues related to distance learning accessibility, as articulated:

Distance education is no silver bullet that can alone solve the challenges posed for higher education by rising gasoline prices, officials warned.

For one thing, many students, especially in rural areas, lack the high-speed Internet connections on which online courses depend.

“The infrastructure doesn’t exist to give all rural students clear online access,” said Stephen G. Katsinas, a professor at the University of Alabama. “Rural America is where the digital divide is most dramatic.” (Dillon, 2008, paragraphs 24-26)

Yet these issues shall pass, and there will be viable options that will ensure the opportunity for high-speed Internet access within the rural communities. However, once these issues pass, the desire for viable options will remain. As such, it is a judicious opportunity to advance the three-dimensional virtual learning environment as a viable alternative to face-to-face learning environments and text-driven learning environments. This is a timely endeavor to undertake, especially with the recent shift in student needs, but innovations must be solidly developed and engineered to ensure stability of the learning environment and viability of the product.

Classroom-in-a-Box Solution and Recommendations

The classroom-in-a-box solution offers several integral elements that are viable alternatives to the more constant architectural considerations within both a bricks-and-mortar learning environment and an unchanging virtual learning environment. Therefore, it is important to articulate the important elements and innovative considerations related to the classroom-in-a-box solution. The following solutions are relevant to hosted or non-hosted grids.

Asynchronous Learning Area

An asynchronous learning area, wherein the instructional support tools are consistently available for the learner’s use, is imperative towards the success of a learning environment, no matter whether focused upon textually driven environments or three-dimensional virtual learning environments. There must be locations within the asynchronous learning area that are for specific instructional materials, as well as the potential instructional elements. The design of this area must ensure that distinct units of instruction are clearly articulated for the learner’s use, as well as media-specific storage facilities through which the instructor can easily upload and compartmentalize instructional elements for the learner’s use. Several elements
that may be articulated as integral within the asynchronous learning area are:

- movie clips for the course
- podcasts
- Microsoft PowerPoint files (or comparable slideshow components)
- Adobe Flash files (or comparable interactive components)
- text downloads (like textually-driven units of instruction or forms)
- scripted objects that simulate real life objects, with both basic information components and problem solving components
- educational environments with scripted objects and space for ad hoc team learning
- other areas of instructional import

Another element that may be of use within this asynchronous learning area is a whiteboard for either synchronous instructional opportunities or archived notes, for use “on the fly” by the instructor or the learners.

In Second Life, there is a great example of an asynchronous learning environment designed by Ohio State University (OSU) - Department of Medicine (The Ohio State University Medical Center, n.d.a), called the Testis Tour, located within the Second Life virtual world environment (The Ohio State University Medical Center, n.d.b). One can teleport an avatar to this Ohio State University virtual environment (also referred as a sim) and take an automated tour with up to three other avatars on a giant flying sperm. The tour has both voice recording and text chat that explains the inner workings of the testis. The avatars are flown into giant 3-D cut aways of a testicle that has a variety of graphics and media, including directional animation. Instructions are also given about how to change the avatar view and the environment lighting to get the best effects for learning. While this tour is part of a specific curriculum, OSU allows anyone to take the tour and experience the learning opportunity.

Team Learning or Learner Collaborative Environments

Team learning is a critical synchronous opportunity presented in the virtual world. If teams are given assignments to be completed in-world, they must have spaces and tools dedicated to the development of those assignments. These areas and tools are not the standard classroom necessities. An instructor must have the resources for the development of tools that promote the ease of use by the learners. One popular tool used for learning in the virtual environment is a Heads Up Display (HUD) (Wikipedia, 2008c), and “In video gaming, the HUD is the method by which information is visually relayed to the player as part of a game’s user interface” (paragraph 1). For instance, an instructor might need to have a blank HUD developed for learners to create a tour of relevant sites. However, the HUD would ideally be designed so that learners would not have to input any specific scripting or programming — they would simply input into boxes. This may cost time and money to have designed, but will save learners from having to learn rudimentary scripting skills.

A great example of using HUDs for learning occurs when a user first enters Second Life with a newly created avatar. The new user will initially show up in an orientation area, and will have a HUD on the screen that gives instructions and assignments as the avatar moves throughout the orientation area. In this way, the user learns fundamental locomotion and functional behaviors relative to the virtual environment.

Push Button Switch Panel

A second room environment within the classroom-in-a-box solution is a flexible, adaptable environment through the use of a push button switch panel. The course instructor can designate the person(s) who may access the push button switch panel, in order to adapt the room’s environmental
architecture through password protected access, to most appropriately meet the instructional needs. The course instructor may maintain total control of the push button switch panel, allow access by instructional assistants, or allow all learners to access the push button switch panel. Of importance is the instructor’s control over this decision, so as to ensure the security and viability of the room’s architectural articulation. Therefore, the environmental instructional task designation area is a location wherein there is a push button switch panel, where the course instructor could change the environment with the flip of a switch; this change in the room environmental structure would be dependent upon the day’s (or hour’s) expectations and activities, between appropriate instructional needs. These instructional needs would shift between specifically structured alternate virtual environments, including the following sets:

- real work settings (industrial processing units, hospital examination and surgical rooms, etc.)
- lecture hall classroom
- smaller classroom
- group work area
- lounge to office

Of course, other learning environment needs of import may arise due to subject-specific needs articulated, such as a laboratory environment or artist gallery.

In Second Life, there are many alternatives for the utilization of panels for environments. These are commonly referred to as “holodecks,” and there are a variety available for purchase. One must become familiar with the “rules” that accompany the use of such environments. For instance, it is recommended that all objects used in holodecks are full-permission and copiable. For this reason, it is often preferred to have those objects developed for specific use, with full-permission licensing.

### Interactive Instructional Components

Integral considerations relate to the opportunity for asynchronous interactive instructional components that are readily available within text-driven distance learning environments, such as:

- blog area
- assignment submission area
- emails
- subject-specific discussion lists
- group work tasks

The need for asynchronous tools that support the sharing of thoughts and ideas and submission of instructionally driven assignments is integral to the success of a distance learning environment that supports both synchronous and asynchronous learning opportunities. The environment must integrate all instructionally relevant tools, including the ability for the learners to submit their assignments through this environment, as well as the vital ability for the instructor to view assignment submissions, evaluate the submissions and offer both viable feedback and grade point articulation for the learner’s review. This would be a desirable element within any learning environment, but it is an imperative component within a distance learning environment. Of course, group work tasks are also important for the success of the learners. No matter whether the learners focus upon study groups or have designated group work assignments, there is a need for the environment wherein there can be synchronous and offline manipulation of documents within a group environment, such as a GoogleDocs or Zoho.com interface. Other areas of instructional import may arise, as subject-specific needs are articulated.

### Heads Up Displays (HUDS)

Also vital within a three-dimensional virtual learning environment are the heads up displays (HUDS) that are scripted to help people do what
would be appropriate within the instructional environment. This may suggest posing animations or gesturing animations, such as to ensure the following animated elements:

- communicating
- teaching
- working

that would appropriately reflect the nonverbal cues that are second-nature within face-to-face learning environments. Scripted voice comments are also integral considerations, to ensure the appropriate enhancement of instructional needs. As well, the effortless distribution of different instructionally relevant elements such as:

- scripted objects
- note cards
- location pointers,
- URLs
- and more

are vital to the enhancement of the learning environment. Each of the HUDS would be appropriately developed and implemented within the designated environmental room architecture, to allow the avatars to act and react as instructionally appropriate and desired. It is critical to ensure that HUDS are designed for the learner that is new to the concept. Detailed instructions for HUD must be built into the HUD itself, or the learner will become stuck in the exercise or environment.

These classroom-in-a-box solutions support the ability of virtual learning environments to more appropriately reflect the traditional instructional needs within a three-dimensional virtual learning environment, while enhancing the environment to ensure the availability of all instructional tools and information, as well as the socially relevant asynchronous elements that have become standard within text-driven learning course management systems.

Sample Lesson – Classroom-in-a-Box

A specific example of a Classroom-in-Box might occur as follows: Lesson for Learning Basic Distillation Operations in a Chemical Processing Unit.

I. Learning Basic Distillation – the learner avatar approaches an empty area that has a panel switch with labels on different buttons. The first button is labeled “Basic Principles of Distillation.” When this button is pushed, a full-scale distillation column pops out of the box. The avatar is dressed in appropriate industrial safety clothing, and approaches the column by walking up a ramp to a designated area. A panel next to column allows the avatar to make the column transparent and learn the specifics of the distillation process, various types of sieves and trays, and relevant safety data by clicking on different parts of the process areas.

II. Integrating Safety Operations – After the learner avatar has reviewed the basics of distillation, instructions are given to go back to the panel and push the button labeled “Integrating Operating Principles and Safe Work Practices.” When this button is pushed, the distillation column disappears and is replaced by a complete processing unit. The avatar is given a HUD that must be worn. The avatar is given an assignment via the HUD that requires moving through the unit, and identifying a specific area that must be properly prepared for repair according to a specific procedure. Part of the procedure includes identifying appropriate personnel that must sign papers and schedule work. As the avatar prepares the work area, appropriate forms must be identified and signatures must be acquired from “robot” avatars. As the appropriate forms are selected and filled out properly, the learner can move to the next step. The robot or pre-scripted avatars will respond correctly to appropriate prompts.

III. Teamwork and Trouble Shooting – When the second part of the exercise has been completed,
the learner is instructed to contact designated team members for a synchronous learning exercise. The learning team schedules their time together and returns to the panel switch. One person then selects the button labeled “Troubleshooting Industrial Processes.” The unit then appears to change slightly, while remaining essentially the same process unit. However, there are now some alarms that can be heard, and a different HUD is given to each learner. The learners are given an assignment that there is a serious problem within the unit, and they must work together to find the problem, following safety and process guidelines. As the learners work their way through the unit, addressing the issues, the situation may escalate if too much time passes, or they miss critical indicators. If the issues are not addressed, the unit will explode.

**FUTURE TRENDS**

The impact of these elements upon the virtual learning environment have more fully affected online learning environments, particularly with respect to the social community of learning and profoundly impacted the discipline of instructional systems design. Yet framing the discussion within three-dimensional virtual learning environments is imperative, so as to more fully develop an understanding of necessary entities and innovations within this potentially ground-breaking learning environment. All of these elements, the shifting hierarchies of needs and interactivities, content knowledge; instructional design elements and semiotic influences, and social interactions, all are crucial elements in the cumulative engagement of learners. However, interesting components are trends and issues that must be considered and may positively affect the three-dimensional virtual learning environment.

**Avatars Travel around the Virtual Worlds**

An interesting article in Information Week’s magazine (United Business Media Limited, 2008) notes that “the color is off the rose” for many companies who desired to jump on the three-dimensional world of Second Life (Linden Research, Inc., 2008c), yet IBM (International Business Machines Corporation, n.d.) is working with Linden Lab (Linden Research, Incorporated, 2008) and have

...recently demonstrated “virtual world interoperability,” which would let avatars move between Second Life and other online worlds. They herald it as a milestone that could turn online virtual worlds into more open environments where avatars cross virtual worlds the way people browse from one Web site to another today. That’s key for uses such as collaboration and education, says IBM. (United Business Media Limited, 2008, paragraph 2)

This realization, which avatars may easily move between three-dimensional virtual worlds, opens the opportunity for persons to maintain their personal avatars and engage in communities throughout innumerable virtual worlds. Further, this style of open movement further embraces the instructional focus upon social communities of learning.

**Social Software: Community Building Tools**

The previous focus upon social communities of learning, especially within online learning environments, leads to the questions that face professionals within today’s world: what types of social software are available, that would engage the learner, enhance the social community experience, and act as a building mechanism rather than a deterrent? What social software, with a short learning curve, will be easy to use and that will quickly become ubiquitous towards the further
engagement of the learner within the social community of learning within the three-dimensional virtual learning environment? This question is still in its infancy, but at least we’ve begun to think in this direction. Even more intriguing is that we have tools available that would support the opportunities towards more appropriately framing and understanding social communities of learning.

On the other hand, where should the discussion begin? As quoted from Martin and Crawford (2008), pertaining to the topic at hand:

The educational community is already comfortable with the idea of audio file integration (podcasts, audio files implemented as forms of evaluative feedback, or audio overviews and additional discussion of subject matter) and video file integration (case studies, assignment project deliverable component, instructional video overview and additional discussion of subject matter, video lecture archive), synchronous online chats (virtual office hours, focused discussions upon subject matter, project group planning sessions), bulletin boards (posting questions, asking for support, carrying on asynchronous group discussions) and emails, but what are other opportunities? (p. 546)

One additional opportunity is the realm of video conferencing. Video conferencing may be described as not the large room that has traditionally been allocated to the behemoth idea of video conferencing, but the speedy ability to videoconference over a small computer screen, that would be more appropriate within the three-dimensional learning environment. Although the idea of video conferencing does not align with the emphasis upon avatars in this virtual world, the necessary emphasis upon learner support suggests the need for a synchronous opportunity for virtual face-to-face realities. Not only do we have the ability to video conference on a one-to-one basis, but there is also the ability to engage with larger groups of people in a synchronous manner. This is a growing area of focus, due to the accessibility to fast Internet speeds and the free, open source, and relatively inexpensive software opportunities that are making video conferencing a viable opportunity that has become a reality within today’s world. There are so many options available today, such as:

- Skype (Skype Limited, 2008)
- Qnext (Qnext Corporation, 2008)
- ooVoo (ooVoo LLC, n.d.)
- JAJAH (JAJAH, Inc., 2008)
- SightSpeed (Logitech, Inc., 2008)
- iVideoChat (Govo LLC, 2008)
- Camfrog (Camshare LLC, 2008a)
- Camfrog Web (Camshare LLC, 2008b)
- Ustream.TV (Ustream.tv, Inc., n.d.)

Due to the obvious need to connect with the learners within the three-dimensional virtual learning environment, there may be times during which synchronous web conferencing opportunities must be made available. As such, the ability to implement a synchronous web conference is of vital importance within any learning environment. No matter whether this synchronous “real world” opportunity is mandated for special lecture series, “real world” office hour opportunities, or even “real world” group work needs, the ability to delve into the first life “real world” must be made available to ensure that it is available when and if the need should arise. The opportunities available within this realm are ever-expanding, and viable social communities of learning engagement may become more focused upon synchronous opportunities. Of course, there is the possibility to engage in video conferencing opportunities as optional opportunities for the learner to engage with the instructor and learner colleagues when desired. At the moment, the video conferencing component is not a reality within three-dimensional virtual worlds, but the opportunity to develop and speak to the need for this element will become a viable reality as these worlds advance.
Along with the other social software environments are the established and engaging social communities that support a friend’s framework, such as Facebook (Facebook, 2008) and MySpace (MySpace.com, 2008). Yet there are several issues related to disturbing behaviors within these realms and, as such, would be inappropriate for consideration within an academic venue. However, what if there were open source options available, that could be enhanced and secured through security measures and controlled by academic institutions and other interested instructional venues? Elgg (Curverider, 2008) is an open source option that is available for use. Not only can a full social networking site be developed within this environment, but this can even be set up as an iPhone widget (Elgg, 2008, paragraph 2). Even more interesting, Elgg may be a social community environment that will frame the next generation of portfolios; from paper-based portfolios to electronic portfolios (efolios), the next generation may well be framed through a social community environment that rivals Facebook and MySpace in usability and interest, yet through a professional focus. Also a fun extra consideration that’s strengths remain to be seen, is Flock (Flock, Inc., 2008b), which is a social web browser that can be implemented through a “Flock-supported social network: Facebook, Flickr, YouTube, or Twitter” (Flock, Inc., 2008a, paragraph 1).

The simplicity of use and viability of the instructional environment towards engaging in a social community of learners is of utmost importance towards the instructional viability and engagement of learners. Yet one cannot disengage from the growing interest in open source software, including portable applications, shareware and freeware software. Of significant interest are the open source software environments that have become available over the previous few years, that focus upon the social community construction opportunities available within today’s realm. As such, several of significant interest are:

- Open Simulator (OpenSimulator, 2008)
- Elgg (Curverider, 2008)
- Drupal (Buytaert, 2008)
- Flock (Flock, Inc., 2008b)

The growing interest in portable applications, or “on a stick” apps, have piqued educator’s thoughts concerning portability of instruction due to the ability to run open source applications off of a portable flash drive without dealing with or worrying about the professionalism and on-task behavior of the information technology staff at different locations. A developing list of portable applications (Rare Ideas, LLC et al. (2008) is worthy of consideration if interested in parlaying open source opportunities and the viability of travel without the hardware and software issues that were previously a serious constraint.

**CONCLUSION**

The traditional instructional architecture of distance learning environments is shifting, with the growing interest in distance learning and virtual learning environments, and the advancements related to social communities of learning within the Web 2.0 environment. As the real world concerns escalate, the interest in distance learning options will continue to explode; however, the reconsideration of distance learning environments and subsequent redesign of distance learning architecture is underway. The primary consideration that is holding back the distance learning community from fully embracing three-dimensional virtual learning environments is the lack of a viable learning course management system. With Sloodle (Sloodle, 2008) introduced as the first viable open source three-dimensional multi-user learning system for virtual environments, it is touted as “an Open Source project which aims to develop and share useful, usable, desireable tools for supporting education in virtual worlds, making teaching easier” (Sloodle, 2008, paragraph
1) that “integrates the Second Life® multi-user virtual environment and the Moodle learning-management system” (Sloodle, 2008, paragraph 1). However, advancements in the architecture must continue. The classroom-in-a-box solution is merely the initial concept towards realizing the viability of a three-dimensional virtual learning environment system.

REFERENCES


Crawford, C. M. (2007). Developing multimedia architectural support within online learning environments: Reinventing modalities of meaning as society moves from the Information Age towards the Conceptual Age within the Knowledge Economy. *The International Journal of the Humanities*, (v. 5). Melbourne, Australia: Common Ground Publishing Party Ltd.


The Ohio State University Medical Center. (n.d.a). College of Medicine Department of Internal Medicine. Retrieved on December 30, 2008, from http://www.internalmedicine.osu.edu/


KEY TERM AND DEFINITIONS

**Active Learning:** May be described as a theoretically based instructional environment emphasis, wherein the learner is actively engaged in a hands-on, active manner.

**Classroom-in-a-Box:** A compressed, or zipped, architectural environment (which may or may not include the subject information for a course, as it may just be a shell environment) that can be set up anywhere within a virtual world.

**Cognitive Load Theory:** A theoretical term that is focused upon ensuring that information loss does not occur while the information is maintained in the learner’s short-term memory.

**Distance Learning:** May be defined as instructional environments that offer learning opportunities to students who are not physically within the same location.

**Learning Community:** An assemblage of people who are focused upon the same learning objectives and are actively occupied and engaged within the same learning environment, either virtually or within a face-to-face environment.

**Learning Environment:** May be described as the architectural location through which learners have the opportunity to conceptualize information and focus upon higher order thinking skills (Bloom, 1984; Bloom, Englarlart, Furst, Hill & Krathwohl, 1956) towards creating information that is useful within the real world.

**Online Learning:** Also referred to as e-learning, is focused upon meeting instructional objectives through digitally-based managed learning environments, whether this mean Internet-based or computer-based.

**Second Life:** A three-dimensional virtual world environment that is inhabited by avatars, and the virtual world is created by the inhabitants of the world.

**Three-Dimensional Virtual Environment:** Also referred to as a virtual world, is a simulated virtual world that is inhabited by graphic avatar representations of real-world persons.
Chapter 4
Three Contexts Methodology: Strategies to Bring Reality to the Classroom

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ABSTRACT

The main objective of this manuscript is to propose a methodology called the Three Contexts Methodology based in the situated learning paradigm. It attempts to integrate three contexts related to the process of learning: 1) the context of the community of professional practice that created the content; 2) the school classroom; and 3) the context in which what is learned is going to be applied. Through this the 3CM strives to improve learning transfer and the integration of technology. To give a theoretical base to the 3CM, first an analysis of how human cognition is naturally intertwined with our social activity is done and how, in this way, professional communities of practice are generated. Then, these ideas are contrasted with the type of cognition that the traditional school promotes and some learning problems are identified. Using these antecedents as a base, the Three Contexts Methodology is described and finally, a set of results are described and analyzed when this methodology was applied to a group of students from a local junior high school.

INTRODUCTION

Given our intellectual ability to reflect on how we think, as human beings we have been asking ourselves about the nature of knowledge and we have come to answers that have produced multiple and different postures. From the rationalists and empiric postures of Plato and his disciple Aristotle to the current discussion related to consider human cognition as an individual phenomenon of processing information or as something social and integrated with the context where it occurs. In fact, Ceci, Rosenblum and DeBruyn (1999) establish that the study of human cognition can be reduced to two paradigms whether we consider or not the context in which things happen.

This categorization of the human cognitive phenomenon, that is to say, individual or social, makes
use of two different units of analysis to study it. On the one hand, is the approach that takes only the cognitive processes of the individual as a unit of analysis, and on the other, the approach that also includes historical, cultural, and contextual factors. A lot of the scientific work of cognitive psychology may be categorized in the first approach; that is to say, with every intention, and to simplify their work, the scientists working in this field of knowledge leave out of their analysis the emotional and cultural factors (Gardner, 1987).

In contrast, the second approach establishes a larger unit of analysis to explain human cognition, because it also includes the social and objective context in which cognition occurs, and in fact, assumes that it is this same context that explains it (Baquero, 2002). Driscoll (2000) expresses it as a change of approach from the individual to the socio-cultural and to the activities of people and Baquero (2002) expresses it as a displacement of the focus toward the situation where people carry out their activities. This change of analysis unit has given rise to the paradigm that establishes that cognition is contextual and culturally situated.

In order to understand this paradigm of situated cognition better and to analyze its pedagogical implications, it is relevant to relate it to the constructivists’ concepts of human learning. As we know, various types of constructivism exist. McGregor (2007) speaks of three; the individual constructivism of Piaget, social constructivism represented by the socio-constructivist position of Vygotsky, and socio-cultural-constructivism that went beyond the ideas of the Russian author. The author, analyzing the pedagogical aspects of the three types, establishes that: 1) teaching with the constructivism of Piaget basically directs the students to develop their own meanings (schemas) in an individual way; 2) teaching with Vygotskian socio-constructivism directs the students to build knowledge through social interaction and by means of a process of negotiation between expert and novice in the zone of proximal development; and 3) teaching with socio-cultural constructivism directs the students to build knowledge by interacting in real communities in such a way that at the beginning they are considered legitimate peripheral participants (Lave & Wenger, 1991) and little by little, interacting with other more expert members, as full participants of that community. According to this categorization, we can say that the paradigm of situated cognition belongs above all to the third type, that is to say, to socio-cultural constructivism.

In education, the perspective of socio-cultural-constructivism has produced very innovative conceptions related to learning such as situated learning, legitimate peripheral participation, and the student as apprentice (Hendricks, cited in Díaz Barriga, 2003). In situated learning, the knowledge construction process during an educational experience is intricately related to the context of practice where it takes place. For this reason, according to this approach, models have been proposed like the Atelier Model of Learning by John Seely Brown (2006), in which it models the type of learning that occurs in workshops of artists and architects, where a group of apprentices develop tasks to become experts under the strict supervision and guidance of a teacher.

In spite of the fact that situated conception has been present in the educational area for more than a decade (for example see Brown, Collins & Duguid, 1989, Brown & Duguid, 2000; Díaz Barriga, 2003, 2005; Greeno, 1998; Lave & Wenger, 1991; McLellan, 1996; Rogoff, 1991; Wenger, 1998), the majority of teaching strategies currently employed still continue to be very grounded in the conception of individual cognition concerned above all with facilitating the processing of information received by a student in an individual way. I consider that this lack of situated vision of human learning is negatively affecting the quality of learning for our students, mainly because the knowledge that they are building, which lacks social elements and contexts, remains stored in an inert way within them with few possibilities of being transferred to other situations of their
Three Contexts Methodology

everyday life. To this end, the central purpose of this chapter is to explore this problem a little further, to propose a methodology based on situated cognition to contribute to its solution and to describe an example of its application.

With this paper, to better understand the antecedents of the paradigm of situated cognition, first I will make an analysis of how human cognition is naturally intertwined with our social activity and how professional communities are thus generated to resolve problems. Also, I will discuss the interest of the professional communities to produce information to communicate their methods of resolving problems and how this information contains cultural elements and contexts that give identity to that community. I will do this in order to contrast this natural form of building knowledge and information with the daily processes of teaching-learning that the school carries out. Using these antecedents as a base, I will later describe the Three Contexts Methodology created to ground the concepts of situated cognition. Finally, I will describe and I will analyze the results found when this methodology was applied to a group of students from a local junior high school.

BACKGROUND

Human Cognition Intertwined with Social Activity

To better understand the paradigm of situated cognition, it is important to consider that, as part of evolution, as human beings we have been developing our intellectual abilities carrying out activities with our fellow men within the socio-cultural contexts that we reside. Hutchins (1999) considers that it is impossible that human cognition not be affected by the complex socio-cultural world where it takes place.

This position that relates cognition with group activity and context has extensive support in international literature. For example, Piaget recognized, although using the individual as a unit of analysis, that as human beings we develop our cognitive structures through a process of adaptation when interacting with our environment. For the Russian psychologist Lev S. Vygotsky, certainly from a social point of view, our superior cognitive abilities have a social origin and, as expressed by Wertsch (1988, p. 196) explaining the Vygotskyian conception of human consciousness, “human beings are conceived as permanent builders of their environment and its representations through their engagement in different forms of activities”. After Vygotsky, his disciples and colleagues developed the activity theory to understand the complex social systems analyzing the origin, structure and processes of the activities that we as human beings carry out as part of our everyday life (Kaptelinin & Nardi, 2006). In general, this connection between thought, activity, and context is also present when we conceptualize human intelligence as a social practice (Resnick, 1996, 1999) and when Maturana and Varela (1987) define our cognition as “an ongoing bringing forth of a world through the process of living itself” (p. 11). Brunner (1971) expressed this connection using the concept of culture when he proposed that during our processes of thought there are present not only individual intellectual resources but also those that our culture contributes to us, such as language, myths, tools, ways of doing different things, etc. Along this same line, Edgar Morin (2000) expresses that “cultures are formed, conserved, transmitted, they develop only through the cerebral/spiritual interactions among individuals” (p. 73), and also, in an unequivocal way, establishes that culture does not only bring with itself a “cognitive dimension is a cognitive machine whose praxis is cognitive” (p. 74). For this philosopher, the influence is mutual; on the one hand, our culture assists us in the process of developing our potential as human beings, and on the other hand, we feed it by exercising our group and individual cognition.

The best example that evidences the firm relation between human cognitive ability and the
socio-cultural is the development of language, for this is the cognitive vehicle through which culture creates and is created (Morin, 2000). Language has arisen during our evolution to assist us in the construction of explanations of our worlds and in the collective solution of our everyday problems. It is an intellectual tool that allows us to speculate on what will happen or has happened in another time or another place. At the contextual level, the relation of context with language is clear in the words that we create to name objects, like tree or in expressions as there and up or yesterday in my house. Barwise and Perry (1999) speak of Ecological Realism to explain that the meaning of the words that we employ are more commonly found in human interaction and their context than just in the head of an individual; for example, these authors comment - when I tell someone “I am right, you are wrong” and you respond that “I am right, you are wrong” both expressions have the same meaning but different contextual situations.

Shared Cognition and Context

In the situated perspective of human thought, the social factor carries special importance. In this sense, Hutchins (1999) asserts that the properties of group cognition are different from those of the individual and that in a context individual cognition is only a part; thus, for this author, the concept context does not only represent an assembly of static environmental conditions, but a much more dynamic and extensive process.

Inside a context occurs what Resnick, Levine and Teasley (1991) call shared social cognition where it is considered that knowledge is not only something individual, but also social, fused to the community itself that is being constructed through the activities carried out by the group. The cited author Edwin Hutchins has been using methods of anthropological investigation to study the process of adaptation of our cognition to take into account the requirements of our natural habitat and to this end invented the concept cognition in the wild. This notion represents the synergy that is created when we enter an activity to solve, with others, the inherent problems in our natural habitat; from those that require very little of the complexity of our thinking as to escape an imminent danger, to those that require all our complexity like to decide where to live, to diminish the proliferation of the virus AIDS or how to navigate a great ship in the immensity of the ocean.

Activity Theory

To understand how we develop our cognitive abilities in the wild is an important quest in the research that has been done under the paradigm of situated cognition. For this, the theory of activity has been used, which offers a socio-cultural framework to analyze systems of human activity (Engeström, Miettinen & Punamäki 1999; Jonassen & Rohrer-Murphy 1999; Quek & Shah 2004).

The theory of activity was originally proposed by Aleksey Leontiev, disciple and collaborator of the famous Russian psychologist Lev. S Vygotsky, for the purpose of using activity as a unit of analysis to be able to develop even more the Vygotskyian ideas (Wertsch, 1988). This theory is defined by Kaptelinin and Nardi (2006) as:

An approach in psychology and other social sciences that aims to understand individual human beings, as well as the social entities they compose, in their natural everyday life circumstances, through an analysis of the genesis, structure, and processes of their activities. (p. 31)

Jonassen and Rohrer-Murphy (1999) recommend using the theory of activity as a “powerful socio-cultural and socio-historical lens through which we can analyze most forms of human activity” (p. 62). Basically the proposal of Leontiev was based on studying a complex system of human activity identifying the triangular relation between a subject, the object of its activity and the mediating tools, physical or psychological, employed during the activity. More recently
Engeström, Miettinen and Punamäki (1999) and Engeström (2002) extended this basic model to study the process more as a system of collective activity thus facilitating its use in studies of situated cognition. Engeström explains the dynamics of a subject that belongs to a community that possesses rules of relationship and division of labor and how this subject, through its repetitive community activity, manages to transform its object into a final product. From this model, Jonassen and Rohrer-Murphy (1999) propose six steps to analyze a system of activities: 1) to identify the purpose, the motives and the goals of the system of activity; 2) to identify the subject, its object and the community to which it belongs, establishing the rules and the division of labor; 3) to analyze the structure of the activities made by the subject; 4) to analyze the mediating tools used by the community; 5) to analyze the context in which the activity happens; and 6) to connect the results of the prior steps in a dynamic system of activities.

The Concept of Contextual Index

From the ideas mentioned above, we can identify that, in our daily life, when thinking in the wild we are immersed in diverse systems of activities that define us in very diverse ways; for example, we belong to a determined profession, to a given social organization, and to a family that certainly resolves problems in its own way. Thus we build our social knowledge as the result of the reciprocal interaction between what we are, individually and in groups, with the characteristics of the different contexts in which we live together. For this reason, our knowledge also includes elements that can be called contextual, because they are connected with the properties of the same environment in which we are creating it. It is in this sense that Brown, Collins and Duguid (1989) say that knowledge created by humans “is, we believe, like language. Its constituent parts index the world” (p. 22).

Reflecting on these ideas, I have considered it pertinent to build the concept of Contextual Index to identify those elements that are added to knowledge since we are building it in a natural habitat (in the wild). A contextual index is knowledge related to the execution of an activity in a given situation (in another situation the indices would be different), this includes aspects of the context, and on how the activity was carried out collaboratively in that situation in addition to what tools were employed. The same problem resolved in two different situations would generate different information, albeit some common without doubt, but therefore different contextual indices. This concept of contextual index tries to represent part of the knowledge that we would build socially when resolving a problem in a particular situation and not in another. The purpose of using this construct is not to have a quantitative variable to measure how much the context adds to the knowledge built, but rather to depend on a useful concept that allows us to identify the presence of the context in human learning to be able to include it as an important part of the methodology that we are presenting in this academic paper.

Original Contextual Indices of Professional Communities

As already commented, as human beings we have been thinking in the wild immersed in systems of social activities to resolve problems since we initiated ourselves as a species on this planet Earth. This is how we have been building relevant knowledge for our survival. At the same time we also realized that this knowledge would not serve us if there was not a way to transfer it to other people and to other situations. Because of this, we began our eagerness to store our knowledge in such a way that it can be useful to us in another time and another place as well as for the rest of our culture. We can say, then, that this ability to think in context is also a process that produces and stores information. Different societies have
developed very complex ways to store and transfer socially produced information from one generation to another. For example, initially we stored information in an analog form in cave paintings and art in general and we transmitted it orally during rituals and ceremonies. Later, with the creation of writing, a form was initiated that prevails to our day, because we learned to store it and transmit it in a digital form. According to the theme that we are discussing, what is important is to identify that this information that we produce and collect as part of an active community includes contextual indices of that community because it is part of the dynamic and complex process of cognition in context. When other people come in contact with this information they build knowledge that also includes a representation of these original contextual indices.

Usually a given social group gathers around a common purpose of solving a problem. During the process of resolving it, they keep the ways in which they did it, the type of tools that they used, and the results obtained. Thus were born professions. For example, the people interested in human health developed curative methods that initially were kept in paintings and codices as those in ancient Egypt. This medical profession, as we know it now, has been generating information that contains many elements of real problems that have been resolved, as the method of operating on a nose, to elements that define the way of being in a particular group; that is, elements that define its culture as the medical method of resolving problems and the terminology and type of tools that are employed. This conforms to what Lave and Wenger (1991) call a community of practice. Therefore, when a human group enters in contact with information produced by another professional community of practice they apply it in their own contexts of life to resolve their own problems. These, without doubt are different than the problems that caused the original production of that information. For example, a doctor today uses original information, but he adapts it to his present circumstances. As we said in the previous section, upon entering in contact with the original information and learning from it he passes through a process of enculturation because the information that he is using brings all the contextual indices of the professional community that produced it. In this way, he learns general structures of medical thinking and methodologies; nevertheless, upon being applied as the solution to his own problems, he adds his own contextual indices which include his form of thinking and doing things. Considering these two types of contextual indices, that is to say, the original and those of use, a natural
dynamic is established that relates the original production of information to its application, where each group that uses it adds its own contextual indices. Now let us contrast this natural dynamic of social thought in the wild with what happens in the school environment.

Cognition in the Wild vs. Cognition in the Classroom

In the previous sections I have explained how our cognition is intertwined with our social activity, how we form professional communities of practice to resolve problems and to produce and store information that includes contextual indices and how we apply that information to resolve our everyday problems; adding, at the same time, our own contextual indices. In this section these ideas will be contrasted with what happens in the School in relation to the process of knowledge construction, for it is in these human institutions where, as a society, we plan that people enter in contact with information produced in the past and build new and innovative knowledge for the purpose of understanding our own culture in contrast to other cultures.

Reflecting on the origin of the School as a social organization, I speculate that this was designed and created originally in a natural way harmonious to the common process of cognition in the wild, on the one hand, to familiarize us with the information and the values that our specific culture considers relevant, and on the other hand, for us to know how to use that information to resolve problems related to our daily lives. In the beginning, our schools were very connected to their context and what was learned in them had almost immediate use, as civic and religious values and the knowledge of how to farm the land. This happened because what was learned held most of the contextual indices of the people that created it, for the information was very close to the immediate reality of the school; as how to farm the land. However, with the passing of time we can say that this reality has vanished from the classroom (Santos, 2007). Because the schools have become enormously complex, and seeking better efficiency and greater effectiveness, they
have systematized their tasks in such a way that, on the one hand, they remove the majority of the contextual indices of the information produced by the professional communities to be able to teach purer contents. On the other hand, they have considerably reduced the educational opportunities to apply learning in realistic contexts, not giving opportunities for the students to bring their own contextual indices to their learning, assuming that what they have stored will find use, in a natural way, in the future. In few words, the School has removed the original contextual indices and does not promote the construction of those of use.

The School Removes the Original Contextual Indices

In today’s school, in search of making its processes efficient, the information that its students learn is conceptualized as a set of independent objects that can be moved, stored and taught separately; that is why the Schools consider their main task to move these objects from a textbook, from a web page or from the knowledge of the professor to the heads of its students, thereby showing its misunderstanding between information and knowledge. This mere movement of content objects between their place of storage and the memory of the student is more efficient when there are less contextual indices. This efficientist concept of learning basically understands the cognitive process of the student as a processing of information, and therefore, as something independent of context. This non-situated perspective of learning has of course benefits for the educational system, above all economic, but the quality of the education of the students is affected when lacking the process of enculturation, because there is an important negative effect on the transfer of knowledge into the contexts of everyday life. When learning objects of content clean of contextual and historic indices, the students do not learn the methods of resolving problems from the professional communities, and consequently, they do not learn to think as medical doctors, engineers and poets. It is a loss because the students finish with an inert knowledge for which they do not find application except in the exams. This happens because, since the process of thought in the students’ heads is to above all recall contents without contextual indices, the students do not possess anything that links what they have learned to their environment, current or future, of life. Because of this, using the concept of Sternberg and Frensch (1993), the students do not develop a mental set for transfer. The knowledge that the students build in our educational institutions is used most often to advance inside the culture of the school that is forming them (Brown, Collins & Duguid, 1989) and rarely do they identify that this knowledge has a relation to the problems of the community where they live.

The School Does Not Promote the Contextual Indices of Use

Combined with the negative effect on transfer of contents cleaned of their original contextual indices, there is also the effect that arises because schools offer few learning experiences where the students can apply what they learned in their own life environments. This situation does not permit the students to add their own contextual indices related to their own everyday contexts, and therefore, the content has still less connection with the context and the possibilities of transfer diminish still more. As I have said, with this situation the quality of learning decreases, because, if we reflect a little, transfer is something substantive to reach the objectives of Education. Nevertheless, there is evidence that this transfer does not always occur (Ceci & Ruiz, 1993; Perkins & Salomon, 1992; Sternberg & Frensch, 1993).

In educational discourse it is common to find recommendations that learning should be carried out in authentic situations and that what is learned be transferable to other contexts and situations, both to the same school and to the student’s everyday life. For example, Merril (2002),
when identifying the five principles of teaching, emphasizes that one of them is that learning improves when knowledge is integrated with the world of the student. Equally, when Wenger (1998) establishes his premises on learning and the nature of knowledge he accentuates that we are social beings and that to know is related to participating engaged in mundane tasks. Even Sternberg, considered one of the most renowned authors of cognitive psychology, in his works includes a social component. In his theory of Triarchic Intelligence (Sternberg, 1985, cited by McGregor, 2007), which has influenced several instructional models, he recognizes analytic intelligence, creative intelligence, and a third one that he calls practical intelligence that has to do with the solution of problems in everyday life. Therefore, in his model of intelligence he is recognizing the importance of the transfer of learning and thinking in context.

Including Contextual Indices Improves the Transfer of Learning

Considering the above, this paper proposes, in short, that the transfer of learning improves if external contextual indices are included in the process of teaching and learning in the classroom. As was already commented, two contexts external to the classroom are identified which must bring contextual indices to promote transfer: that of the community of practice that originally built the content, and that of the everyday life of the student where the student is expected to apply what has been learned (see Figure 1).

In fact, both processes are related, since learning elements from the context of the original community of practice serves the student to connect what is learned with his or her own context of practice. When including both contextual indices together in learning we are integrating the cognitive processes of the students in the classroom with the system of activities of the communities of practice and with the everyday culture of each one of our students.

Due to these notions, the methodology described in this paper has been given the name Three Contexts Methodology (3CM) in reference to the three contexts related to school learning: 1) that of the professional community, 2) that of the classroom and 3) that of the everyday life of the student (see Figure 2). The research that is being carried out to validate this methodology is done to better understand how the transfer of knowledge of a context to another is affected by the presence of these contextual indices.

The Three Contexts Methodology

The Three Contexts Methodology (3CM) was created from the ideas discussed in the previous sections to help teachers and instructional designers in the application of pedagogy based on the paradigm of situated cognition. Next, I will describe this methodology establishing its assumptions about human cognition, presenting its main objective and listing and explaining the set of instructional strategies that it proposes. And finally, to clarify the strategies better, I will present in detail a case study where the 3CM was employed.

Instructional Objective of the 3CM

In essence, the Three Contexts Methodology strives to improve the quality of learning in the classroom promoting the type of human cognition described in the previous sections of this chapter. To realize this, its main objective is to promote the process of transfer of learning in two ways: 1) facilitating enculturation by means of including contextual indices of the professional community that originally built the content; and 2) by means of including contextual indices of the natural habitat of the student’s everyday life.
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Instructional Strategies

To reach the stated general objective, the 3CM proposes the following set of three educational strategies to develop learning experiences:

Strategy 1. To Preserve the Original Contextual Indices

Make sure that the selected content to be learned contains contextual indices of the community of professional practice that originally produced that information. The pedagogical interest here is that, upon including original contextual indices, we encourage our students to learn to think as those communities. This is achieved by asking students to perform activities similar to the ones that are commonly carried out as part of the professional work of the community of professional practice that originally produced the content.

However, to be able to design these types of activities the teacher or designer must first understand the system of activities of the original community of practice. As previously explained in the background section of this manuscript, to better understand the system of activities of the original community of practice it is recommended to use some of the ideas of activity theory. In particular, the six steps recommended by Jonassen and Rohrer-Murphy (1999) to analyze how a system of activities can be adapted; the steps they suggest are: 1) to identify the purpose, the motives, and the goals of the system of activity; 2) to identify the subject, its object, and the community to which it belongs, establishing the rules and the division of labor; 3) to analyze the structure of the activities made by the subject; 4) to analyze the mediating tools used by the community; 5) to analyze the context in which the activity happens; and 6) to connect the results of the prior steps in a dynamic system of activities.

Considering these steps, to include some of the original content’s contextual indices, the 3CM proposes that a teacher or a designer should gather information concerning the following eight topics to understand the system of activity of the community of practice:

1. The main purpose for the professional activities of the community of practice. For example, a designer developing an online simulation of nursing, after interviewing several professional nurses and checking several academic nursing programs on the
Web, establishes the main purpose for the nursing profession as: To offer an integral service within the areas of health and human services.

2. The general outcome that results from performing the professional activities of the community of practice. For the nursing example, their profession’s general outcome was established as: To individually or collaboratively care for the life functions of the community or the single person so as to improve their health according to nursing principles.

3. The types of objects that result from performing the professional activities of the community of practice. For the same nursing example, some of the objects identified were:
   - A community program to promote health and prevent illness.
   - An administrative program to solve health problems in an organization.
   - A clinical diagnosis
   - Attend a sick person
   - Assist a surgical procedure

4. The tools the community of practice employs to mediate its activities. For the nursing example, some of the tools that were identified are:
   - The know-how that comes with experience
   - Theoretical models
   - Nursing procedures
   - Medical equipment as monitors, infusion pumps, manometers, etc.
   - Set of surgical instruments

5. The division of labor within the community of practice. For the same nursing example:
   - Chief Executive Nurse
   - Sub-Chief Nurse
   - Supervisors
   - Floor Nurse
   - Intensive Care Nurse
   - General Nurse
   - Nurse in training

6. The rules and norms that the community of practice follows to perform its activities. For the example:
   - Health care is offered following legal, ethical and bioethical principles.
   - A nurse has moral integrity and her professional practice is based on humanist philosophical principles.
   - Nursing knowledge is created through research done with scientific rigor.
   - Nursing activities have a scientific base.
   - Nursing activities are always done showing respect for the person’s values and traditions.
   - Aseptic norms are always followed.

7. The components of the activities, which are called actions. For the nursing example some instances of their actions are:
   - To support medical doctors (physicians, dentists and surgeons)
   - To provide care for the ill and injured
   - To provide care at childbirth
   - To design and apply a community program to promote health and prevent illness.
   - To educate the community in self-care
   - To diagnose the sickly and provide hospitalization

8. The components of the actions, which are called operations. Just a few operations for the nursing profession are:
   - In a hospital emergency, to press the blue or red code button.
   - To measure the patient’s blood pressure using a manual manometer.
   - To measure the patient’s temperature using a thermometer.
   - To administer medications

Once the designer in the example has gathered and analyzed the information regarding the previous eight topics, he has a better understanding
of the system of activities of the nursing profession. He is now more able to design learning experiences for his online simulation so that his students can perform activities similar to the ones that professional nurses do and be enculturated in the nurses’ ways of thinking and doing, which is the main pedagogical objective of this first instructional strategy.

In general, to gather together all this information regarding the system of activities of a professional community is a rather difficult task. Nevertheless, a teacher can use three different methods for collecting data: 1) interviewing members of the community in person or via e-mail; 2) observing professionals performing their activities; and 3) reviewing the Web pages of the educational institutions that offer academic programs in the different professions. Academic departments usually publish a list of learning outcomes to profile their graduates.

**Strategy 2. To Learn in Situated Learning Environments**

Allow students to learn in Situated Learning Environments so that they can live authentic learning experiences that promote the type of situated cognition described in the notions presented previously. The pedagogical objective of this second instructional strategy is to simulate in the classroom the system of activities identified with the information gathered during the first strategy so that students can actually live a process of enculturation on what it means to think and be a professional practitioner of a certain community of practice. To achieve this, the 3CM proposes that the teacher develops a complete learning environment.

This concept of learning environment, although sometimes wrongly used to name any type of learning experience, has been extensively discussed in the educational literature (for example see Jonassen, 1999; Perkins, 1992; Wilson, 1996) and is accepted to be a constructivist instructional methodology. This is why the 3CM considers that a learning environment can be an effective way of pedagogically grounding the situated cognition paradigm. According to the previously cited authors, a learning environment is a space where students collaboratively perform meaningful learning activities using tools and information resources to develop problem-solving skills and socially negotiate the construction of meanings. In addition, considering that the 3CM has a socio-cultural-constructivist perspective, it proposes that a situated learning environment (SLE) should be created where students, according to Wilson’s (1996) analysis of the different views of knowledge, enter in a process of “enculturation or adoption of a group’s ways of seeing and acting” (p. 4).

To support the teachers’ development of the SLE, the 3CM recommends the use of an adaptation of the model of David H. Jonassen (see Figure 3) to design constructivist learning environments (Jonassen, 1999).

The model has the following components:

1. **The Problem and its Context:** It is proposed that the students solve problems that engage them in activities similar to the ones that the original community of practice traditionally do. For this reason we should get them involved in contexts that simulate that of the original community. Continuing with the nursing case that was presented to exemplify the first instructional strategy, the problem’s context can be established describing all the complexities of a hospital in, for example, a Web site. Then the teacher can give students the roles of professional nurses and ask them to solve typical nursing problems like providing the right care to an injured patient or giving the appropriate support to a surgeon. This can be accomplished developing a complex electronic simulation program or through simpler face to face learning experiences.
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2. **Tools:** It is proposed that the tools (physical and psychological) employed to solve the problem be similar to the ones that the members of the original community of practice use. Continuing with the nursing example, the Web site can include tools like simulated manometers and thermometers and offer just in time instructional aides to scaffold the learning of specific procedures.

3. **Related Cases:** As part of the scaffolding, similar cases are presented where similar problems were resolved. For the nursing example, the Web page can include a database of nursing cases describing how similar problems were solved at different hospitals.

4. **Information Resources:** The simulated context should contain rich resources of information relevant to the problem and related to the original community of practice. Through this component, the teacher makes sure that the students relate this information to the course’s content. The idea is that students, in order to solve the problem, need to read and comprehend the new information. It is common that students tend to solve the problem using only their previous knowledge and do not see the need to also employ the new content for that purpose. If the teacher detects this happening, he must redirect the students’ attention to the new content. For the nursing example, the Web site can include a simulated library were nurses can go to search for relevant information to solve the problems.

5. **Area of Simulation:** The situated learning environment should provide the students the opportunity to test the solutions to the problem that they observe and to receive feedback. For this, if available, complex electronic simulators can be used; however, a simpler solution is that the teacher revises the students’ hypotheses regarding the possible solution for the problem at hand and offers feedback in terms of the future consequences if that solution is implemented. In the nursing example, e-mail messages, chat technology or face to face feedback can be used for this purpose.

6. **Three pedagogical axes present at all times:**

   1. **Coaching:** Instead of just engaging in traditional information transfer, the teacher acts more as a coach for her students. Thus, she should constantly supervise the student’s performance and offer feedback only when needed. A teacher using the nursing simulation can coach her or his students during the classroom experiences and through the use of the learning technologies that the simulation Web site affords like e-mail, chat, discussion forums, etc.

   2. **Scaffolding:** The learning of the students should always be supported by resources of different types. For the example, the nursing simulation can include computers, textbooks, audio-visual materials, and of course the teacher himself. In this way, students can get the support they need. Over time, students tend to make less use of the scaffolding structure.

   3. **Modeling:** Similar cases should be presented to the students where similar problems were resolved so that they have the opportunity to shape their learning. These cases should only support the students’ learning through giving them hints about how the problem can be solved, but should not solve the problem for them. For the nursing example, a set of cases can be developed and stored in the Web page so that students can review them whenever they consider that they can be of help for their problem solving efforts. The teacher can also present them in class to make sure that the students review them.
Strategy 3. To Bring Contextual Indices of Use

It is important to assure that the students live learning experiences that permit them to bring contextual indices of their own contexts of life. To do so the 3CM recommends asking the students to carry out activities in their everyday life environments making use of different technologies, therefore it is recommended that the students, as part of the activities:

1. Bring evidence of their life environments related to the problem that is being resolved to the classroom. For this situation different audiovisual and computer technologies can be used.
2. Present and explain the evidence found to their classmates. This helps with reflection on the issue and better links the content with their own contextual indices.

Going back to the nursing example, students can be asked to bring photographs or videos they have created to explain some of the concepts, which are part of the content that they are learning. For example, they could be asked to take photographs demonstrating the concept “bioethical principles”, bring them to class and explain them to the rest of the students. In this way, the students engage in reflective thinking when they are taking the photographs and also when they are explaining their ideas to the group. Moreover, during the classroom explanation, the teacher has an opportunity to evaluate the students’ comprehension of the concepts because the photograph is representing the students’ constructed knowledge.

To better clarify each one of these educational strategies, the following section will explain in detail how they were applied in a case study that was carried out in a local public junior high school.

CASE STUDY WHERE THE 3CM WAS EMPLOYED

Situation

To apply and evaluate the 3CM, a group of 7th grade students in a Mexican public school was selected made up of 14 boys and 16 girls of between 12 and 13 years of age. Working closely with one of its teachers, first the content was selected and the learning objective was established, which were related to the area of geography because it was one
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of the subjects that should be learned in the days during which the study was developed. The theme addressed was: Globalization and Socioeconomic Inequalities and the planned learning objective was: Understanding the main variables and their interactions that promote social inequality in the process of globalization.

The research team that developed, applied and evaluated the situated learning environment was formed by the teacher of the group, a researcher and a graduate student working on her thesis. Once the situated learning environment, along with its materials, was developed, it was applied to the student group for two weeks during the scheduled geography class, which permitted us to be with the students around 12 hours in total. To compile the data of the study all the work sessions were videotaped, annotations in a fieldwork notebook were made, various works produced by the students were collected (written solutions to the problem, oral presentations of the solutions, and photographs taken in their home contexts), and subsequent to the work sessions, the teacher and some of the students were interviewed. The data were analyzed inductively using a method of constant comparison.

Application of the Strategies

Strategy 1. Conserving the Original Contextual Indices

The purpose of this strategy is for the learning experience to include the contextual indices of the community of professional practice that produced the information that is being selected as content. In this case of the junior high school, the purpose was for the students to understand the community of practice of geographers and the type of activities that they carry out. In this case, we were interested to see if they might acquire something of the epistemological framework of the professional community of geographers. As was already commented, to carry out this strategy the 3CM recommends to use the activity theory to better understand the system of activities of a professional group. In Table 1 the information that was compiled for the community of geographers is summarized. It was gathered interviewing geographers and analyzing the type of learning outcomes that the universities that educate them report in their official Web pages.

Carefully analyzing the activity system of geographers and the topic of learning, it was decided that the learning objective for the students was: To understand the main variables and their interactions that promote social inequality in the process of globalization. The goal was that the activities and the cognitive processes of the students during the learning experience would coincide with some of the geographers. For this reason, we asked them to resolve a problem and analyze complex information on the current globalized environment and to propose solutions to one of the problems that emanates from the geographical world situation.

Strategy 2. Learning in Situated Learning Environments

The research team developed a full situated learning environment to permit the students to interact in and in which they could live the sought learning experience. In Table 2 the components of this environment according to the design model used are shown.

Strategy 3. Bringing Contextual Indices of Use

As was already explained, with this activity we sought for the students to bring contextual indices from their own life environments so that they would be able to integrate them in their learning experience. To carry out this instructional strategy we asked the students to take photographs in their contexts of daily life. For this purpose, first digital cameras were distributed to them by team, they
were instructed on how to use the cameras, and it was indicated that they should bring images that represented the solutions that they found for the problem presented. Once the work teams brought the cameras back, the photographs were placed in a file on the classroom’s computer in an order

Table 1. Activity system of the community of geographers

<table>
<thead>
<tr>
<th>Community</th>
<th>Professionals working in different disciplines of the social sciences. Purpose of their activity: To study the social aspects of the world applying theoretical models and methodologies to diagnose and propose solutions to present problems.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
<td>Group of Geographers working in social, private, public and educational sectors. Purpose of their activity: To study the geographical space, its complex relationships and its organizational methods to contribute to the socio-economic well being of the country. In order to accomplish that, they gather spatial information to identify problems regarding the dynamic organization of the territory, including the relationships: society-nature. They also propose actual solutions to promote development, the ordering of the territory and solve social imbalance.</td>
</tr>
<tr>
<td>Tools</td>
<td>• Theoretical models and concepts related to geography. • Research methodologies • Territorial analysis and cartographic methodologies • Methods and techniques for map creation and interpretation. • Measurement instruments and remote sensors • Cartography • Geographical information systems • Computers, software, video, audio and photographic equipment</td>
</tr>
<tr>
<td>Rules</td>
<td>• Practice is done according to the norms accepted by the international community of geographers • Practice must be done with scientific rigor • Research is done based on postulates of a research paradigm • Qualitative and quantitative research are based on their own postulates • Research questions should match the used methodology • Practice and research is done based on a theoretical frame of reference • Always cite appropriately ideas taken from other practitioners</td>
</tr>
<tr>
<td>Division of labor</td>
<td>• Directors of the project as a whole • General advisors • Designers of data gathering instruments like interview and observation guides • Producers of materials • Field workers</td>
</tr>
<tr>
<td>Object</td>
<td>• Geographic Information Systems • Risk analyses • Urban studies • Global studies • Environmental impact studies • Cartographic representation • Vulnerable territorial zones studies</td>
</tr>
<tr>
<td>Outcome</td>
<td>The socio-economic well being of the population and the country’s development.</td>
</tr>
<tr>
<td>Actions</td>
<td>• Develop geographic information systems • Administer the environment • Plan the territory • Analyze information coming from the population and the environment, interpret that information and propose solutions. • Analyze information coming from global populations and environments, interpret that information and propose solutions. • Gather, organize and display data bases regarding spatial and non-spatial information. • Integrate satellite data, statistics, aerial photographs, etc. • Advise business specialist regarding landscape resources.</td>
</tr>
<tr>
<td>Operations</td>
<td>• Gather, integrate, analyze and represent spatial information • Urban and town planning • Community planning • Industrial planning • Neighborhood planning</td>
</tr>
</tbody>
</table>
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Results

Analysis of the data showed interesting results about the aforesaid 3CM pedagogical goal, which basically aims to increase the quality of learning through implementing the situated paradigm type of cognition in the classroom by including original contextual indices of the professional community that created the content and contextual indices of use of the students’ own every day contexts.

Table 2. Components of the Situated Learning Environment Saving Ourselves from the Abyss of Inequality

<table>
<thead>
<tr>
<th>Component</th>
<th>Situated Learning Environment (SLE) Title: Saving ourselves from the abyss of inequality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective of the SLE:</td>
<td>To understand the main variables and the interactions that promote social inequality in the process of globalization</td>
</tr>
<tr>
<td>The problem and its context</td>
<td>6 teams of 5 students were created, each one received written information about how the countries around the world are socially and economically connected, and how some of these countries are suffering enormous social inequalities. They were then asked to respond to the questions: Why is social inequality part of the process of globalization? What are the causes of social inequality during the process of globalization? Are there solutions so that social inequality would no longer develop during the process of globalization?</td>
</tr>
<tr>
<td>Tools</td>
<td>• Computer and video projector, • Photographic camera, • Model explaining the relationships of globalization in the textbook</td>
</tr>
<tr>
<td>Related Cases</td>
<td>Information was also distributed to them on how a professional team of geographers resolved a similar problem related to the use of water. The related case was built so that the students could realize how a problem such as this could be resolved, that is: 1) begin with brainstorming ideas, 2) reformulate the problem in your own words, 3) identify causes, 4) read the related information and 5) identify solutions.</td>
</tr>
<tr>
<td>Resources of information</td>
<td>• Textbook (where the topic of globalization is adequately explained), • Distributed Materials, • Computer, • The teacher and the investigators</td>
</tr>
<tr>
<td>Area of Simulation</td>
<td>No simulator as such was developed. Nevertheless, the teacher and the investigators were always present to give feedback on the possible consequences of their decisions. This served the students to test the possible hypotheses that were being formulated in their process of resolving the problem.</td>
</tr>
<tr>
<td>Coaching</td>
<td>During the experience the teacher of the material and at least an investigator were always present to guide the work of the students and to respond to questions.</td>
</tr>
<tr>
<td>Scaffolding</td>
<td>All during the experience the students were provided with: materials, textbook and tools.</td>
</tr>
<tr>
<td>Modeling</td>
<td>Together with the problem and its context, a case was distributed to the students in which a professional team of geographers described how they resolved a similar problem related to the use of water</td>
</tr>
</tbody>
</table>

that they established. At the end of the experience each team was asked to give a presentation of their solution to the problem displaying their photographs to the class using a video projector; the idea is that the team continues in their cognitive process of integration of the content and the contextual indices.

Including original contextual indices as an instructional strategy seeks that the students develop a new epistemological frame, in this case that they learn to think as geographers do. This means a profound cognitive change for the students that can only be achieved in the long run; thus, we were not expecting to identify this type of cognitive change in this short study. We were more interested in acknowledging how the dynamic of the developed situated learning environment, created by the inclusion of the original contextual indices plus the contextual indices of use, affected the students’ learning.

In this regard, we found few examples that showed that the students had satisfactorily reached the sought learning objective, which stated that they would be able to understand the interactions between the variables that promote social inequality in the process of globalization. This

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general result was concluded after evaluating: 1) the students’ written solutions to the problem; 2) the oral presentations that they gave to the class to explain their solutions displaying the photographs taken in their home contexts; 3) the photographs themselves; and 4) the transcriptions of the students’ interviews.

**Analysis of the Students’ Written Solutions**
The majority of the solutions proposed by the teams in writing did not delve adequately into the complex relation between globalization and social inequality. That is to say, the teams in general based their discussions on acknowledging the social inequalities that exist in Mexico and, consequently, their solutions were directed at reducing those inequalities by empowering the poor by means of, for example, increasing their salaries, lowering prices, or asking the government to distribute free products and materials to the underprivileged population. That is, their solutions did not show that they were identifying variables and relations that cause social inequalities in the process of globalization, information that could be inferred from their textbook. In fact, none of the written proposed solutions included concepts clearly related to the process of globalization.

**Analysis of the Students’ Oral Presentations**
Although in their written solutions the teams did not identify globalization concepts, in their oral presentations of the solutions some aspects about globalization could be recognized. For instance, they discussed examples where international influences appear in the local culture. One of the teams presented a Mexican employee working for an international fast food chain (see Figure 7). When presenting the photograph, they commented that international businesses employ poor Mexicans and that the salaries are low. A second team proposed an innovative solution, where they suggested that the poor should organize to sell their own products to the final consumer. Another proposed that Mexico should export more to reduce its impoverished population. And then one more proposed that the country should permit more international businesses to enter Mexico, because the taxes they pay would be able to help support still more poor people. Nevertheless, the majority of their solutions were centered on asking the government to offer more resources to reduce the poverty in Mexico.

Although the teams that presented did not orally express the complex relation between the depicted situations and globalization (why these situations happen), it is clear how, by deciding to take these photographs, they did develop an intuitive grasp of the topic and, most importantly, they were able to relate the rather abstract concept of globalization to their daily contexts by including their own contextual indices of use, result that supports the 3CM pedagogic assertion.

**Analysis of the Students’ Photographs**
The analysis of the photographs taken by the students in their life environments, for which a rubric was designed, shed relevant information on the study because the photographs showed contextual indices of their life environments that could be related to the subject matter on globalization and social inequality. As aforementioned, most of the solutions offered by the different teams were associated with the different ways to diminish poverty and in this way to reduce the social inequalities present in the Mexican society. According to this solution, the majority of the photographs were taken to prove how the social inequalities do, in fact, exist. They looked for instances of these inequalities in their own local contexts. However, in some photographs intent to relate some aspects of globalization could be identified because they captured images where the international presence is acknowledged.

In general, four categories of photographs could be identified:

1. Rich and poor contexts are shown to prove inequalities (see Figure 4).
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Figure 4. Examples of Category 1 photographs showing rich and poor houses to prove inequalities

2. Products in their local markets are shown to propose that to diminish poverty all prices must remain the same (see Figure 5).
3. Objects produced in foreign countries are shown to prove international presence in their contexts (see Figure 6).
4. Mexican personnel are shown working at international companies to prove international presence (see Figure 7).

With the Category 1 photographs students showed that social inequalities in fact exist. In Category 2 they tried to propose a solution to the problem of poverty, but not related with globalization. Category 3 and 4 photographs demonstrate a deeper process of reflection on the topic in the students’ decision to take them, because they show a little more of the complex relation between international elements and those of the local culture. Students accomplished this by thinking about the problem and discussing it with their teammates during the process of deciding what photographs to take. A good instance of this is the photograph that shows the sale of beans in a popular market (see Figure 6), a very traditional Mexican food, but here has a sign with the price and the name Michigan.

It is also interesting to identify that the students categorized the photographs from their own reality; for example, they categorized a house as rich although it was clearly a middle class home (judging from my own reality). This is an interesting result, because it shows how, irrelevant of how abstract the content that students are studying may be, they ground or anchor it to their own comprehension of life, something completely in agreement with the paradigm of situated cognition.

Figure 5. Examples of Category 2 photographs showing products in local markets to propose that to diminish poverty all prices must remain the same
Analysis of the Students’ Interviews

In the interviews with the students after the study in which we basically asked them “How did you learn?”, we found that a good portion of them responded that they did not recall much of anything of what they read in the textbook, and that they had not used the information supplied to resolve the problem. Nevertheless, in the interviews many had positive references to collaborative work with their classmates, something that was always being promoted on the part of the investigators. Likewise, the majority reported that they had liked the experience and felt satisfied with what they had learned during the experience. They probably used the content read in the textbook to solve the problem, although, due to the situated essence of the learning experience, they used it in an innovative way.

We think that this group of students did not effectively reach the objective of learning presented because we were asking them to learn based on a methodology to which they were not accustomed. For example, we were asking them to take responsibility for an important part of their own learning, when they were used to only passively receiving the information from their teachers. In essence we were asking them to employ a series of abilities and strategies of thought that they had not developed to any great extent, like voluntarily looking for relevant information to resolve a problem and to reflect collaboratively. Nevertheless, the results of this experience were very useful to better understand how the 3CM functions. Above all, to realize how the inclusion of contextual elements as part of the whole experience of learning affects the students’ cognitive processes by linking the student’s mental representations of the content to contextual elements putting in motion, in this way, the students’ otherwise inert knowledge.

CONCLUSION

Understanding how human cognition is intricately linked with the context where it takes place opens many important possibilities to improve the quality
Three Contexts Methodology

of learning; nevertheless, we still need to understand in greater depth how this perspective applies to the process of teaching and learning.

With this purpose in mind, in this paper I proposed a teaching methodology based on the paradigm of situated cognition. I call it the Three Contexts Methodology (3CM) because it attempts to integrate the three contexts related to the process of learning; that is to say, 1) the context of the community of professional practice that created the information that we later refer to as content; 2) the context where the learning of that content happens, as for example the school classroom; and 3) the context in which what is learned is going to be applied. The basic instructional purpose of the 3CM is to integrate these three contexts in the same activity of learning to resolve problems related to the construction of knowledge that remains inert in the student without possibility to be transferred to the solution of his daily life problems. In short, the 3CM proposes how to return reality to the classroom.

This methodology is still in its testing phase, and further research is needed. Nonetheless, during the study previously described where the methodology was applied we were already able to identify several of the 3CM strengths and weaknesses and also what type of research is needed to further validate this methodology in the future.

Some of the 3CM strengths are:

- It is a systematized way to ground the situated learning paradigm.
- Serves to design instruction that includes contextual elements.
- The student’s cognitive process is strengthened while relating abstract concepts with context, which empowers them to build knowledge that does not remain inert.
- Gives a different dynamic to the process of learning.

Some of the 3CM weaknesses are:

- The gathering of the necessary information to comprehend a system of activities would be a rather difficult task for a regular school teacher.
- It is complex to use; it takes extensive amounts of time and effort to produce a complete SLE.
- A teacher would need several sessions of training before being able to use the 3CM.
- The efficacy of the methodology depends on the students having already developed skills to learn collaboratively in a learning environment.

FUTURE TRENDS

The situated learning paradigm and how it can be applied in the teaching and learning process yields promising implications for instructional designers and teachers. The 3CM proposal described in this manuscript can be used to ground this learning paradigm. However, further research is needed before this methodology can be used more extensively. Some suggestions for future research are:

- Longitudinal studies to see if students, over time, change their epistemological frames and transfer learning to other contexts and how they do it.
- Studies that explore the use of some of the 3CM components are desirable. For example, how does the level of a student’s collaborative skills affect the 3CM efficacy?
- New studies should be done where the 3CM is applied to different types of student populations. For instance, populations with different age or different educational levels. It would also be very interesting to see how the 3CM methodology works in a corporate setting.
REFERENCES

Baquero, R. (2002). Del experimento escolar a la experiencia educativa. La “transmisión” educativa desde una perspectiva psicológica situacional [From the school experiment to the educative experience. The educative “transmission” from the situated psychological perspective]. Perfiles Educativos, 24(98), 57–75.


Three Contexts Methodology


Morin, E. (2000). Cultura y conocimiento [Culture and knowledge]. In P. Watzlawick & P. Krieg (Eds.), *El ojo del observador [The eye of the beholder]* (pp. 73-81). Barcelona: Gedisa.


Three Contexts Methodology


KEY TERMS AND DEFINITIONS

**Situated Learning:** The paradigm of situated cognition has a socio-constructivist perspective; it claims that the knowledge construction process is intricately related to the context of practice where it takes place. This theory shifts the emphasis from the individual to the socio-cultural (Driscoll, 2000) and, in this sense; it allows us to conceptualize the teaching and learning process as a complex system of human activity. For this paradigm, learning is understood as participation in a community of practice; thus, used as the base for instructional design, it promotes the creation of complete dynamic learning environments where students are changed through engaging in complex social relations.

**Shared Cognition:** This is the term used to refer to group cognition. For some researchers group cognition is different from individual cognition (Hutchins, 1999) and, thus, the knowledge built during shared cognition is only possible because of the human interaction. If the same activity is lived alone, the end knowledge would be different. For Resnick, Levine and Teasley (1991) this social shared cognition is merged into the activities performed by a community of practice. This perspective of shared cognition gives an innovative base to the study of collaborative learning in the classroom because collaborative learning can be conceptualized as a cognitive ability.

**Activity Theory:** The theory of activity was proposed by Aleksey Leontiev, disciple and colleague of Lev. S Vygotsky. In this theory human activity is used as the unit of analysis. It basically presents a socio-cultural and socio-historical framework to comprehend complex human systems. Its aim is to analyze human beings and their social systems in their natural habitats through the study of their activities (Kaptelinin and Nardi, 2006). Human activity is here understood as a triangular relation between a subject, the object of its activity and the mediating tools, physical or psychological, employed to do the activity. This perspective gives an entirely different view to the use of technology in the learning process because here technology is not conceptualized as a mere optional object, but rather relates a subject with his end purpose.

**Contextual Index:** A contextual index is a construct with which to identify those elements that exist in our knowledge that are linked to the contexts where that knowledge was built. This knowledge is intricately related to the characteristics of a particular situation where a type of activity is performed. Thus, contextual indices built in a certain situation would be different if built in another situation. This is not a quantitative concept, but rather an abstract concept to identify the presence of the context in learning. Contextual indices are classified in two categories: original contextual indices and contextual indices of use.

**Original Contextual Indices:** When a given community of practice engages in certain types of
problem solving activities, it also makes an effort to produce information to document how they, as a group, solve problems and what tools they use. This information also includes contextual indices that are linked to the situations where that community did their professional activities. When other people come in contact with that information, they also learn part of the original contextual indices of the community of practice that produced it; and, in this way, they are enculturated by adopting part of the culture of that community.

**Contextual Indices of Use:** When people gather together to solve problems they apply information that was produced by other communities of practice when they solved similar problems. During this problem solving process people add their own contextual indices, and thus their end knowledge includes original contextual indices of the other communities and their own contextual indices of use. Therefore, according to the situated learning paradigm, when a group of students in a classroom at an educational institution enters in contact with content, they should be given the opportunity to on the one hand learn the original contextual indices, but also apply that content to their own contexts to add their own contextual indices of use. In this way their built knowledge is not inert and the transfer of learning is promoted.
Chapter 5
Creating Supportive Multimedia Learning Environments

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ABSTRACT
A strategy for developing effective multimedia instruction should be based on evidence presented by cognitive science and backed by research. Unless guided by instructional design principles, multimedia learning products run the risk of being unusual and entertaining but not effective. An effective design strategy at a minimum should embrace; recognizing learner differences, creating good multimedia messages, managing cognitive load, providing opportunities for active cognition, and monitoring learner engagement, intentions and progress. Activity theory, when integrated into multimedia instruction can support the creation of constructivist learning environments. Activities are ways that learners interact with the outside world and cognition is part of the interaction. Using multimedia to develop opportunities for learners to participate in active cognition can enhance the learning environment Active cognitive engagement should include active, interactive and reflective e-learning. The challenge for instructional designers is to position multimedia in an environment that supports the realization of meaningful learning.

INTRODUCTION
This chapter presents a strategy for developing effective multimedia instruction based on evidence presented by cognitive science. The strategy is based on research and may guide instructional designers in creating supportive multimedia e-learning environments. The underlying assumptions of this chapter are that learners have individual styles of learning, construct their own meaning and that the learner is at the center of the learning process. Though learning differences exist, environments can be created that provide the learner with effective, functional and appealing places to learn.

The end of the twentieth century has produced changes in technologies and new ways of thinking
about how people learn. The new paradigm supports a constructivist view that learners create their own meaning. Learning is seen as an active, intentional and constructive practice. Learners in constructivism are actively engaged in the learning and responsible for creating knowledge. This is a vast departure from traditional didactic pedagogy where the teacher is seen as the purveyor of knowledge. In constructivism, community and environment are relevant aspects of the learning experience. Learning environments must provide authentic activities or ways for learners to interact with the objective world, which support their intention of meeting learning goals. The challenge for instructional designers is to create environments rich with crucial learning attributes that support a cognitive, constructivist paradigm.

Creating effective multimedia instruction means creating environments that adhere to cognitive learning theory, utilize the results of high quality research and apply these to a learning situation. By creating multimedia messages that are grounded in how the human mind works, managing cognitive load, fostering active cognition, and creating learner engagement, instructional designers can create supportive and effective constructivist learning environments.

Chapter Objectives

The reader will be able to:

- Understand how constructivist theory and cognitive science can aid in the creation of effective instruction for multimedia e-learning.
- Appreciate the importance of creating a supportive learning environment when using multimedia.
- Evaluate several influences on learner centered design when using multimedia in learning environments.
- Identify three different strategies for creating active cognitive engagement.

BACKGROUND

Understanding the human brain and the complexity of the processes involved in learning is a division of the cognitive science field. The field is relatively young, very dynamic, and expanding. Advances in technologies and computers give scientists the ability to create expert systems, robots, and artificial intelligence. These advances have also given scientists a better picture of how the mind works. Cognitive science is the study of how the mind works (Boring, 2003).

The establishment of this area of study began in the 1940’s and 1950 with developments by computer pioneers like Alan Turing. Turing realized that computers could be programmed to understand language, solve math problems and play chess. This established the theory that the human mind operated much like a computer with inputs and outputs. The theory that minds were programmable and ran on brains with capacities was a shift in paradigms. Other advances in the fields of linguistics and neurophysiology contributed to the knowledge base of how the human brain processes information. Continuing research in the areas of cognitive psychology and cognitive neuroscience are creating images of the human brain and mapping out the processes. Along with learning about the brain, scientists are learning about how we learn (University of California Berkley, 2005).

Instructional design and development professionals are concerned with the process of recognizing learning needs and goals. Instructional designers must also determine which delivery methods meet these needs. E-learning is a viable and economical alternative for delivering learning materials and creating a learning environment. There are many varieties of e-learning including those targeted at higher education, K-12 education, corporate training and the military. These varieties can be delivered in as many forms including WBT (Web-based leaning), CBT (computer based training), learning management systems, virtual
classrooms and a wide assortment of other forms. Generally, instruction that is designed for and delivered on a computer system is classified as e-learning (Allen, 2003). Multimedia can be defined as the combination of pictures and word (Mayer, 2001). Interactive multimedia is the combinations of audio, video, text graphics, and animations that are used to deliver the e-learning.

Effective e-learning is learning that facilitates transfer and retention of content to the learner and meets the learners learning goals. In good e-learning understanding or knowledge is enhanced, behavior changes, processes are improved or some other function gets better (Allen, 2003). Over fifty years of research support the findings that it is not the media but the instructional methods that make the difference in learning. Yet each form of multimedia has unique affordances. The challenge for instructional designers is using these distinctive capabilities to deliver instructional methods and meet learning objectives. (R. Clark, 2003).

ISSUES, CONTROVERSIES, PROBLEMS

Contemporary Learning Theories

Contemporary learning theories consist of a confusing collection of theories with a distinctive language and a considerable amount of common ground between epistemologies. This is further distinguished by the division into two camps: those that apply to adults and industry and those that apply to children and K-12 education. Learning theories are concerned with the foundations, scope and validity of acquiring knowledge. Generally, learning theories are classified by dominant traits in the paradigm. Four learning theories are relevant to the discussion of creating cognitively supportive multimedia learning environments because either the theory is currently dominant, has influence reflected in one of the other theories, or because it provides a context or framework for comparison. The four major classifications are: behaviorism, cognitivism, constructivism, and humanism. These are only the general classifications of hundreds of individual learning theories and models (Leonard, 2002).

Behaviorism

Behaviorists consider learning to be a change in observable behavior that results from an experience and lasts over time. This is important because, insights, goals, ideas, and any other change that exists only in the learner’s mind are not considered. B. F. Skinner’s concept that behavior changes because of contiguity or the pairing of stimuli and response is at the heart of behaviorism. Skinner also contributed the concept of operant conditioning which affirms that learners respond to the consequences of an outcome and this can influence future behavior. This sets up a system of rewards and punishments. Pavlov also contributed to behaviorism with his famous dog experiment. This led to classical conditioning and respondent behavior which greatly influenced learning for the last half century and still plays a strong role in education today (Eggen & Kauchak, 1999, pp. 197-214). Despite distracters, this is still a force in learning and instructional design circles. The reconceptualization of learning challenges this theory by presenting alternative theories that are more learner centered. (Leonard, 2002, p. 16)

Cognitivism

Cognitivism is not an uncomplicated or solitary paradigm. Cognitive science is at the root of cognitivism. Learning takes place in cognitivism when a learner processes information that comes from the outside world by building a mental construct of the information. Cognitive information processing (CIP) relies on the analogy of a computer with components for processing, such as input, storage or memory, retrieval or output. Like behaviorism, cognitivism purposes that learning consists of the
formation of associations. Inputs in some form are linked to what is already in storage or prior knowledge. In this way, the learner makes cognitive connections, between what is known and what is being learned.

Cognitivism concerns itself with automaticity, pattern recognition, feature analysis and mental models. The concept of chunking developed by Miller (1956) where information is arranged in bits (7+ or – 2) for short term memory recall, is a classic in cognitivism (Driscoll, 2000, p. 88). Situating problems to be practiced and solved in context is also a characteristic of cognitivism. Cognitivists are interested in the influence that context has on input. In the world of e-learning and multimedia, cognitive load has resurfaced as a real concern. Cognitivism is a strong and vital force in the design of e-learning and in delineating how learners think and learn. Like all the other learning theories, this one too, has distracters (Leonard, 2002, p. 30).

**Constructivism**

The movement in recent years in contemporary learning theory has been toward a constructivist approach. This approach is learner centered and focuses on creating supportive learning environments. Constructivism is not a single vision. The fields of educational psychology, instructional technologies, and sciences contribute many influences and multiple expressions of ideas that constitute the learning theory referred to as constructivism. This view supports the connotation that knowledge comes through an individual’s internalization of events that happen in the outside world. Constructing knowledge is the learners’ attempt to make sense out of their world by interacting with it. Learners are not “empty vessels to be filled” (Driscoll, 2000, p.376) but rather take an active part in the learning process. This idea is central to and universally accepted as an integral part of the theory of constructivism.

Constructivism makes the role of the learner an active one rather than a passive one. The learners must be actively engaged in order to build, understand and decipher the outside world (Eggen & Kauchak, 1999). In Western educational circles this is a revolutionary concept. Traditional instruction is reliant on organizing and categorizing information, independent of the learner (Hein, 1991). These methods that supported the industrialization of western cultures from the agrarian era relied on transmitting information. The emphasis was on information recall. As learners became exposed to increasing amounts of information, the ability to problem solve, retain and transfer knowledge became very important. The old methods were just not very effective. Traditional methods of learning just did not support these critical cognitive processes (Mayer & Reigeluth, 1999). With constructivism, the emphasis is on the learner so motivation, autonomy, inquiry and discovery on the part of the learner become paramount to the learning process. Constructivism is the predominant theory embraced today in many traditional and non traditional learning venues (Leonard, 2002, pp. 7-39).

The paradigm shift toward constructivism is centered on the position of the learner. Learners in constructivism are actively engaged in the learning. The instruction or teacher is no longer the center of the creation of knowledge. Constructivists believe reality is relative to the learner. This has also influenced pedagogy because constructivists believe that to come to the truth multiple perspectives or groups of learners working together have a better chance of accomplishing it. A social aspect is introduced with constructivism and so is the concept of learning environment.

**Humanism**

Like constructivism humanism is concerned with the individual learner. Although some skeptics have dismissed this as a true paradigm, humanism and constructivism coincide. Humanism emphasizes that learning and thinking are driven by a desire to be a complete and fulfilled human being.
capable of making decisions and positively affecting others. Humanistic views of motivation believe that learners seek gratifying experiences.

This theory which originated in the mid 1950’s has had resurgence because of the emphasis on learner growth and potential (Eggen & Kauchak, 1999). Humanism in many ways is a reaction to cognitivism and behaviorism. These theories are diametrically opposed. Humanism does not support the kind of logic that reduces the human learning to either a response to an environmental stimuli or internal inputs and outputs. The emphasis in humanism is on the whole person. This is expressed as the interaction of physical, emotional, intellectual and interpersonal elements that are combined to reinforce self actualization (Leonard, 2002, p. 86).

The Big Shift: Cognitive Constructivist Environments

The shift in the underlying assumptions of how learning occurs, from a knowledge transfer paradigm, to an active process learners use to construct knowledge has not been swift nor has it been definitive. The dichotomy centers on the view of learning as information acquisition or as knowledge construction (Mayer, 2001). In the information acquisition model learners are passive and instruction is about transmitting information to the learner. Instruction that relies on lecture and/or audio or video to disseminate the information to the learner follows this pattern. There are many examples of this because it is easiest to prepare, it is common and has a familiarity to learners and many instructors or trainers rely on their own educational experiences to create courses. Many do not understand active learning (R. C. Clark, 2003).

The behavioral model can still be found in many multimedia and computer based courses as well as in classrooms. Direct instruction is a program where structure, sequencing and systematic skill development approximate many of the attributes of behaviorism. Direct instruction has been the focus of a vast amount to research and has been shown to be highly effective instruction in certain cases (Marchand-Martella, Slocum & Martella, 2004). Characterized by short lessons, frequent reinforcement and feedback and many small correct responses to build large chains of knowledge behaviorism was a natural for adaptation to the emergent technologies. (R. C. Clark, 2003)

The evolution of the Internet and other instructional delivery mechanisms that make one-on-one learning possible anywhere on the globe has also been characterized by more learner involvement and responsibility. Learning is now the responsibility of the learner. This learner liberation creates the need for a dynamic environment where learners can actively choose their own involvement in the learning process. Constructivist learning environments are learner centered places where knowledge is constructed by each learner rather than transmitted from a teacher or instruction (Wilson, 1996).

The environment now has an importance in learning that it did not previously occupy. The fundamental requirements are a learner and a space where learning can occur. This new paradigm is a more accommodating concept of learning. The environment is any place “where learning is fostered and supported….a place where learners may work together and support each other as they use a variety of tools and information resources in the guided pursuit of learning goals and problem solving activities” (Wilson, 1998, p. 5).

The challenge to creating these constructivist environments lies in understanding how learners learn. Barriers to learning can be removed and techniques and strategies to promote learning employed (Stage, Muller, Kinzie & Simmons, 1998). This construction requires an integration of new knowledge coming from the environment with prior knowledge existing the learner’s memory. Cognitive input is required to facilitate active construction of new knowledge. Instruction
is about promoting this construction by supporting psychological processes that mediate it. The cognitive-constructivist approach to learning positions the learner in an environment that supports the active processes learners use to construct knowledge (R. C. Clark, 2003).

**SOLUTIONS AND RECOMMENDATIONS**

**Using Multimedia to Support Cognition and Learning**

Advancements in cognitive sciences have given instructional designers new guidelines for applying the affordances of multimedia delivery to the way that humans learn. Cognitive theories of learning can help the instructional designer achieve a particular goal, using whatever variety of instructional systems design (ISD) an institution or organization chooses. ISD consists of a systematic approach to creating e-learning through the process of analyzing, designing, developing, implementing and evaluating a learning solution. The goal of instructional designers is to create e-learning products that are effective, functional and appealing to learners (Clark, 2002). This section focuses on the general application of advances in cognitive science and the overall aptitude for creating meaningful instruction. It examines the implications of using findings that are based in research on the ability of instructional designers to design and deliver effective instruction. It also covers the implications of learning styles, and investigates creating learning environments, cognitive load, learner presence and the importance of content and context.

**Research Based**

The literature suggests that e-learning courses should incorporate the results of well documented and high quality research. It also suggests that instructional design professionals use care in interpreting and applying these results. Although designing courses that are based on the results of research is more expedient, designers must be aware of what is practical and applicable to a particular situation. Until recently there was a void in the research base for designing e-learning and multimedia learning. There has been growth in this area and more useful and high quality research is becoming available (Clark & Mayer, 2003).

Three forms of research provide the foundation for the research base available to instructional designers: informal studies, controlled studies and clinical trials. Informal studies take the form of observing learners and or asking them about their learning. Informal studies can be useful but also has a risk attached to them. These types of studies do not adhere to rigorous scientific standards. Even controlled or formal studies can measure different attributes of the learning experience, such as processes and outcomes, and yield a wide variety of results. Empirical research provides the best information for application of cognate learning theory. Clinical trials measure the outcome from e-learning courses compared to some other venue and can be useful but are limited. These studies can be influenced by extraneous variable and there are many in the field of learning. Ruth Clark (2003) presents five questions that are critical to the consideration of the quality of research:

1. How similar are the learners in the research study to your learners?
2. Are the conclusions based on an experimental research design?
3. Are the experimental results replicated?
4. Is learning measured by tests that measure application?
5. Does the data analysis reflect statistical significance as well as practical significance? (Clark & Mayer, 2003, p.45).

These questions must not only be answered but the answers must be applied to the particular learning audience and interpreted with care.
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Michael Allen (2003) suggests that the results of research are often misinterpreted and applied inappropriately. Instructional designers must resist the temptation to universally apply research finding and must be aware of the context and circumstances surrounding the present learning situation. There are also often contradictions that exist in the research. Many universal theories that may be appealing may not be correct in certain situations.

There are many areas that show promise and the collection of high quality studies is continuing to grow. Some of the areas that show promise are learning styles, creating learning environments, prior knowledge, learner presence, cognitive load, and content and context.

### Implications of Individual Learning Styles

A great deal of ongoing research supports the conclusion that different people learn differently. Research in cognitive psychology indicates that people show significant individual differences in problem solving and decision making activities. Although it would be impossible to cover all the available research, this review will highlight the work of Howard Gardner on Multiple Intelligences, David Kolb’s Learning Styles Inventory, and VAK. There are many others.

One of the most popular theories of explaining intellectual diversity is Howard Gardner’s Theory of Multiple Intelligences (MI). Gardner’s Theory of Multiple Intelligences has been around for about two decades and has caused more than one debate over validity (Logan 2002). Howard Gardner (1983) published *Frames of Mind*, and in it he argued for the existence of several comparatively independent human intellectual capabilities. Gardner’s theory suggests an entirely new way of thinking about learning. If learners have different kinds of intelligence then there must be different ways to teach them and reach them. Instead of a single intelligence factor, g, this theory is multidimensional. Gardner originally reported seven intelligences, which operate independently of each other (Mettetal, 1997). The number of Gardner’s proclaimed intelligences has changed to ten but the concept of multiple intelligences has been widely accepted throughout the educational and training communities (Snyder, 2000).

The Kolb Learning Styles Inventory is a four stage model that defines learning styles as: concrete experience, observation and reflection, the formation of abstract concepts and generalizations, and hypothesis tested by active experimentation leading to new concrete experience (Ginther, 1999). Kolb’s Learning Styles Inventory and Experimental Learning Theory have interesting connections to other concepts such as the Meyers-Briggs Type Indicator and Carl Jung’s belief that learning styles come from people’s preferred way of functioning in the world. (Chapman, 2005)

The VAK model uses audio, visual and kinesthetic sensory receivers as the main channels of input into the learners’ brain. The theory indicates that for most learners one of these is the dominant channel. The dominant channel can vary by task. These channels can also be combined in a variety of ways. Most importantly, this can and does vary by individual learner and indicates that not every one learns in the same way (D. Clark, 2000).

There is a great deal of research available to substantiate that learners have individual differences. This is significant because a paradigm shift in educational circles places the learner at the center of instructional design. Traditional epistemology assumes that the teacher is the transmitter of information and that better instruction means conveying ideas in a clearer format. The new paradigm assumes that knowledge is constructed and is the process of making meaning, not the transmission of knowledge. This new approach also focuses on the social and communal nature of making meaning.

This shift is known as constructivism and is really a collection of theories many find promising. Instructional pedagogy has embraced the promise of constructivism (Jonassen, 2000).
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Creating a Learning Environment

Creating learning environments supportive of individual learners is demanding. One of the most appealing features of e-learning is also one of the greatest challenges. E-Learning provides the opportunity to deliver learning on an individual’s desktop. Understanding the delivery environment, the physical environment, the platform, the interface and the level of support available for the learner are critical components in e-learning. Reviewing the multitude of components that make up the learning environment can be a daunting task, yet all of these workings can have an effect on learning. Designing for the new paradigm means instructional designers are challenged to design constructivist learning environments (CLEs) that support the learning process. This is a formidable task. One of the challenges is to understand of what exactly makes up a CLE. Another difficulty comes from then applying ever evolving technologies to deliver the CLE. Several theoretical frame works have attempted to provide guidelines for creating CLEs.

Jonassen (2001) provides eight characteristics needed to create meaningful learning environments when using technologies. The environment should keep learners: active, constructive, collaborative, intentional, complex, conversational, and reflective. Active assumes the learner is engaged in conscious processing of information and responsible for the outcome. Constructive indicates the learner is able to integrate prior knowledge in order to construct meaning. Collaborative implies the building of communities and social supportive networks. Intentional suggests that learner behavior be directed toward a cognitive goal. This goal should be learner defined for any given learning circumstance. Complex indicates that the learning should be presented to reflect problems with multiple components and perspectives. This is done to encourage higher order thinking. Contextual implies tasks should be situated in a real world context or problem solving environment. By teaching knowledge framed in a useful context transfer is facilitated. Conversational indicates the environment should foster communication and interaction. Reflective is about including the metacognitive aspects of learning and increasing understanding through internalization.

Honebien (as cited in Wilson, 1998) has established seven goals for CLEs. Many of these concepts coincide with those presented by Jonassen. The seven are: providing experience with the knowledge construction process, providing experience in and appreciation for many different perspectives, a context that is real and relevant to the learning, encourage ownership and voice, provide a social experience, use multiple modes of representation, and encourage self awareness or reflexivity (Wilson, 1996, p.11). There are many other versions of guidelines and rules for successful creating CLEs.

An important breakthrough for the new paradigm came through the concept of situated cognition. This idea says “knowledge is situated, being in part a product of activity, context and culture in which it is developed and used” (Brown, Collins & Duguid, 1989, p.32). Activity and context are regarded as an integral part of learning. There is no separation between what is learned and how and where it is learned. This is an enormous departure from traditional didactic education which treats knowledge as a separate substance. However, situated cognition integrates the activity and the situation with the learning, there is no separation. Psychological research supports this principle. In situated cognition, activities and context are an integral part of the learning experience. This also becomes a very important concept in designing CLEs. A great deal of work has been done in this area but much more needs to be researched. This new conceptualization changed representation from something that had to happen before knowledge could be obtained to one that focused on activity and perception. Situated cognition wrestles with the implications of explicit knowledge and implicit understanding.
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These create dilemmas for designers of CLEs (Brown et al., 1989).

Activity theory is another important concept for instructional designers attempting to design CLE’s. Practical design advice for constructing CLEs, and especially applying the analysis phase of methods like Instructional Systems Development (ISD) to constructivist pedagogy, has not been forthcoming. The needs analysis and task analysis by their nature have the wrong connotations because they assume “relevant knowledge can be embedded in the instruction for transfer to the learner in any context” (Jonassen & Rohrer-Murphy, 1999, p. 62). Activity theory is very consistent with the philosophical underpinning of constructivism, situated cognition, and social cognition and everyday cognition. It focuses on the interaction of human activity and the human mind in a relevant environmental context. In activity theory there is no separating the activity from the context. An activity system involves not only they kinds of activities present but also the people, the goals of the participants, results from the activity, norms and rules that circumscribe the activity, and social and communal circumstances surrounding the activity.

Jonassen (as cited in Reigeluth, 1999) warns against misinterpreting the concept of authentic tasks or problems that is so central to constructivist pedagogy. By insisting that authentic equates to real world, designers are very narrowly interpreting authentic. Authentic problems can involve the community of learners, the physical setting, goals, constraint, affordances, and tools which intercede with activity. Activity theory provides a framework for designing CLEs. Authentic can also mean personally relevant or meaningful. Authentic for designers of CLEs means activity that engages the learner.

Learning environments are regarded as authentic when similarity exists between learning activity and some meaningful context for that activity. Authenticity is a relative term and varies according to the learner. Evaluating authenticity must include learners’ life-worlds and professional domains. Authenticity is not something that can be mandated by instructional designers, communities of practice or the desires of the learner. Authenticity is found in the learner alleged relationship between the preparation they are carrying out and the use and value of these practices. The “buy in” of the learner is critical to authenticity (Barab, Squire & Dueber, 2000, p.38).

At the center of activity theory is the idea that consciousness and activity are one. Activities are the human interactions with the objective world and the conscious mind is part of the interactions. Not only is activity a prerequisite for learning, but the learner is the central character defining learning activity. Activity and consciousness are mutually supportive and exist together. Consciousness is the unifying agent bringing attention, intention, memory, reasoning, and speech together. Vygotsky claimed “you are what you do” (Jonassen & Rohrer-Murphy, 1999, p. 65).

Intention is another principle of activity theory. Learners adjust and prepare activities. There is a goal orientation inherent in the proposed activity. Activity theory claims that knowing and doing are indivisible and initiated by intention. The basis for this intention is the object of activity. By transforming the object of activity the learner moves closer to their goal. This transformed object is the motive for other activity. Just like technologies and delivery systems have affordances, objects have affordance for activity. A dynamic relationship exists between the object and the activity (Jonassen & Rohrer-Murphy, 1999).

Nearly all instructional design projects are a vigorous process. According to activity theory, learning intentions emerge from contradictions between what the learner needs to know to accomplish a goal and what they do actually know now. This reframes the development of CLE’s by instructional designers to include embedded tasks that target learner goals and intentions. Authentic has to mean more than just real world, it must include meaningful association between
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the instruction and application of these exercises. Problem-based-learning (PBL) is one example of framing instruction as the resolution of problems (Windschitl, 2002). Problem solving may offer a well conceived context to make experiences meaningful and memorable.

Instructional designers must evaluate instructional solutions not only in terms of technological attributes, but also in terms of constructivist principles. Technologies can provide opportunities to solve complex problems in authentic and supportive environments. Designers must integrate the principles that support learning as an active process, which happens in context, is social and communal in nature and is reflective. Instructional designers must try to match the affordances of technologies with the affordances of objects for learning. Technologies can provide enormous opportunities for social connectivity and communities without the traditional limitations of setting. Instructional designers have the opportunity of creating objects for learning, that permit learners to manipulate resources and engage in ideas using attributes that are unique to the technologies, but still focused on supporting learners in meeting their goals (Dricoll, 2002).

An intentional shift in the conceptualization of instruction away from teacher and lecture toward constructivism positions the instructional designer to approach design with the learner as the central component. The understanding that the learners approach instruction with prior knowledge and expectations based on their life-worlds supports designing environments that reach the individual learner where they are. Instead of trying to persuade learners that a learning environment approximates the real world, designers should try to create environments that present meaningful and authentic problems that have intrinsic meaning for the learners. Three possible frameworks are: the incorporation of collaborative learning, apprenticeships, and cognitive flexibility. Simplified scenarios that exist primarily in the courseroom reduce the potential for meaningful learning. When learners perceive problems as unrealistic and inapplicable to their lives, these principles are not being met. The challenge then for instructional designers is to use technologies to present critical learning factors supportive of constructivist pedagogy. The instruction should be presented in ways that are related as closely as possible the way the knowledge will be used (Petraglia, 1998, pp.53).

Cognitive Load

The physical environment and the online environment can create additional cognitive load issues for the learner. In the physical world, the use of telephones, social interactions, building acoustics and home office distractions can hinder the learner (Driscoll, 2002). The platform which can include the hardware of choice, learning management system, operating system and even the browser can contribute to the components that make up an e-learning environment (Vaughan, 2004).

There seems to be an overall consensus that for e-learning to be effective it is very important for the learner not to have to think about the technology. This just adds to the cognitive load and erodes learner confidence. The interface is what lies between the learner and the learning. The disciplines of usability and human factors have enhanced the science of interface design (Krug, 2000). Volumes have been written on the nuances of the interface but a few idiosyncrasies are worth mentioning because they so heavily impact learner cognition. The interface should be transparent, instructive, easy to interpret and understand, predictable, aesthetically pleasing, and supportive. The learners must be able to focus limited cognitive resources on the learning (Ambler, 2000).

The idea of cognitive load took form with the proposal of chunking which was first published by George Miller in 1956. This is a set of guidelines that indicates the cognitive system can only process seven plus or minus two items of information
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at one time. Once more items are introduced to the brain, thinking and learning processes shut down. Cognitive load theory is a universal set of guidelines that apply to all media, all learners, and all types of content (Clark, Nguyen & Sweller, 2005).

Some of the most promising research to date is in the area of cognitive load. Richard Mayer (2001) has developed a theory of multimedia learning and provides an approach to designing multimedia. “Meaningful learning outcomes depend on the cognitive activity of the learner during learning rather than on the learner’s behavioral activity during learning.” (Mayer, 2001, p. 1) The research conducted by Mayer focuses on the dual channel approach which limits the definition of cognition to verbal and pictorial channels in short term memory. The theory operates under the assumption that cognitive resources for each of these channels are limited and not necessarily equal. Mayer believes that words and pictures can complement each other. Instructional messages should be designed so that learners have the greatest chance for human understanding and that involves creating messages that integrate visual and verbal messages. Mayer presents three modes of producing multimedia: the delivery mode, the presentation mode and the sensory mode. The delivery mode puts the emphasis on the devices used to present the material rather than on the learner. The presentation mode assumes that the learner is separate from the presentation and relies heavily on Pavio’s dual coding theory. The sensory mode, which Mayer ascribes to, is learner centered and assumes that the individual learner, through the sensory receptors of that learner, processes incoming materials. This is learner centered because it takes into account learner differences (Mayer, 2000).

Another concept is that learning occurs by active processing in the memory system. New knowledge must go through short term memory and then be actively encoded to get into long term memory. The process of encoding the new knowledge is called rehearsal. Instructional methods that overload this short term or working memory make learning more difficult. The combination of information that must be held in working memory the new information, and prior knowledge make up cognitive load. Instructional designs that reduce cognitive load free short term memory and provide more capacity in memory for rehearsal and integration. Instruction should also take into account prior knowledge and context. The probability that retention and transfer will occur is increased if these hooks are added to the new information presented to the learner (Clark & Mayer, 2003).

Learner Presence

Learning is an individual, unique and personal accomplishment. No one can learn except the learner. Instructional designers and technologies cannot do it for the learner. In order for learning to occur, the learner must have an active cognitive presence. Perception, recall, analysis, information storage, rehearsal and application can only be done by the learner. In order for learning to take place learners must focus energy on learning. Motivation to learn comes from responding to assessed needs, opportunities and believed rewards (Allen, 2003). Motivation does not come from static observation. Levels of motivation are context sensitive and can be changed.

Interactivity is a way to engage the learner with the instructional materials. “Interactivity allows learners to act on their motivations” (Allen, 2003, 155). Not all interactivity is created equally. The complexity of the content can increase element interactivity. The structure and sequencing of the instruction or the instructional objective an also increase element interactivity. The degree of integration and coordination necessary from the content can be compounded and create an increase on cognitive load. Combining auditory and visual channels when presenting materials can accelerate learning by taking full advantage
of available capacity in working memory (Clark et. al., 2005).

Interaction also takes on a broader meaning in instructional design. Bill Clancey a pioneer in constructivist application in the artificial intelligence (AI) community came up with the concept that what people do is oriented in their interactions. How content is interpreted is itself an interaction and unpredictable. People do not interact in a linear fashion, the continually adjust and reinvent. This has implications for instructional designers. Clancey advocates that instructional designers become participant observers in the community of practice and use ethnographic methods to observe and reflect on the situation. This also has implications for participatory design where the learners actually participate in the redesign process with the designer (Wilson & Meyer, 2001).

Content and Context

Learners can make meaning out of learning if the content is situated in context (Berge, 2002). Situated Cognition is a theory that implies that learning and thinking take place only in situated context. There is no learning or thinking with an accompanying situation. Context then becomes an integral part of the learning experience. It becomes critical to design learning environments that support the tacit conveyance of knowledge. Because the learner is the one who makes sense out of the material it is nearly impossible to systematically convey knowledge in the way behaviorist principles expounded. Situated cognition can and should be both prescriptive and a deceptive approach to context. Applying situated cognition to real world designs involves applying the constraints and affordance of learning environments to specific situations (Wilson & Meyers, 2000).

FUTURE TRENDS

Strategy for Developing Effective Multimedia

A strategy for creating effective multimedia instruction must be based on the evidence of how people learn. Unfortunately, designing instruction that is cognitively effective for the learner is not always intuitive. Evaluating the current research based literature is a good place to begin. A realization that the field of multimedia e-learning is and will continue to grow and more and new and perhaps contradictory findings will emerge is also paramount. This strategy takes into account the complexity of the undertaking and recommends an approach based on high-quality research (Allen 2003).

Opportunities exist through the analysis, design, development, implantation and evaluation phases of instructional design to apply the knowledge currently available. The strategic significance must be to create effective instructional environments by taking into account human cognitive processes.

Cognitive load theory is universal so it can support all aspects of multimedia design. It applies to all content and in all contexts and is relative regardless of what combination of text, audio, video, graphics or which delivery technologies are used. It applies to face to face instruction as well as e-learning. It applies to all learners and all instruction and instructors. Evidence based research provides a set of guidelines and principles to be applied with care. Learner similarities and differences must always be considered in conjunction with the learning goals and objectives. A strategy for creating effective multimedia learning must also support creating a learning environment that minimizes wasted mental resources and uses cognitive resources in ways to maximize learning (Clark et. al., 2005).
Supportive Learning Environments

Learner centered designs for multimedia learning environments are created by incorporating cognitive learning theory, utilizing results of empirical research and applying these to a learning situation. This begins by creating multimedia messages that are grounded in how the human mind works. Messages that are grounded in cognitive methods observe some if not all of the principles of multimedia. The principle of multimedia explains that learners learn better from words and pictures than just words. Observance of the principles of dual processing and limited cognition in concurrence with active processing set the foundations for constructing multimedia messages. Choosing relevant text, organizing words in coherent representation, select relevant visual images, organize the visual images in a coherent representation, and integrating verbal and visual images where possible. Adhering to the principle that the processing of spoken verbal information is processed in the auditory channel, pictures are processed in the visual channel, but written words are processes in the visual channel and then the auditory channel. Written words create more load than either pictures or spoken words. By combining words and pictures, and using both channels, learners are presented with an environment that accelerates expertise. (Mayer, 2001)

The type of cognitive load can influence the effectiveness of multimedia instruction. Interpreting the literature suggests that to create an effective learning environment ineffective forms of cognitive load should be minimized and the helpful forms maximized. Cognitive load comes in three varieties: intrinsic, germane, and extraneous.

Intrinsic load is imposed by the complexity of the content. Intrinsic load is determined by the information and expertise s associated with the instructional goals.

Germame load is mental work imposed by the instructions to meet the instructional goal and extraneous load is irrelevant and a waste of mental resources. These are accumulative and specific to individual learner and learning goals and objectives. Developing well defined objectives that meet learner needs and organizational goals is critical to managing intrinsic load. Situating the learning in a context supportive of the learner and measuring prior knowledge can support manageable intrinsic load.

Germame load can be managed by a variety of examples to support near transfer and far transfer. Near transfer is the ability of the learner to apply the learning in this situation and the far transfer is the ability of the learner to apply the learning in different settings. Self explanation can help the learners understand the underlying principles and form basic models and schema. Teaching the learners through rehearsal and metal modeling are also recommended, depending on the situation.

Extraneous cognitive load should be eliminated as much as possible because it is irrelevant to the learning goals and wastes valuable mental capacity. A recommendation to eliminate redundancy in content and extraneous visual, text and audio can minimize extraneous load. To present an environment that s supportive of learning instructional materials should concentrate on the essentials of content and eliminate redundancy in delivery modes (Clark et. al., 2005).

Supportive leaning environments engage learners in the construction of knowledge and provide the individual with activities that support relevant knowledge in a context that promotes understanding and remembering. This provides an environment where collaboration, activities and reflection combined with feedback and context allow the learner to make meaning out of the content (Berge, 2002).

Active Cognitive Engagement

Active cognitive engagement though is not the same as interactivity. Interactivity is critical component of training and learning. Active cognitive activity though can come in several forms includ-
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ING active, interactive, and reflective e-learning. Active e-learning is designed to be encouraging and directive. Active learning is learner controlled and encourages higher order thinking and exploration. It involves students in original projects and invites inquiry. Interactions with the instructional materials, learners and instructors are an essential part of learning activities in a learner centered environment. Vygotsky theorized that a great deal of learning takes place in a social environment and interactions among people can spark that learning. Active cognition though can also take place in the learner’s head. Reflection is often overlooked but one of the most valuable form of cognitive engagement to facilitate transfer and retention (Berge, 2002).

CONCLUSION

A strategy for developing effective multimedia instruction should be based on research and empirical evidence of how people learn. Yet instructional design is both an art and a science. Without the finding of research guiding instructional design, multimedia learning products run the risk of being unusual and entertaining but not effective. An instructional design strategy for incorporating multimedia at a minimum should embrace; recognizing of learner differences, creating good multimedia messages, managing cognitive load, providing opportunities for active cognition, and monitor learner engagement.

Constructivism is a learner centered approach to learning that focuses on creating supportive learning environments. This is not a single theory but rather a conglomeration of ideas inherent in psychology, instructional technologies, and science. This paradigm is revolutionary in its departure from traditional educational belief. Constructivism makes the learner an active participant in the learning process. This is a dramatic departure from a vision of learning as the transfer of knowledge. Re-conceptualizing learning as an active process has come about at the same time as advances in cognitive sciences and technologies. Understanding how learners learn and how to create supportive environments where learning can occur supports authentic and active instruction.

Constructivist learning environments support activities and interactions that adapt to and engage the learner. Using situated cognition incorporates the idea of activity and context with learning. Incorporating activity theory supports the creation of constructivist learning environments. It philosophically focuses on the interaction of the human mind and human activity in a relevant environment. Activities are ways that learners interact with the outside world and cognition is part of the interaction. A relevant environment is one that supports the learner in achieving their learning goals. The challenge for instructional designers is to position multimedia in an environment that supports the realization of meaningful learning.

Multimedia should be engaging and not boring for the learner. Effective multimedia instruction must provide the learner with a supportive environment that facilitates retention and transfer of the content. This requires incorporating different learning activities for different types of learners. It also necessitates creating instruction that is grounded in cognitive methods and observes some, if not all, of the principles of multimedia. The principles of multimedia say that mental capacity is limited and that using pictures and words to represent material is a more efficient use of the dual channels in working memory. Good multimedia messages do not require the learner to over think or under think but present the appropriate information in just the right way. Cognitive load can also be managed and extraneous cognitive load should be eliminated because it is irrelevant to learning goals and wastes valuable mental resources. Instructional designers must also build into the environment ways for learners to monitor their intentions and progress. Opportunities for learners to participate in active
cognition also enhance the learning environment. Multimedia developed for learner engagement should include active, interactive and reflective e-learning.

REFERENCES


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KEY TERMS AND DEFINITIONS

Activity Theory: This focuses on the interaction of human activity and the human mind in a relevant environmental context. In activity theory there is no separating the activity from the context (Jonassen & Rohrer-Murphy, 1999).

Behaviorism: This learning theory considers learning to be a change in observable behavior that results from an experience and lasts over time. Based on B. F. Skinner’s concept that behavior changes because of contiguity or the pairing of stimuli, insights, goals, ideas, and any other change that exists only in the learner’s mind are not considered (Eggen & Kauchak, 1999).

Cognitivism: Is not an uncomplicated or solitary paradigm. Cognitive science is at the root of cognitivism. Learning takes place in cognitivism when a learner processes information that comes from the outside world by building a mental construct of the information.

Cognitive Science: The study of how the mind works. More broadly it can be defined as a multidisciplinary and study of the human mind and behavior (Boring, 2003).

Constructivism: This theory says that knowledge comes through an individual’s internalization of events that happen in the outside world. Constructing knowledge is the learners’ attempt to make sense out of their world by interacting with it. Learners are not “empty vessels to be filled” but rather take an active part in the learning process (Driscoll, 2000, p.376).

Constructivist Learning Environment (CLE): Constructivist learning environments are learner centered places where knowledge is constructed by each learner rather than transmitted from a teacher or instruction (Wilson, 1996).

E-Learning: This is instruction that is designed for and delivered on a computer system is classified as e-learning. Effective e-learning is learning that facilitates transfer and retention of content to the learner and meets the learners learning goals. In good e-learning understanding or knowledge is enhanced, behavior changes, processes are improved or some other function gets better (Allen, 2003).

Humanism: This theory which originated in the mid 1950’s has had resurgence because of the emphasis on learner growth and potential. It emphasizes that learning and thinking are driven by a desire to be a complete and fulfilled human being capable of making decisions and positively affecting others. Humanistic views of motivation believe that learners seek gratifying experiences (Eggen & Kauchak, 1999).

Instructional Systems Design (ISD): ISD consists of a systematic approach to creating e-learning through the process of analyzing, designing, developing, implementing and evaluating a learning solution (Clark, 2002).

Multimedia: This can be defined as the combination of pictures and word. Interactive multimedia is the combinations of audio, video, text graphics, and animations that are used to deliver the e-learning (Mayer, 2001).

Situated Cognition: This idea says knowledge is developed and used in part by being situated in interactions human beings have with activity, context and culture (Brown, Collins & Duguid, 1989).
Chapter 6

Using CPS to Promote Active Learning

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ABSTRACT

According to Meyers and Jones, active learning theory originated from two fundamental premises: learning engagement and learning styles (1993). When students are actively engaged in the learning process, they learn better. What can an instructor do to achieve this goal? This chapter will discuss one of the approaches – the integration of the Classroom Performance System (CPS), and will cover three aspects: 1) incorporating CPS based on active learning theory, 2) discussing student positive feedback on CPS use experiences, and 3) sharing CPS best practice with other educators to promote active learning from teaching, design and administration perspectives.

INTRODUCTION

It has been a challenge for teachers to engage students in active learning, especially in large lecture classes. At the University of Houston, most of undergraduate core curriculum courses are offered in large classes. It is very difficult for the instructors to involve students in the process of learning. The main teaching method is lecturing and normally there are no classroom activities. This kind of large class often requires additional personnel to manage the classroom attendance and grading, but still, the retention rate and student learning outcomes present a tough challenge. Some faculty members have been trying to integrate instructional technology to facilitate student learning, for example, to stream lecture content, or produce podcasts and upload to iTunes, or convert the PowerPoint presentations to a flash movie and upload to YouTube for on-demand replay. To a certain extent, it helps some students review the course content and make up missed classes. But, this kind of technology will not promote creative learning, critical thinking, neither will it improve interactive communication between instructors and students.
The Classroom Performance System, or “clickers,” as they are commonly called, offers a management tool for engaging students in the large classroom (Caldwell, 2007). There are several similar products available from various manufacturers. While the brands may differ, their functions are basically the same. CPS is a product from eInstruction. The University of Houston started a CPS initiative in fall of 2005. It was used as an instructional tool to enhance classroom interactive learning. Faculty members work together with instructional designers to effectively integrate this classroom technology into both teaching and learning. A lot of classroom activities were designed based on active learning theory to engage students in classroom learning and to address different learning styles. A formal research study was conducted to solicit feedback from students’ learning experiences in summer of 2006. This pilot class had a total number of 21 students. The data collected from the study provide valuable information regarding clicker course design and the efficacy of active learning. Then, clicker technology was expanded on campus and used in large classes for registering attendance, integrating classroom activities for active learning, and providing instant feedback for teaching and learning for the course delivery improvement. A research study was incorporated in the process of clicker technology implementation.

This chapter will cover three sections. Section I of this chapter will discuss the rationale of research framework – active learning. Active learning as an effective approach to address passive learning, this section will talk about the existing issues in large lecture classes, the reasons that active learning approach is used through CPS technology to address those issues. Section II will discuss the data collected from the latest research study in spring of 2008. The data will show how the clicker activities were used to promote active learning from the perspectives of learning engagement, developing student skills, high-order thinking, and teacher’s instant feedback on student learning. Section III will share the best practices of clicker use from teaching, design and administration perspectives, how to accommodate clicker activities into lecture content and incorporate activities in the learning process.

ACTIVE LEARNING AND CPS

1. Active Learning

The major characteristics associated with active learning as summarized by Bonwell and Eison (1991) as: 1) students are engaged in learning activities instead of passive listening; 2) instruction emphasizes the development of student skills rather than just the transmission of information; 3) students are involved in higher order of thinking and receive immediate feedback from the instructors, and 4) greater emphasis is placed on the exploration of attitudes and values to increase student motivation in learning. From these characteristics, we can easily see that active learning is shifting the balance from teacher-centered lecturing to student-centered learning. Students learn to a greater depth of understanding when they are actively involved in the process through activities, interaction with other students, critical thinking and increased learning motivation.

“Active learning does not diatribe against lecturing” (Meyers & Jones, 1993, p. 5). Quality lectures are absolutely necessary in guiding students in their learning of new knowledge through enlightening important concepts and providing examples for further understanding. “Good lectures justify themselves by ‘dramatizing creation of knowledge’ and by ‘interpreting that knowledge’ to listeners” (Meyers & Jones, 1993, Corder, 1991, p. 9). The key issue here is what students should do with the lecture materials, mechanically memorizing or digesting content through various activities for thorough understanding. “The strategies promoting active learning are defined as instructional activities involving
students in doing things and thinking about what they are doing” (Bonwell & Eison, 1991, para. 2). Classroom activities include both individual and group activities. Yazedjian, Kolkhorst, and Boyle (2007) summarize several benefits of group activities as comprehension enhancement, anonymity reduction and accountability promotion.

2. CPS Promoting Active Learning

“Traditional lecture methods in which professors talk and students listen, dominate college and university classrooms” (Bonwell & Eison, 1991, para. 1). Students in the classroom passively listen, while busily taking notes. As such, students rarely interact with other students or the instructor. The education process is simply information transfer. Students memorize the content from the classroom and regurgitate it for the purpose of taking tests or exams. In this model, engaged learning does not really happen on the student side. In large lecture classes, student classroom interaction is even less possible. The typical large class assessment format further reinforces this type of teaching style with simple multiple-choice questions.

These passive learning problems caught the attention of some educators who have been trying to find solutions to engage students in the process of learning, and to shift learning to student side through classroom interactions, activities, group projects, classroom discussion bulletin, collaborative learning, different assessment format and effective use of classroom technologies. CPS is one of such technologies.

In lecture-based classes, time management is very important. There will be problems if learning activities are not managed well in this setting. For example, teachers will not have enough lecture time for course content delivery, and organizing students into group activities in large classes may be logistically difficult. If the group size is too big, there is no guarantee of every student’s participation. After the group activity, it is very difficult to draw student attention back to the instructor for the results review, discussion and additional lecture material. The classroom may become chaotic. CPS has been used to incorporate various classroom activities for both individual learning and group learning through effective use of different types of questions. Caldwell (2007) summarized the common uses of clicker questions that can increase or manage interaction, assess student preparation and ensure accountability, obtain student opinions by polling, exercise diagnostic assessments, quizzes or tests, and perform practice problems, etc. Clicker activities in classroom make learning fun and maximize student engagement in class. Another very important feature of CPS is to empower the instructor to continuously adjust lecture topic to focus on the points where, through student polling, it has become apparent that students are struggling with comprehension. In this way, the instructor most effectively utilizes classroom time. “Clickers give faculty the ability to fine-tune their instruction based on student responses” (EDUCAUSE Learning Initiative, 2005, para. 8). Students from the clicker class commented that “I liked that it showed the percentages per answer. Knowing how many people ‘got it wrong’ helped the professor give attention to areas that needed it without wasting time on concepts everyone already understood;” and clicker “helped the instructor to understand if her point was clear and if not where it was unclear. This information was then presented from a different angle or explained better.”

3. Active Learning Addressing Different Learning Styles via CPS

People learn in different ways (Meyers & Jones, 1993). This has become an even bigger challenge for teachers in today’s more global classroom with students from across the world. Besides different learning styles, there are other factors that can influence student learning behavior and classroom performance, for example, different ages, cultural values, educational systems, and communication patterns, etc. A study conducted by Freeman and
Liu (1996) suggests that Asian students tend to ask fewer questions whether from instructor or students than do western students. Gudykunst and Matsumoto (1996) summarize that low-context communication (direct, explicit, unambiguous communication) is prevalent among members of individualistic cultures (western culture), while members of collectivistic cultures (eastern culture) use predominantly high-context communication (indirect, implicit, and reserved communication). Students with different background have different educational expectations. Adult learners differentiate themselves from younger college students in that they have rich personal experiences and they validate their experiences through learning (Meyers & Jones, 1993). They like to have more interactions with instructors and others. Since the clicker activities create a non-threatening environment for all learners, integrating CPS activities allows each student to have his/her “voice” heard no matter what background they have.

STUDENT FEEDBACK ON ACTIVE LEARNING

In order to find out if CPS truly promotes active learning, the office of Educational Technology and University Outreach (ETUO) at UH conducted a pilot research study in summer of 2006 in a graduate class in the Bauer College of Business. The data collected from students’ survey were very encouraging. Students reported positive experiences in using clickers in classroom learning, and the interaction between the instructor and students was greatly improved. Starting from fall of 2006, a formal research study has been implemented at the end of each semester. By spring 2008, there were four formal research studies conducted.

A survey research method was used to conduct the studies. The instrument was designed based on the Active Learning theory, collecting data from the perspectives of student learning engagement, student learning styles, interaction between instructors and students, teaching and learning effectiveness through the use of clicker technology. Faculty members who were using clickers in teaching were invited to participate in the study. In each semester, there were 4-5 faculty volunteered their classes to take the survey. These faculty members were from different colleges and teaching in different discipline areas. They used clickers in more or less different way, from classroom attendance to quizzing, but their objective of using clicker technology is the same – learning engagement and promoting active learning. The following data indicate how clicker technology promotes active learning based on student feedback.

1. Engaging Different Learners

“Interaction and engagement, both important learning principles, can be facilitated with clickers” (EDUCAUSE Learning Initiative, 2005, para. 12). The survey results from our five studies indicate that clicker activities in classrooms have greatly facilitated active learning and incorporate these two learning principles in the learning process. The latest data collected in spring of 2008 show that 72% (N=279) of participants reported that clicker activities fostered a positive atmosphere for learning engagement and instructors inspired the interest in the content of the course through clicker activities. Sixty-six percent of students brought up that they were more attentive to subject learning with the integration of clicker activities in class, and a majority of students found that they were able to interact with instructor more as compared to the class not using clickers. Following are some of the statements from students:

These are just few examples from the participants, but they are powerful and persuasive enough to show that clicker activities are truly promoting an engaged learning in traditional classrooms. We can also see that students are enjoying the activities, which is a very important motivation for them to learn. One important key to the success of
integrating clicker technology into the classroom is the instructor’s dedication and good preparation of the class activities beforehand. Eighty-five percent of students indicated that the instructors were well prepared for clicker activities to engage students in active learning.

2. Developing Student Skills

Besides interaction and engagement, clicker activities can also help students build communication and collaboration skills, which are essential and imperative skills for their future career. Communication is not all about what a person wants to say, but more importantly it is about how a person listens to and understands and learns to respect different opinions. Clicker activities in the classroom allow each student to freely present his/her opinions and the polling results will provide the opportunity to rethink and reflect on those opinions to make learning more meaningful. More than 80% of respondents reported that clicker activities helped to promote communication between students. More than 81% indicated that clicker activities promote the communication between students and instructors. Fifty-two percent of respondents learned to value new view points in the class through clicker activities. More than 41% reported that their communication skills were improved in classes using clickers (25% of respondents did not provide answers). Several students commented that “we could share our thoughts about personal opinions” and “at times when we had opinion questions they were kind of fun to learn what everyone else thought in the class.” “It showed me the majority opinions on personal based questions. I liked knowing the ideas of the people around me and the instant feedback.”

Through different kind of interactive activities, students learn to appreciate each other’s input and build up their own confidence level. More than 42% of participants agreed that they developed more confidence in themselves with the integration of clicker in learning. In several courses the instructors designed interactive group activities to encourage student collaborative and peer-to-peer learning. More than 76% of students enjoyed working in collaboration with fellow students through the clicker-based team activities.

3. Engaging Students in Higher-Order Thinking

The clicker activities integrated into the lessons not only made the learning more enjoyable, but more importantly, it engaged students in higher-order thinking. Clicker activities can emphasize important concepts, help students identify and solve problems, and help them practice reasoning and evaluation to promote creative ideas, which leads to greater comprehension and knowledge retention. More than 72% of students indicated that clicker activities developed their critical thinking skills in the subject area. Seventy-one percent of students opined that clicker activities challenged them to think. More than 66% of students agreed that clicker activities in class required them to learn more than just factual information. Eighty-one percent of students agreed that the instructor used clicker activities to help clarify important concepts in the course.

4. Instant Feedback – Key to Success in Active Learning

One of the most important characteristics of active leaning is that students receive immediate feedback from their instructor. In large classroom settings, lacking these devices, this is almost impossible to achieve. The obstacle discussed by Bonwell and Eison (1991) is that large class sizes prevents implementation of active learning strategies since the instructors simply do not have enough time to cover the teaching content and at the same time to get feedback from students. The powerful advantage that clicker technology has brought into large classroom teaching is that it enables the instructor to solicit instantaneous
feedback on student comprehension of the content material, the quality of instructional delivery, and instant guidance for instructor to adjust teaching focus. More than 85% of students reported that the instructor responded promptly to student feedback through clicker activities. Eighty-one percent of students stated that the instructor cleared the point of confusion based on the feedback from clicker activities. Thus, through clicker use, instructors seemed to have greatly improved their teaching efficiency. Fifty-three percent of students thought that the instructor was more effective in teaching through the use of clickers. More than 61% of students agreed that the instructor improved the quality of instruction based on the feedback from clicker activities. Students really benefit from the instant response. One student stated that clickers provided “the interaction with the professor, real time response when questions where answered wrong. I’ve had some horrible classes that took instructors weeks to get simple homework assignments back.” The instant feedback can also guide student learning and study focus. “I enjoyed the class discussion reviews using the clickers. The instant feedback system is helpful to know what questions you should spend more time studying.”

BEST PRACTICES FOR ACTIVE LEARNING USING CPS

1. Clickers: Beyond the Classroom

The educational paradigm of the “learned elder” professing knowledge to a small audience of eager and absorbed students is sadly, a rare situation considering the financial and logistical problems faced by today’s college students. Moreover, considering that most students exist in a multi-media, multi-modal, and multi-tasking world, they expect the same experience from education. Large class size, diversity, cultural mores, and human nature (i.e., a few more prepared students dominating the conversation while most deign to participate) tend to limit interactivity and engagement.

So how can we enrich our students’ educational experience? Classroom Performance Systems (CPS) can enable learning that is not just active and more engaging, but a classroom experience that is more effective and efficient than straight-lecture format alone.

While clicker technology is physically limited to the classroom, experiences with the clicker should transcend the classroom. By actively engaging interaction between student and content, your students will take with them the knowledge of what they know, and even more important, self-awareness of what they do not know and thus on what they need to focus.

2. Clicker Best Practices

The best practices discussed in this section are from the perspectives of a faculty member and an instructional designer employed by a College of Pharmacy at a large, major urban university. The practices discussed below are based on their experiences using ‘clickers in the classroom’ for over four semesters.

The best practices are grouped into three categories: 1) Buy-in, 2) Engagement, and 3) Administration. The first category, “buy-in”, provides tips that will ensure participation by the stakeholders in your clicker program. The second category, “engagement,” lists strategies to assist you in the design of successful clicker questions and practices. The final category of “administration” presents guidelines on ways to make buying and registering the clicker pads as user-friendly as possible.

1. Buy-In

Stakeholder buy-in. When implementing any new technology-driven program, support by your stakeholders is a requisite for project success (Borghini, 1998). Your institutional administration,
Using CPS to Promote Active Learning

educational technologists, IT staff and faculty should all be on board with the program’s implementation and goals. Bottom line, project success is diminished if the various stakeholders will not fully participate. Carrot versus the stick. Students more favorably view clickers when clicker use is a constructive experience. Clicker exercises modeled as a positive reinforcement (for example, as extra credit) versus a summative tool (such as a quiz grade) or punitive action (using them to take attendance) are more likely to elicit engagement and thus promote active learning in the classroom. When in doubt – ask! Take a survey to ascertain students’ attitudes towards the clickers.

Poll your students during the semester, once the clicker program has been implemented, to gauge program success. Surveys will provide valuable data on student perceptions of clicker efficacy. Moreover, letting students actively engage in shaping their learning by valuing their attitudes and values should be a motivational factor for increased active learning (Bonwell & Eison, 1991). Inform students about clickers. The syllabus should include a section on clickers to ensure that students understand that clickers are a course requirement. Describe how the technology will be used and the process for buying/registering the clicker pads. While this tip may not seem like overt active learning, involving students in all aspects of the learning process should both empower and motivate them-especially if you discuss how they will have veto power over the clicker program later in the semester!

2. Student Engagement

You can’t fit it all in, so don’t try. In our enthusiasm to embrace new teaching tools, the tendency is to overuse technology. More importantly, these technology-laden presentations, due to their complexity and the speed at which they must be delivered, tend to limit the students’ input and voice, leaving them to ask “what is important here?” and, “do I need to know all of this?” The main goal of using CPS personal response pads or “clickers” should be to draw the student back into the discussion, even when PowerPoint is the instructor’s tool of choice. When anticipating the use of CPS in a course, the most important concept to embrace is that you will not have the same amount of time to deliver every topic or concept in a single classroom session (Caldwell, 2007). Clicker use in the classroom eats up class time. While introducing CPS and active learning may seem like a trade-off, by deciding which concepts are absolutely essential and should be reinforced using CPS, the goals set by the instructor become more focused and the student gains a better understanding of the take-home messages.

If we must sacrifice content to active learning, how can we deliver the full course content? There are several well-documented ways to provide topic enrichment (for review, see Caldwell, 2007). One practice that has been used to enrich and supplement the classroom session is to post course content to be reviewed before the class on electronic blackboards or in the library. These postings may include an abbreviated PowerPoint presentation of 10 to 12 slides, containing review and new information and displaying information that will not be covered in lecture. This PowerPoint may or may not have narration or more descriptive explanations in the “notes” window of the PowerPoint editor view. Additionally, the pre-class posted material could include a textbook or other reading assignment accompanied by assessment questions. The instructor may gauge student access and utilization of this pre-lecture material by using a CPS question early within the lecture period. It should be made clear to the students that they are responsible for this material and that questions covering that posted material will appear on the next exam. Despite student resistance to textbook reading and independent study, these exercises have the added benefit of preparing them for life-long learning. Question design. There are various articles in the literature that describe how to incorporate CPS pads questions into a lecture
Using CPS to Promote Active Learning

(Robertson, 2000, Caldwell, 2007). Several practices are worth reinforcing with regards to the design of such questions. When considering the introduction of CPS into your lectures, it is important to consider the number of questions that maximize opportunities for active learning without being disruptive. When the potential for active learning is realized by the instructor, it is tempting to think if “some” is good, “more” is better. However, most instructors using CPS pads have learned through experience that there is an optimal number of CPS questions per class period. With too few CPS questions, students tend to lose focus and find clickers an annoyance, but too many CPS questions are disruptive. Typically, for a 50 minute class period, 2-3 questions are optimal (Robertson, 2000, Caldwell, 2007).

Regardless of the types of questions used and at which point they should appear in lecture, it is also worth emphasizing that simple, but well-designed questions keep the focus on the topic and maximize class efficiency. Given the diversity of the current student body, it may even be appropriate to read the question aloud for clarity, prior to initiating the exercise.

Another best practice for question design pertains to results display after the question is posed and answered within the class period. The instructor may choose to use an instant display of the results, either as a graph (pie, bar) or by simply listing the number of respondents for each answer choice. While any of these types of visualization are informative, the most important aspect of results display is the discussion of results. Reviewing results does impinge on class time. However, the students are able to ascertain their own performance relative to others and the instructor now has the opportunity to clarify any misconceptions that become apparent. Thus, the clickers provide an opportunity for student questions and discussion, an activity that appears to be one of the most important aspects of CPS use.

CPS questions may be generally grouped into two types: prior knowledge/recall or analytical. Prior knowledge/recall questions, as implied, challenge the student to recall knowledge they are expected to have acquired in some previous course or from the current course material presented earlier in the lecture or lecture series. Specifically, prior knowledge questions inform the instructor as to where a diverse student body stands prior to building on a knowledge foundation. Additionally, prior knowledge questions serve to bring students to the same point in the topic of discussion, rather like a “you are here” arrow on a map. Used early in the lecture period, this type of question should offer a straightforward reminder of a topic that is vital to understanding the next progression. In contrast, “recall” questions are those asking the student whether they understood or are able to “recall” the material from the pre-class postings or a recent class session (Caldwell 2007). The average, engaged student will do very well on either prior knowledge or recall questions. Nonetheless, the instructor should be prepared to be flexible. Depending on the responses obtained, the instructor may opt to review or elaborate on the topic highlighted in the question or progress along in the lecture.

When carefully crafted, “analytical” questions provide the student with an opportunity to apply either prior knowledge or recalled information to infer the answer. If students have the knowledge and comprehend the topic at hand, the correct answer should be the logical choice. Nonetheless, given variations in the levels of prior knowledge and typical student reluctance to revisit or focus on information until just before the test, the results seen with analytical questions tend to be distributed across the various answer choices. It is very important and valuable to discuss why each choice is either correct or incorrect. Moreover, when students commit to an answer using the clicker but find out their choice is incorrect, their individual but significant investment may prompt them to ask why their reasoning did not take them to the correct answer. This is an ideal time to stimulate class discussion. Clicker appeal: Rewarding their
Using CPS to Promote Active Learning

When clicker use offers the student a benefit rather than a penalty, students seem to approach this technology with a different motivation. With this in mind, a practice that has been very successful in our college is to use a previously discussed clicker question as extra credit on either a semester exam or the final. This extra credit question is used verbatim from its appearance in lecture. However, receiving credit for this question depends on two criteria: the correct answer must be chosen on the exam (but not necessarily, in the original class exercise) and the student must have participated using their clicker, on the day the question was presented. Since students have no idea from which lecture the extra credit question will be taken, they are motivated to attend class and participate in clicker exercises. If the extra credit question is carefully selected from the bank of questions from the learning unit, in addition to rewarding students who have voluntarily participated, the instructor acquires data allowing comparison of the in-class and the exam performance to gain a perspective on the learning that has taken place.

The table below presents an example of the types of results obtained by using CPS in this way. In the example below, a pre-class reading assignment on the therapeutic uses of this drug was posted to the electronic blackboard. The question in Table 1 is a simple recall question. The in-class student response rate for this question was 94%. However, the results from the in-class exercise are broadly distributed across the answer choices. These results suggest that only about 25% of the students read the pre-class assignment and the remainder of the students inferred incorrectly, the use of this drug. As suggested above, why each answer choice was correct or incorrect was discussed after the exercise. When the in-class results are compared to the exam question results, a considerable improvement in student performance is noted.

Any prior knowledge, recall or analytical question may be selected for exam extra credit. If a comparison as to the degree of learning that has taken place is desired, the extra credit questions should be one for which the student choice distribution was broadly distributed and the question was adequately discussed after the exercise. The “reports” option in the CPS software is helpful in guiding extra credit question choice. This particular practice, while not requiring attendance, has encouraged attendance as well as learning. In an average of seven classroom sessions from the spring 2008 semester, the average CPS participation in a 2nd year pharmacy class was 84%/9.

Data - Use them or lose them. With CPS for PowerPoint, one can collect and analyze a vast amount of data but are these data useful? The software automatically collects and stores the data for each teaching session but navigating the various report options is mind-boggling, especially considering the poor descriptors used these. It is useful to peruse the various options and determine whether or not this type of data is useful for your purposes. For example, the CPS “Response Report” lists the question, the response choices and the percentage of students that have

![Table 1. Comparison of in-class, real-time CPS assessment with re-introduction as exam extra credit](image)

<table>
<thead>
<tr>
<th>Multiple choice question and choices</th>
<th>In-class Responses</th>
<th>Exam Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the main therapeutic use for the drug sulfasalazine?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Used in combination with trimethoprim for urinary tract infections.</td>
<td>24%</td>
<td>5%</td>
</tr>
<tr>
<td>B. Used topically to treat ocular infections.</td>
<td>32%</td>
<td>3%</td>
</tr>
<tr>
<td>C. Used in combination with erythromycin for upper respiratory infections.</td>
<td>12%</td>
<td>0</td>
</tr>
<tr>
<td>D. Used to treat ulcerative colitis and other inflammatory bowel conditions.</td>
<td>32%</td>
<td>92%</td>
</tr>
</tbody>
</table>

In-class student response rate for this question 115/123 or 94%
Using CPS to Promote Active Learning

Table 2. Sample data extracted from “Question Grid Export” option

<table>
<thead>
<tr>
<th>Pad ID</th>
<th>Serial #</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th># Correct</th>
<th>% Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>KEY</td>
<td>A</td>
<td>A</td>
<td>C</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>R1625AA</td>
<td>C</td>
<td>+</td>
<td>+</td>
<td>2</td>
<td>66.7</td>
</tr>
<tr>
<td>37</td>
<td>R119BA4</td>
<td>+</td>
<td>+</td>
<td>B</td>
<td>2</td>
<td>66.7</td>
</tr>
<tr>
<td>18</td>
<td>R16259A</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>52</td>
<td>R1999CE</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>3</td>
<td>100</td>
</tr>
</tbody>
</table>

selected each choice. These data are important if you plan to compare the “in class” responses to the “extra credit” responses. To download more specific data, such as whether or not a student participated in a class session or which answer they selected, the “Question grid export” is the more appropriate file (Table 2).

The data file displays the student information, their degree of participation and their actual responses to each question posed in a particular session. If an instructor wishes to track a student’s progress, this report will provide that information. However, if instructors want to provide the student with progress reports, the data found in the e-Instruction CPS allow this as well. Most software programs interface with electronic blackboards for easy posting of results. Often, these reports track the student’s progress without giving them much information about the question or responses chosen. If the use of the clicker is strictly formative then these reports may have limited use (Figure 1).

Do CPS devices increase student learning? Some studies show a slight but significant enhancement in student grades (Kaleta & Joosten, 2007). In a recent review by Caldwell (2007), the author describes a study in which the proportion of students receiving a higher letter grade was increased in the groups that employed clickers in the classroom. Moreover, student attrition was also less in classes where clickers were employed (Caldwell, 2007).

The effective use of clickers in a classroom will ultimately depend on the teaching goals of the instructor and whether or not they are comfortable with both the technology and the necessary reorganization of their lectures. Considering the overall positive attitudes seen with CPS in many classrooms as well as the opportunity for more classroom interaction between the student and instructor these devices seem to offer a measure of active learning that has been missing in the large classroom venues found in education today.

Figure 1. Student study guide report
3. Administration

For a clicker program to be successful, the administrative processes and procedures should be seamless and user-friendly. So while the following best practices are not ‘active learning’ per se, they should assist you in implementing a successful clicker program that allows instructors to get right to the business of student engagement and interactivity. **Keep it simple.** Make it uncomplicated for students to purchase the clicker technology. Communicate with your students (before the semester starts, if possible) to let them know where they can buy the clicker pad and enrollment subscription, if applicable; what costs are involved; and other crucial details (e.g., store hours, battery requirements). **Make it easy.** Make it effortless and user-friendly for students to register their clickers. For example, if you use a learning management system (LMS) such as WebCT, put an icon (clearly marked as ‘Register Your Clicker’) on the homepage of each course in which the students are using clickers. Develop and distribute instructions via e-mail, LMS, or website containing information about where and how to get help along with user help documents (e.g., “How to register your clicker”, “How to use your clicker”, and “What to do when your clicker dies”). **When possible help defray student costs.** In the past two years the College of Pharmacy supported the clicker program by purchasing the students’ semester enrollment codes at an annual cost of approximately $20 per student. Alternately, check with your Educational Technology Department to see if there are any clicker pilot programs or grant funds available. **Training and support.** Create faculty-development programs to assist instructors new to CPS with clicker integration; conduct hands-on training on the technical aspects of student response systems. These systems do not seem to be uniform across the various brands nor are they foolproof or simple to master. User support is essential to success—make sure your help desk is ready to assist students and faculty alike. Request that IT or Educational Technology staff be present in the classroom for the first few sessions of clicker use. **When clickers go bad.** Have a backup plan for when technology breaks. Even with clicker sessions pre-planned, well-practiced, and ready to roll, sometimes the technology just will not work as intended. Have a ‘Plan B’ to introduce active learning into the session. Keep the exercise and poll the audience by the old-fashioned show-of-hands. Clearly, the data collection will be sacrificed but giving the students the opportunity to process the question still provides a welcome break in the routine in addition to the very valuable discussion of the question that follows. **Make technology work for you, not against you.** Before you initiate your clicker program, research current best practices and follow the lead of ‘clicker trailblazers’ and ensure that active learning is your primary goal. Keep your program simple. Keep students in the communication loop. For example, allow them to make suggestions as to their best use. Following these easy tips will allow you to drive the bus, not the technology.

**CONCLUSION**

The goal for active learning is to improve student overall competency in problem solving and knowledge application. CPS improve the efficiency for teaching and learning, and CPS-based interactivities in classroom not only help instructors quickly identify the teaching focus but more importantly help students actively engage in the whole learning process. The data collected from our study also indicate that students enjoy the learning experiences with the integration of CPS technology. “Learning requires thinking, and the key to successful teaching is to encourage students to engage in active ways with subject matter, to test and challenge their knowledge” (Lesgold, n.d. para. 1), and CPS is the effective tool to achieve this success.
REFERENCES


Section 2
Instructional Technology Applications
Chapter 7

Wired for Learning—Web 2.0 for Teaching and Learning: Trends, Challenges, and Opportunities for Education

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ABSTRACT

This is an introductory discussion into Web 2.0 technologies for teaching and learning. It is based on a review of the current literature and thinking around Web 2.0 and its potential in education. There has been a surge in internet services that attract the label “Web 2.0”. Wide acceptance of this term implies that together these services identify a change in the nature of the World Wide Web. This report seeks to define Web 2.0 and how it can be used. Consideration is also given to how these new technologies create opportunities for educational practice. Because these opportunities are not yet being widely taken up, the present discussion focuses on identifying challenges that may be impeding adoption of Web 2.0 ideas in teaching and learning.

INTRODUCTION

Time magazine picked the public as “Person of the Year” for 2006, because the editors were convinced that the public was “seizing the reins of the global media”, creating “an explosion of productivity and innovation”, and helping to frame a new digital democracy. The editors who made the choice wrote, “Web 2.0 is a story about community and collaboration on a scale never seen before. Web 2.0 is about the cosmic compendium of knowledge Wikipedia and the million channel people’s network YouTube and online metropolis MySpace. Web 2.0 is about the many wrestling power from the few and helping one another for nothing and how that will not only change the world, but also change the way the world changes” (Grossman, 2006). The fascinating story described by the editors at Time magazine was made possible by the brand new Web 2.0 tools.

As of July 2008, the term “Web 2.0” coined by O’Reilly Media in 2003 has more than 72.2 million
Web 2.0 refers to the recent expansion of the Web which can be thought of as a new layer on top of the Web and refers to the ways the platform, the Web, is used. Previously, WWW sites were relatively static sites and provided the user information. This second generation of Web tools includes communication tools, interaction with media and humans, and collaboration and sharing. Web 2.0 tools allow users to create online content—they are writing to the Web. Many of these tools require less technical skill to use the various features thereby allowing users to focus more on the information exchange between collaborators (Parker & Chao, 2007). These tools allow users to be more engaged which hopefully means that learners are more engaged in learning.

For education to not step up and maximize the Web 2.0 resources for teaching and learning is to risk becoming marginalized as a viable influence in helping to shape the 21st century (McLester, 2007). But there is still a huge amount of disagreement about what Web 2.0 means to education. This chapter is an attempt to present a broad overview the potential applications of Web 2.0 for teaching and learning.

BACKGROUND

Web 2.0 is a set of web services and practices that give a voice to individual users. Such services thereby encourage internet users to participate in various communities of knowledge building and knowledge sharing. This has been made possible by the ever-extending reach of the (world wide) ‘web’. Meanwhile, navigating and exploring this web of knowledge has been greatly facilitated by the increased functionality of the web ‘browser’. The browser has thereby become the network reading/display tool that offers a universal point of engagement with the Web. More than that, the web browser has become a platform for of the use of digital tools in community interactions. Further, Web 2.0 refers to the recent expansion of the Web. This expansion can be thought of as a new layer on top of the Web and refers to the ways the platform, the Web, is used. Previously, WWW sites were relatively static sites and provided the user information. This second generation of Web tools includes communication tools, interaction with media and humans, and collaboration and sharing. Web 2.0 tools allow users to create online content—they are writing to the Web. Many of these tools require less technical skill to use the various features thereby allowing users to focus more on the information exchange between collaborators (Parker & Chao, 2007). These tools allow users to be more engaged which hopefully means that learners are more engaged in learning.

With a number of technological developments comes the creation of new ways of using the Web. Moreover, changes in access and speed have been accompanied by developments in software and data management. They also afford new patterns of internet use. In particular, the familiar web browser has become more versatile and easy to use. It has allowed a wider range of user interactions, collaboration, problem solving, and virtual teaming.

These changes and to some degree technological innovations have led to a more participatory experience of internet use (Cook, 2008). Thus, Web 2.0 has provided a version of internet experience that encourages individual users to upload: that is, to offer up their own contributions to a vast and interleaving exchange. This is implicitly contrasted with the former (Web 1.0) experience of the internet, which was more a matter of downloading: that is, accessing the contributions of a much smaller set of information providers. In sum, the barriers to production and distribution have been loosened: an invitation for widespread participation is in place.

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1.0) experience of the internet, which was more a matter of downloading: and passively receiving information, which is, accessing the contributions of a much smaller set of information providers. In sum, the barriers to production and distribution have been loosened: an invitation for widespread participation is in place.

O’Reilly and Musser explain that although each pattern is unique, they are by no means independent. In fact, they are quite interdependent. Thanks to open sources, lightweight programming, lightweight technologies, and public interface, Web 2.0 applications lead to creativity and better software applications. Ideologically, with Web 2.0, data value is created at multiple user layers, and micro-content flows between domains, servers, and machines through two-way access.

Software applications are designed above the level of a single device, and are intended to integrate services across handheld devices, iPods, PCs, and Internet servers. It has been anticipated that some applications will never end the beta cycle, as new features are developed and becoming available even daily. This phenomenon, which is called “the perpetual beta” by some, is sometimes achieved by harnessing the collective intelligence of users, who become co-developers. As the market shifts to a model of shared online services and user-generated micro-content, success often comes from data, which is called the next “Intel inside” by O’Reilly and Musser.

Web 2.0, with its advantages of low cost production and distribution combined with infinite shelf space, is driving the change of the Long Tail economic model described by Chris Anderson. For an explanation of Long Tail, consult the Long Tail homepage (http://www.thelongtail.com/) or the RSS Feed on this topic (http://feeds.feedburner.com/TheLongTail). The many faces of wikis are good examples of the Web 2.0 characteristics mentioned above.

People have also tried to explain the concept by examples, by outlining Web 2.0 with themes and by identifying what IT IS and what IT IS NOT:

- It is important to recognize … that “Web 2.0” is not anything other than the evolving Web as it exists today. It is the same Web that we’ve had all along (Introduction to Web 2.0, 2005).
- Web 2.0 is not about technology; it’s about sharing information (Porter, 2005).
- Web 2.0 is an attitude not a technology. It’s about enabling and encouraging participation through open applications and services (Talis, Web 2.0 and All That, 2005).
- Web 2.0 is about people, not technology. Sure it needs innovative technologies to facilitate it, but they are just in a support role (O’Reilly, 2005).

The list goes on and on. However, the question that should be asked is what was it that made us identify one application or approach as Web 1.0 and another as Web 2.0 in education? This question is particularly urgent due to the fact that in teaching and learning, some see Web 2.0 technologies as new and innovation instructional tool to help engage, enhance, and extend current educational practices.

**MAIN THRUS AND DISCUSSION**

The term “Web 2.0” was first notable on the first O’Reilly Media Web 2.0 conference in 2004. According to Tim O’Reilly’s (O’Reilly, 2005) speech, although Web 2.0 suggests a new version of the World Wide Web, it does not refer to an update to any technical specifications. At first the concept was only a brainstorming and to clarify the differences between Web 1.0 and Web 2.0 (Table 1). For example, personal websites is Web 1.0, blogging is Web 2.0, which means the Web 2.0 is not only a new marketing buzzword, but in fact exist things on the Internet. It also doesn’t have a hard boundary, but rather, a gravitational core, like the “meme map” of Web 2.0. Furthermore, Web 2.0 is a new form of internet application
that is more interactive, customized, social and media-intensive (Shannon, 2006). Based on these concepts, O’Reilly (O’Reilly, 2005) suggested seven main characteristics that could describe this term:

1. **The Web as Platform**: O’Reilly suggested three groups of web site and then compare then by showing the advantage of web application. He showed the drawback of desktop application which requires the user to pay and the risk of competition will lower the market share of specific application, say here, a web browser. And pointed out the power of “Long Tail”, which emphasize the collective power of the small sites that make up the bulk of the web’s content. Finally he also take the example of BitTorrent, which demonstrate the concept of “the service automatically gets better the more people use it”.

2. **Harnessing Collective Intelligence**: It emphasizes the power of collective intelligence. He gives the example of success websites which provide the collective information from users, but not web sites themselves. It

<table>
<thead>
<tr>
<th>Web 1.0</th>
<th>→</th>
<th>Web 2.0</th>
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<tbody>
<tr>
<td>about client-server</td>
<td>→</td>
<td>about peer to peer</td>
</tr>
<tr>
<td>about companies or organizations</td>
<td>→</td>
<td>about communities</td>
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<td>about dialup</td>
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<td>about broadband</td>
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<td>about owning</td>
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<td>about taxonomy</td>
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<td>about Web forms</td>
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<td>Web applications</td>
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<td>about wires</td>
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<td>about wireless</td>
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<tr>
<td>architecture of consumption</td>
<td>→</td>
<td>architecture of participation</td>
</tr>
<tr>
<td>attempts to create walled gardens</td>
<td>→</td>
<td>building value through open fields</td>
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<td>centralized</td>
<td>→</td>
<td>Distributed</td>
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<tr>
<td>content management systems</td>
<td>→</td>
<td>Wikis</td>
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<tr>
<td>content produced by someone else</td>
<td>→</td>
<td>content produced by the user</td>
</tr>
<tr>
<td>deliberate</td>
<td>→</td>
<td>spontaneous, emerging</td>
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<tr>
<td>directories (taxonomy)</td>
<td>→</td>
<td>tagging (“folksonomy”)</td>
</tr>
<tr>
<td>domain name speculation</td>
<td>→</td>
<td>search engine optimization</td>
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<td>download culture</td>
<td>→</td>
<td>remix culture</td>
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<td>home pages</td>
<td>→</td>
<td>about blogs</td>
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<tr>
<td>individual</td>
<td>→</td>
<td>social, memetic</td>
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<tr>
<td>personal Web sites</td>
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<td>Blogging</td>
</tr>
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<td>publishing</td>
<td>→</td>
<td>Participation</td>
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<td>read only</td>
<td>→</td>
<td>read/write</td>
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<td>loosely couple</td>
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<td>screen scraping</td>
<td>→</td>
<td>Web services</td>
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<td>static</td>
<td>→</td>
<td>connected, dynamic</td>
</tr>
<tr>
<td>transmission</td>
<td>→</td>
<td>Syndication</td>
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</table>
also pointed out the organic growth of the Web 2.0 nature. And gave a conclusion that network effects from user contributions are the key to market dominance in the Web 2.0 era. Finally, he pointed out the hottest feature of Web 2.0, blogging, which aggregated the wisdom of crowds would also be an essential part of harnessing collective intelligence.

3. **Data is the Next Intel Inside:** This part of content concentrate on the competitiveness of owning data. He gave the example of online Map service providers. Although they publish the map service in different way, however, they need the original map data to implement all these applications. So he gave the concept of who own the data, they may have the chance to own the market.

4. **End of the Software Release Cycle:** This paragraph shows that current modern Web 2.0 sites were trying to shorten their release cycle in order to follow up the newest requirement or resist any kind of accident. It also mentioned the open source dictum, “release early and release often” would be a trend of Web 2.0 sites.

5. **Lightweight Programming Models:** This paragraph pointed out the advantage of using lightweight programming models. For example, the using of lightweight service by Amazon and the simplicity of organic web services which introduced by Google. O’Reilly also addressed three significant facts. First, Support lightweight programming models that allow for loosely coupled systems, which lower the complexity of web service. Second, Think syndication, not coordination, which means webs should try to syndicating data outwards, but not controlling what happens when it gets to the other end of the connection. Third, Design for “hackability” and remixability, which emphasized that only if one service’s barriers to re-use were low, it could enjoy the success of redistribution and popularity.

6. **Software above the Level of a Single Device:** It gave an example of iTunes, which was a desktop application, but combine the massive web back-end to provide more information. It didn’t install every data but seamlessly reaches the same idea of owning the whole web database in your local system. Although it wasn’t a web application, however, it leveraged the power of the web platform which using the core principle of Web 2.0.

7. **Rich User Experiences:** By using some newest technology or the combination of old ones, it provided a lot of new user experiences which never exist before. And those improvements were one of the most attractive characteristic of Web 2.0.

All above briefly explain the development of current Web 2.0 trend. And most of the technologies have already existed before the appearance of this terminology. So what they try to do is to clarify the concept of the developing situation. At least, Tim O’Reilly (O’Reilly, 2006) made a more compact definition of Web 2.0 that “Web 2.0 is the business revolution in the computer industry caused by the move to the Internet as platform, and an attempt to understand the rules for success on that new platform.” It was almost the essential part of the topics he mentioned above. Web 2.0 also includes a social element where users generate and distribute content, often with freedom to share and re-use. This can result in a rise in the economic value of the web to businesses, as users can perform more activities online (Barnwal, 2007). However, those implementations are based on some technologies that we can’t ignore.

While attempting to clarify just what they meant by Web 2.0, in September 2005, Tim O’Reilly and other attendees of an important Web 2.0 conference formulated their sense of Web 2.0 by examples (O’Reilly, 2005). The authors have combined the individual examples from O’Reilly (2005), Governor (2005), Brown (2007), Drum-
goole (2006), and Barnett (2005) into a single list so that readers can formulate their own sense of Web 2.0 through these examples. The list of contrasting terms of Web 1.0 and Web 2.0 presented in Table 1 may help to summon up much of the Web 2.0 ethos.

Put together, the developments in Web 2.0 create four broad forms of impact, which can be summarized as research, comprehension, engagement, and writing.

On the higher order thinking side, Web 2.0 presents opportunities for users to develop confidence in new modes of inquiry and new forms of literacy, including information literacy, technology literacy, digital literacy, and tradition reading and writing literacy (Cook, 2008). Web 2.0 users acquire the skills that are necessary to navigate and interrogate new knowledge space. Users also become literate in digital formats for expression: formats that go beyond the familiar medium of print.

On the social side, an effective Web 2.0 user must becomes comfortable with collaborative modes of engagement and interactions. The Web 2.0 users also welcome new opportunities for writing and sharing information on the internet as well as engage an audience that comes integral to the support of that information exchange.

To support these activities, a range of new online tools have emerged. Most of them exist as web-based services that are accessible through a traditional browser. However, most of them are also free to use and can be downloaded to a wireless handheld device, a laptop, and mobile computer, and even a cell/mobile phone. These tools have stimulated considerable growth in young people’s recreational use of both the tool and the web. Much of this has been concentrated on gaming, communication, and shaping online spaces for the expression of personal identity.

Online games with the Web 2.0 flavor, allows the web to coordinate the actions of geographically separated players. Interest in network communication has concentrated on text-based chat systems. While the celebration of personal identity has been through ‘social networking’ sites, within which users can develop an online identity and space to be shared with selected friends. Some inevitably are a source of concern in relation to the protection of young people from predatory contacts or from reckless commercial marketing (Cook, 2008).

The variety of actual activity that is embraced by Web 2.0 is summarised in Table 2 along with examples of websites to illustrate each category. The table suggests the following overarching themes:

- First, Web 2.0 is about a scaling up of user participation that creates new possibilities for sharing and ‘network effects’ that are emergent from this new scale. Thus, many categories in the table refer to technologies that put users into contact with others: letting them enjoy an exchange of opinion, digital products, or conversation. The greater the number of people participating, the greater the value derived.
- Second, such sharing can evolve into more organised forms of joint knowledge building. Thus, Web 2.0 is about creating arenas for user collaboration.
- Third, Web 2.0 is about exploring a wide range of expressive formats. This is because digital media create new opportunities for manipulating more than the conventional texts of communication: in particular, they encourage exploration of images, sound and video. Moreover, these opportunities have now become widely available.
- Finally, the rich and democratic patterns of exchange and publishing that Web 2.0 affords mean that the internet offers novel frameworks and resources for research and inquiry.
## Wired for Learning

### Table 2. Major categories of Web 2.0 activity for educational considerations (Websites are given as examples only and no recommendation or endorsement is intended)

<table>
<thead>
<tr>
<th>Category</th>
<th>Websites</th>
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### Definitions

- **Media sharing**: Uploading and downloading media files for purposes of audience or exchange. Users empowered to download and upload to the internet were quick to swap digital files of their music collections via centralised websites. While music-sharing thrived on users copying of commercial material, photo-sharing (Flickr) involved user-generated content. The video-sharing that then emerged is a mixture of recycled film/TV and homemade clips (You Tube). Personalised versions exist for individual broadcasting (castpost). Other visual media that are popular for sharing include slideshow presentations (slideshare) and sketches (sketchifi). Sites now exist to package and present the various shareable media creations of individuals (loudblog), with increasing emphasis on rating and commentary from users.

- **Online games and virtual worlds**: Rule-governed games or themed environments that invite live interaction with other internet users. Being able to interact with other internet users invites the playing of games. Because users may be strangers, the game rules must avoid assuming mutual familiarity. Naming a sketch drawn by someone else, for example (isketch). Or having invisible user/partners suggest labels for random photographs – which also helps search engines tag them (imagelabeler). More traditional partner-based electronic games are possible with internet connections between players (worldofwarcraft). ‘Virtual worlds’ create screen environments that allow users to navigate this space and interact with others through avatars. They do not demand game-like rules but they may have an economy for trading goods or services (secondlife). These spaces may be themed so as to narrow possible interactions in rooms such as in a hotel (habbo) or in mock-uped places (virtualibiza). They may be tailored for special interest groups (clubpenguin). For very young users they may be based on managing a pet-like avatar (webkinz), with extensive marketing links.

- **Social networking**: Websites that structure social interaction between members who form subgroups of ‘friends’. An early form of internet social interaction was based on the dating agency principle (match). Recent sites organise real world meetings between members, such as meeting for Saturday breakfasts (fruhstueckstreff) or simply based on tracking mobile phone location (dodgeball). Other sites convened members online based on alumni relations (friendsreunited) or on business CVs (linkedin). However, the greatest success has been in sites that allow users to create digital spaces into which they can invite ‘friends’ to share messages, texts, videos etc, or to play games. Some have a strong student base (facebook), some are more media-oriented (myspace), and some are more for teenagers (bebo). Others create social links based on users tagging their personal goals (43things), or declaring themed interests, such as green politics (care2) or clubbing (dontstayin). Finally, tools exist for special interest groups to design their own social network sites (ning).

- **Blogging**: An internet-based journal or diary in which a user can post text and digital material while others can comment. Web services offer users space and tools to launch their own ‘blog’ (blogger). Some encourage interaction around themed concerns and thus resemble social networking sites (livejournal). Search engines exist for the ‘blogosphere’ of blog postings (technorati). Some users favour shorter, more whistlebl and multimedia postings (tumblr). While micro-blogging sites allow only short entries, these can be from other devices such as phones; updates can be sent to selected other users (twitter). These sites tend to thrive on building a community of signed-up ‘followers’ for their authors.

- **Social bookmarking**: Users submit their bookmarked web pages to a central site where they can be tagged and found by other users. Some sites collect and aggregate tags on bookmarks that users have shared, thus allowing organised search (del.icio.us) based on personal tags or a ‘folksonomy’. Others incorporate user annotations with the tagging (diigo). Services exist to extend this beyond web pages: for instance, allowing users to share, tag and search on books that they are reading (librarything). Such activity encourages folksonomies or private or user-defined categorisation schemes rather than the more traditional hierarchical and constrained taxonomies.

- **Collaborative editing**: Web tools are used collaboratively to design, construct and distribute some digital product. Sites may allow users scattered across large distances to collaborate in making a single entity such as a film (awarmofangels). By centralising documents on a shared web server, a group of users may edit those documents rather than hold many individual copies (docs.google). More structured sites allow the production of collaborative artefacts such as novels (glypho).

- **Wiki**: A web-based service allowing users unrestricted access to create, edit and link pages. The wiki construction process is best known through the public, collaborative encyclopaedia wikipedia. Similar ventures exist for more focused interests such as travel (wikitravel.org.en) or television knowledge (tviv). Or users may use the wiki concept to design and maintain a personal organisar (tiddlywiki).

- **Syndication**: Users can ‘subscribe’ to RSS feed enabled websites so that they are automatically notified of any changes or updates in content via an aggregator. Individual sites offer buttons that allow users to subscribe and thus be posted updated material. Other sites exist to ease the subscription process and allow users to select a profile of feeds (bloglines). However, the best known form of this feeding involves podcasts: audio or video files that can be delivered to subscribed sites. Websites act as portals to finding these podcasting sources (podcast.net).
Web 2.0 in Education

The affordances of Web 2.0 seem to harmonize well with modern thinking about educational practice. In particular, these new technologies promise learners new opportunities to be independent in their study (Cook, 2008). These technologies encourage a wider range of expressive capability. They facilitate more collaborative ways of working and they furnish a setting for learner achievements to attract an authentic audience. To encourage these possibilities, Web 2.0 tools have evolved that create distinctive forms of support for learning and for independent research in this new internet.

However, with the enthusiasm for adopting Web 2.0 practices in education, there is little evidence that discusses the benefits for using web 2.0 in the teaching and learning process. This is not helped by the fact that there remains very little research activity guiding the effective application of these new tools and practices with the teaching and learning process (Cook, 2008). This may reflect the fast-changing nature of services and, therefore, the reluctance of researchers to aim their interest at such a moving target. However, slow educational uptake also reflects the fact that adoption of Web 2.0 creates a number of practitioner tensions; these exist as significant challenges to innovation.

Many education researchers agree that not only are many of today’s students digital natives, they also possess an information-age mindset (Frand, 2000). In order for something to hold their attention, they must be actively engaged in the content and visuals are used to convey information (McLester, 2006). To function effectively in the latest version of Web development, users need to be flexible and comfortable with the collaborative nature of the environment and the technology.

The evolution from Web 1.0 to Web 2.0 reflects this change of mindsets. Given the Web 2.0 ethos of sharing micro-content across services and the importance of social software, it is only logical that crossbreeds of news services and social software have emerged. Amid this outbreak of Web 2.0 services, what are the pedagogical possibilities? More perplexing to educators can be how do we harness the power of these new technologies to more actively engage students and increase their learning. The answer lies in web 2.0.

With the marrying of web 2.0 and education comes many issues that reflect such a commitment. As of any marriage there are issues that arise. Just like a traditional marriage of two individual who come from different perspectives, so is web 2.0 and education. These issues include a learner-centered discourse, demands on the teacher, organizational infrastructure, and teacher training and development.

The learner-centred discourse within the use of Web 2.0 and education may be welcome, however, should not imply that there are no significant new demands on teachers. Many are hesitant to invest in acquiring the new competencies required by Web 2.0. The resources are largely generic rather than content-based and so teachers find hidden calls on their time to orchestrate the relevant activities (Cook, 2008). Further, institutions need to decide whether to contain Web 2.0 activities within the local areas of their learning platform, rather than risk learners publishing in the open internet. That decision is closely linked to the widespread anxiety felt regarding the threats to safety that arise from unconstrained internet interactions. It is also closely linked to the duty schools feel to restrict pupils’ access to certain more playful (or morally suspect) sites that extensive Web 2.0 activity might indirectly make available.

Teachers also will have to manage the consequences of a strongly collaborative form of working that Web 2.0 activity invites. This raises issues for managing individual assessment, as well as personalisation tensions when dealing with learners who may want to learn and express themselves more privately (Cook, 2008). Teachers may also have reservations about the forms of study and research that Web 2.0 encourages. This applies
in particular to the ease with which digital media and a large arena of informal knowledge encourages cut-and-paste solutions to personal research. Managing a mature approach to how learners study is a significant challenge for teachers. They must guide students into recognising the basis of authority for internet-published work – over and above simply helping them to do the necessary navigation and exploration in this environment. Teachers may also have reservations about the multi-tasking modes of working that a rich Web 2.0 desktop environment may cultivate.

In addition the use of Web 2.0 for education, presents a danger of focusing too much on the technology, rather than pedagogy or instruction. What may be more significant about these developments is that they highlight a certain ‘disposition’ that practitioners might adopt in relation to teaching and learning. Web 2.0 innovations may require closer attention to those matters of pedagogy rather than attention to novel internet configurations (Cook, 2008). This commitment entails teaching and learning disposition is not new. It is an attitude that acknowledges the multi-perspective nature of knowledge, the reality of multiple perspectives, the value of collaborative thinking, and the significance for creativity of the learner.

However, with education and Web 2.0, new tools provide a fresh drive for the way of thinking in education. These Web 2.0 tools alone do not form the necessary basis for realising such a disposition. The associated ideas have long been debated within discussion of pedagogy. Therefore, it has already accepted that they can only be pursued when the underlying curriculum and regimes of assessment have been designed to be in sympathy with them (Cook, 2008). It is true that the enthusiastic uptake of Web 2.0 tools depends on an educational disposition: that is, the acceptance of particular attitudes towards knowledge and knowing. But all of this can only be made to take flight if it is located within systems of educational delivery, management and assessment that have been fashioned in harmony with such attitudes.

Educational Possibilities with Web 2.0

Table 2 identified 12 categories of Web 2.0 activities. In Table 3, the same 12 categories are explored in relation to their possible application to teaching and learning. Again, websites are identified that are indicative of the activities described and are more explicitly educational in design.

**CONCLUSION**

“Web 1.0 was about connecting computers and making technology more efficient for computers. Web 2.0 is about connecting people, and making technology more efficient for people,” commented one visitor of the O’Reilly Radar blog in October, 2005. In the education arena, the “people” mentioned in the above statement will be replaced by “students and teachers” (O’Reilly Radar, 2005). As stated above, openness, social learning, virtual learning, and meta-services of the micro-content combine into a larger conceptual strand of Web 2.0 when applied in education settings, one that sees users as playing more of a foundational role in information architecture.

Consumers’ experience with Web 2.0-class software is setting the bar of what software can and should be. Web 2.0’s inevitable arrival within the education system is likely to follow the pattern set by the first generation of the Web, only to become more pervasive and essential. These issues are in need of further research.

**REFERENCES**

### Table 3. Categories of educational Web 2.0 activity (Websites are given as examples only and no recommendation or endorsement is intended)

<table>
<thead>
<tr>
<th>Category</th>
<th>Example Websites</th>
</tr>
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</table>
| Media sharing                     | http://youtube.com/group/reteachers  
http://www.bbc.co.uk/blast  
http://www.zentation.com  
http://www.miniciti.com  
http://www.notecentric.com        |
| Media manipulation                | http://www.gliffy.com  
http://www.thumbstacks.com  
http://www.yoono.com  
http://www.googlelittrips.com  
http://www.frappr.com             |
| Online games and virtual worlds   | http://www.fablusi.com  
http://www.powerupthegame.org  
http://swi.indiana.edu/arden  
http://www.schome.ac.uk  
http://vue.ed.ac.uk               |
| Social networking                 | http://apps.facebook.com/mynewport  
http://www.schoolnetglobal.com  
http://www.goldstarcafe.net  
http://learnhub.com               |
| Blogging                          | http://edublogs.org  
http://www.sandaigprimary.co.uk/pivot  
http://blogs.longeaton.derbyshire.sch.uk  
http://blogs.warwick.ac.uk  
http://www.nature.com/blog         |
| Social bookmarking                | http://www.bibsonomy.org  
http://www.citeulike.org           |
| Collaborative editing             | http://www.google.com/docs  
http://thinkature.com  
http://www.bubbl.us  
http://www.virtual-whiteboard.co.uk  
http://www.britishcouncil.org/etwinning.htm  
http://www.skoolaborate.com       |
| Wikis                             | http://pbwiki.com/education.wiki  
http://en.wikiversity.org/wiki  
http://knowhomeschooling.com  
http://westwood.wikispaces.com  
http://www.squidoo.com             |
| Syndication                       | http://podcastschool.net  
http://itunes.stanford.edu          |


**KEY TERMS AND DEFINITIONS**

Blog: A site maintained by an individual, organization or group or people, which contains recurrent entries of commentary, viewpoints, descriptions of events, or multimedia material, such as images, pictures or videos. The entries are typically displayed in reverse chronological order with the most recent post being the current focus.

Net Generation Students: The present generation of undergraduate students who have grown up in a world dominated by technology and surrounded by multimedia.

Podcasting: A multimedia file distributed over the Internet using syndication feeds, for playback on mobile devices and personal computers. Though podcasters’ web sites may also offer direct download or streaming of their content, a podcast is distinguished from other digital audio formats by its ability to be downloaded automatically using software capable of reading feed format.

Social Networking: A website is an online resource for building virtual social networks communities of individuals with common interests or who are interested in exploring the interests and activities of others.

Web 2.0 Technologies: A variety of new technologies, such as blogs, wikis, and media sharing sites and social network sites that provide user–centered opportunities to create and share content.

Web 2.0: A trend in World Wide Web technology, a second generation of web-based communities and hosted services such as social-networking sites, wikis, blogs, and other new technology approaches, which aim to facilitate creativity, collaboration, and sharing among users.
Wiki: Short for “wiki wiki” which means “rapidly” in the Hawaiian language is a website that allows users with access to collaboratively create, edit, link, and categorize the content of a website in real time covering a variety of reference material. Wikis have evolved from being purely a reference site into collaborative tools to run community websites, corporate intranets, knowledge management systems and educational sites.
Chapter 8
Revisit Planning Effective Multimedia Instructions

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ABSTRACT
Multimedia benefits students learning in many different ways. There are so many things that students can do and learn because of the variety of instructional media that is available for their use. The use of instructional multimedia increases an instructor’s ability to propose and execute teaching strategies that come with a multiplicity of learning styles. Therefore, there are a myriad of reasons why teachers use these resources both as a teaching tool and as a teaching resource. Several strategies can be implemented so that teachers have opportunities to become skillful in attaining technological fluency. This chapter reviews the trends and issues of today’s multimedia education, and attempts to provide strategies and guidelines for planning multimedia instruction. The effective use of pedagogical design principles with appropriate multimedia can allow greater individualization, which in turn fosters improved learning, greater learner satisfaction, and higher retention rates.

INTRODUCTION
Technological capabilities are growing in today’s world by leaps and bounds. Over the past few decades, there have been remarkable advances in computer and interactive media technology. As a result, there has been a tremendous increase of investment in school technology and media use. Teachers are also being asked to learn the skills and techniques required to use computers and instructional media in classrooms.

The diverse characteristics of different multimedia and the capabilities that they provide for
learning have direct implications on the design of multimedia strategies and materials (Fahy, 2005). Goldman and Torrisi-Steele (2005) state that “the essential value of interactive multimedia technologies is that they can be used effectively to empower students to take a more pro-active role in acquiring, analyzing and synthesizing information” (p. 191).

Although today’s technologies make possible the use of multimedia by helping to move learning beyond a primarily text-based and linear arena into the cyclical world of sights, sounds, creativity, and interactivity, the challenge is whether the essence of multimedia can be integrated into an essential discipline (Gonzalez, Cranitch, & Jo, 2000). If some pedagogical design principles and appropriate media are used effectively, multimedia can permit greater individualization, in turn fostering improved learning, learner satisfaction, and retention rates (Fahy, 2005).

This chapter discusses the definition of “multimedia,” including the trends and issues of today’s teaching and learning. The goal is to review the benefit of using multimedia instruction, and to attempt to provide some strategies and guidelines for planning multimedia instruction. By outlining some fundamental issues and considerations affecting implementation of multimedia, the authors discuss some challenges and impacts of multimedia instruction when teachers are ready to move from simpler to more complex combinations of media for teaching. Additional examples drawn from literature are also included to discuss the use of multimedia in education and the strategies of planning effective instruction.

### INTEGRATING MULTIMEDIA TECHNOLOGIES

The rise in the usage of technology is bringing about rapid change in the educational environment. In keeping with this changing environment, teachers need to discover ways to broaden their range of teaching methods so that they can produce more effective learners. Emerging trends including individualized learning, cooperative learning, collaboration learning, learner center approach, and assessment portfolio have been playing an important role in education. Research indicates the importance of increased technology integration in the classroom. When using interactive technology, students not only learn more quickly and pleasantly, but also learn the much needed life skill of learning how to learn (Vogel & Klassen, 2001). However, many educators today are facing the issue of integrating technology into their instruction (Wang & Speaker, 2002).

Technology continues to change dramatically. Although it may be recognized by educators that multimedia technologies have the potential to offer new and improved learning opportunities, many educators fail to realize this potential (Torrisi-Steele, 2005). Similarly, Kaufman (2002) also summarizes that most teachers have been taking advantage of technology’s mass storage capacities, but they have not exploited its greater potential to motivate knowledge construction and facilitate problem-solving. As a result, a number of educators using multimedia technologies in their learning environments are mainly limiting its use to a tool for data access, communications, and administration (Conlon & Simpson, 2003) rather than a tool for integrating curriculum (Torrisi-Steele, 2005). This lack of true integration results in minimal change in both pedagogical strategies and learning environment (Tearle, Dillon, & Davis, 1999).

Failure to implement effective technology integration could be associated with teachers’ technology skills and attitude as well. As Speaker (2004) concludes, student use and perception of a multimedia educational experience is highly dependent on the attitude of the teachers and her/his ability to provide useful contextual information in a format that meets the criteria of relevancy and interactivity in a student-centered approach. However, research (Torrisi-Steele, 2005) shows that teachers are generally unprepared for the
technology changes, and often lack the skills, as well as technical and pedagogical knowledge, to implement effectively those technologies in their learning environments. As a result, students’ classroom practice may not meet student or teacher expectation especially in the area of integration and use of multimedia (Speaker, 2004) because today’s students are often far more skilled at using digital media than most of their teachers. Torrisi-Steele states (2005), “The effective integration of multimedia in the curriculum depends not on the technology itself but rather on educators’ knowledge, assumptions, and perceptions” (p. 26). Therefore, teachers should have a desire to integrate and plan effective multimedia instructions into their classroom.

WHAT IS MULTIMEDIA?

The term “multimedia” means different things to different people; however, definitions of multimedia tend to agree in substance (Fahy, 2005). Fahy (2005) states that “the term 'multimedia' refers to the provision of various audio and video elements in teaching and training materials” (p. 3). Ivers and Barron (2002) define multimedia as “the use of several media to present information” (p. 2); Mayer (2001) views multimedia as “the presentation of material using both words and pictures” (p. 2). To Peck (as cited in Speaker, 2004) multimedia is “as a computer controlled combination of two or more media types, to effectively create a sequence of events that will communicate an idea visually with both sound and visual support” (p. 242). Not only do Roblyer and Schwier (2003) define multimedia as “a computer system or computer system product that incorporates text, sounds, pictures/graphics, and/or audio” (p. 329), but they also imply its purpose as one of “communicating information.”

Due to the growing delivery of media by computer and the merging of increasingly powerful computer-based authoring tools with Internet connectivity, it seems that the term “multimedia” is now firmly associated with computer-based delivery. Although the term has not always been associated with computers (Roblyer & Schwier, 2003), Gonzalez et al. (2000) write that “multimedia cannot be experienced without the technology because it is the technology that creates the experience” (¶ 9). Therefore, Gayeski (1993) defines computer-based multimedia as “a class of computer-driven interactive communications systems which create, store, transmit, and retrieve textual, graphical and auditory networks of information” (p. 4). In other words, computer-based multimedia involves the computer presentation of multiple media formats (e.g., text, pictures, sounds, video, etc.) to convey information in a linear or nonlinear format (Ivers & Barron, 2002).

With an increased availability of digital information options, multimedia is now viewed as a combination of different media (i.e., text, pictures, sounds, video, animations, etc.) used to present multimodal information, in conjunction with computer technology. However, most definitions only take into consideration the basic instructional delivery system. These definitions may be less meaningful, particularly in education, if multimedia cannot be incorporated with the way people learn and work. Because multimedia enables kinesthetic instruction and learning, multimedia can be a very powerful pedagogical tool if teachers can focus on the foundation for learning. By integrating multimedia into teaching and learning, students can work with increased information in more creative ways than ever before to make the knowledge more applicable and retainable.

MULTIMEDIA LEARNING

The capability of multimedia provides teachers with an array of learning pathways to offer students. According to Biggs (1999), learning is a way of interacting with the world. In other words,
learning takes place through the active construction of knowledge by the interaction between information received through different channels and existing knowledge stored in the learner’s long-term memory (Christie & Collyer, 2005). Wild (1996) describes successful learning as the successful interactions between learner, context, and instruction. Multimedia promotes interactivity as a form of learning, and offers many possibilities for enriching the knowledge or information for learners. As Zhang (2005) concludes, multimedia instruction along with high levels of interaction can help maximize learner engagement and learner retention.

**Benefit of Multimedia Instruction**

There are many benefits of interactive multimedia instruction. The first is compliance with the requirements of No Child Left Behind Act of 2001 (NCLB). The challenges of NCLB no longer allow schools the luxury of viewing technology as an add-on function at the periphery of instruction, a curriculum enhancement or as an occasional frill that makes learning more fun; instead, schools and particularly teachers must adopt and embrace technology so that it restructures the way learning is managed and administrated (Tetreault, 2005). Multimedia facilities control of the pace, sequence, difficulty, content, and style so that instructional media presentations can be customized to each student’s distinctive needs. With multimedia, teachers can monitor and promote student learning. Students, on the other hand, are exposed to a multimedia learning environment that adjusts to individual students’ skill level, knowledge background, preferred learning style, and pace of learning. Multimedia, viewed in this light, complements the requirements of the NCLB Act, which calls for the Secretary of Education to “conduct a rigorous, independent, long-term evaluation of the impact of educational technology on student achievement using scientifically based research methods and control conditions” (as cited in Means & Haertel, 2004, p. 9). This type of evaluation seeks to evaluate the investments made to bring instructional media into the classroom. If the Education Secretary finds positive results in the use of instructional media in the classroom, then it shows that the national investment has indeed been a worthwhile venture.

Another benefit of media-based instruction is the reduction of the time required to reach instructional objectives. If teachers do not have to spend instructional time repeating material that most of the students already know, then the learning of new material can occur more quickly. Since effective media-based instruction is designed to keep students interested and more involved in educational material, this instructional mode promotes wise use of both student exposure to instructions and use of teacher’s time.

Multimedia instruction also provides a stimulus for learning by increasing social interactions and cooperation. Hoyle (1994) reports that there is a relationship between students involved in multimedia-based environment with collaboration and higher-order thinking, hypothesis formation, and reflection. Mevarech and Light (1992) report on a review of studies which investigated the potential of multimedia-based learning environment to enhance group work provides convincing evidence of the value of group work and collaboration, and its positive impact on productive learner dialogue, interchange of ideas and negotiation of solutions.

With one-to-one interaction being regarded as an educational ideal, efforts to realize this through information technology have included intelligent tutoring systems and telementoring. These intelligent tutoring systems, like their human counterparts, are fully expected to respond flexibly to student inputs so as to optimize progress toward a learning objective. It involves one-to-one interchanges between tutor and student, typically relying on e-mail exchanges between a student and experts in that field. The program’s success is extremely dependent on the match between the
mentor and the student (Kovalchick & Dawson, 2004).

New knowledge media such as video productions, simulations and microworlds extend the range of experiences and concepts that can be brought into school. For example, field trips are regarded as classic ways to explore worlds not easily represented through school-based instructional materials. With today’s virtual reality, students can experience an interactive ‘field trip’ without leaving their classroom. In addition, providing multimedia instruction has been found to have a positive impact on students’ perceptions of teachers. For example, teachers who use presentation visuals are judged to be better prepared, more concise, professional, clearer, credible, and interesting (Vogel & Klassen, 2001). Also, multimedia technology can enable teachers to work together to share material and complement each other’s expertise, thereby adding value to education (Alavi, et al, 1997). The use of multimedia also links students and classes together as well as enhances the ability of government and business experts to participate in education.

**Use of Multimedia Instruction**

The strength of multimedia instruction lies in its ability to adapt to students’ individual differences and capabilities of controlling the learning path. With the new trend in education that emphasizes the importance of learning with technology instead of learning from technology (Jonassen, Howland, Moore, & Marra, 2003); the accessibility of multimedia technologies has presented an array of choices to instructors. There are many ways that computer use can and does benefit students’ learning. One of the first instructional uses of computers and software programs was simply for drill and practice. This was seen as a beneficial use for students who need extra or special practice when the teacher just did not have enough time to perform this task.

Computer-assisted instruction is another valued use of multimedia. This requires more advanced instructional programming than drill and practice programs. This type of software provides concepts and content in a straightforward approach. As Chipman (2003) indicates, “The computer offers management of the student’s study efforts through pacing and interspersed questions” (p. 39). These programs can vary from simple to more sophisticated where the computer may respond differentially to student responses with preprogrammed responses of its own.

Simulations are another popular use of multimedia. Simulations represent safe environments in which student can interact. “Simulations make it possible to experience an approximation of a phenomena that otherwise might merely be talked about” (Chipman, 2003, p. 40). Simulations open new possibilities in teaching and permit students to practice events or phenomena that might be too hazardous or too intricate to duplicate, but to be effective, they must be integrated with a larger curricular context. For example, in a science class, if students are learning the body parts of frogs, students can use a computer program to simulate a frog dissection, instead of cutting up an actual frog. This simulation may not give students the hands-on experience; however, it is much cheaper and it can be used over and over. It is also more flexible because the frog can be reassembled by the program, and the simulation can avoid sacrificing a real frog.

Another popular use today of multimedia is streaming video. Streaming video revolutionizes the way visual content is used in the classroom for clear demonstrations of proficient performance. It also provides more learning potential that the use of VCR’s, and empowers teachers and students to study a broader range of topics with the potential for higher retention and comprehension, which is a key to maximizing student achievement (Holland, 2005). With streaming video, students can now watch a lecture, tutorial or presentation online via normal modem, and at the same time review the
corresponding documents or materials in a highly compressed, web browser accessible format.

Multimedia offer many other uses from the elementary school level to higher education. Some of these uses include drill and practice software, problem-solving software, web-base software, data analysis and reporting software and presentation software (Bitter & Pierson, 2002). These are all tools that can and should be very valuable assets for many grade levels and subject areas. For example, presentation software such as PowerPoint, allows teachers to place class materials together in a dynamic and meaningful manner. The ability to integrate sound, picture and video into PowerPoint slides offers tremendous potential to captivate the child’s attention and give the child a sense of control over the learning process that makes it more palatable (Yu & Smith, 2008). Interactive applications, such as the World Wide Web, can be used as a main information resource for students to access anytime and anywhere, or for the storage of instruction materials including class notes, presentation visuals, and video recordings. In addition, data analysis and reporting software, such as Excel, provides all the functions to manipulate numbers, takes numeric and alphanumeric format data as input to a matrix, performs matrix calculations, and produces a computed spreadsheet as the main output. For instance, students in math and finance related classes might be able to use Excel to perform predefined calculations automatically, to run statistical functions, and to display charts. In many ways, it is easier to use a computer than a calculator since numbers are visible all of the time on the computer screen. Students can move gradually from using computers as a super-calculator to using them for modeling or simulation. In other words, they can move from using them to ask “What is” questions to “What if” questions. Thus they also can be used as decision-making aids.

MULTIMEDIA FOR EFFECTIVE INSTRUCTION

The term effective instruction as it is used today does not mean the same thing that it did just a few years ago. It once meant simply teaching the basics - reading, writing, and arithmetic. Now it means much more. It means not only teaching the basics, but also teaching concepts and problem solving using multimedia. Students can do and learn using a variety of instructional media that is available to them. There are myriad reasons why teachers must use these resources both as a teaching tool as well as a teaching resource. One reason is the ever-increasing amounts of interactive instructional media resources that have become available all over the world and in our schools. In many instances, today’s students are more technology savvy than many teachers. Many states have added technology proficiency to their teacher licensing requirements, making it necessary for policy makers, teacher educators, teachers, and school administrators to employ teachers who are proficient in the use of instructional media and to provide appropriate classroom resources (Zhao, 2003). Teachers are responsible for creating a learning environment that emphasizes the impact of content and increases student learning (Vogel & Klassen, 2001). With the assistance of multimedia technology, demands on the teacher in a technological learning environment are increasing, and the importance of planning effective multimedia instruction is growing at all educational levels.

PLANNING FOR MULTIMEDIA INSTRUCTION

The value of integrating multimedia technology into classrooms at all levels has been discussed in many research studies in different disciplines (Agarwal & Day, 1998; Stone, 1999). Gonzalez et al. (2000) indicate that “multimedia is more
than a collection of sound, images, video and animations. It is a vital, dynamic field offering new challenges, interesting problems, exciting results, and imaginative applications” (¶ 5). They point out the challenge - whether the unique essence of multimedia can be distilled into an essential discipline (Gonzalez et al., 2000). Successful technology integration involves careful evaluation of the curriculum and learning goals (Ertmer, 1999). The following section provides examples of strategies and guidelines for planning multimedia instruction. The pedagogical aspects of effective instruction are the main focus in this discussion.

**Technology Standards**

The first logical and practical step for multimedia instruction is to look at educational technology standards for teachers at the state level. Most states should have these standards in place as part of their blueprints or guidelines on what should be minimally taught at each grade level. State objectives provide minimal goals for technology and media integration; teachers must then integrate these goals throughout the curriculum so that media and technology become part of the instructional environment, not just a supplement to it. Nationally, all teachers are expected to meet new technology standards designed by the International Society for Technology in Education (ISTE). Since rapid advances in technology are putting new demands on educators and students, ISTE refreshed the National Educational Technology Standards for Teachers (NETS•T) in 2007 and unveiled the new NETS•T in 2008. The updated standards provide a framework for educators to use as they transition schools from Industrial Age to Digital Age (ISTE, 2008). The comparison chart of the 2000 and 2008 ISTE technology standards is listed in Appendix A.

**Design and Development Principles**

The quality of the learning experience depends considerably on the design and presentation of instructional materials (Sanders & Morrison-Shetlar, 2001). A number of studies provide principles that can guide teachers in the design and development of multimedia instruction. Mayer’s (2001) work is one such example. He suggests that successful learning requires students to perform five actions, with direct implications on the design of effective multimedia instruction:

- Select relevant words from the presented text or narration
- Select relevant images from the presented illustrations
- Organize the selected words into a coherent verbal representation
- Organize selected images into a coherent visual representation
- Integrate the visual and verbal representations with prior knowledge (p. 53)

In order to guide the design of multimedia instruction, Mayer (2001) identifies seven useful principles that contribute to student retention.

- **Multimedia Principle:** Students learn more efficiently from words and pictures than from words alone.
- **Spatial Contiguity Principle:** Students learn more efficiently when corresponding words and pictures are presented near rather than far from each other on the page or screen.
- **Temporal Contiguity Principle:** Students learn more efficiently when corresponding words and pictures are presented simultaneously rather than successively.
- **Coherence Principle:** Students learn more efficiently when extraneous words, pictures, and sounds are excluded rather than included.
• **Modality Principle:** Students learn more efficiently from animation and narration than from animation and on-screen text.

• **Redundancy Principle:** Students learn more efficiently from animation and narration than from animation, narration, and on-screen text.

• **Individual Differences Principle:** Design effects are stronger for low-knowledge learners than for high-knowledge learners and for high-spatial learners rather than for low-spatial learners (p. 184).

Learners are the core in the realm of teaching and learning. Since successful interaction design that engages learners in exploring knowledge and experiences is the result of careful analysis of the learner and of the learning outcomes (Goldman & Torrisi-Steele, 2005), Fardouly (as cited in Goldman & Torrisi-Steele, 2005) provides some questions to guide successful interaction design while constructing multimedia interactivities:

- Who are the learners? What do they need or want to learn? In what environments will the learning be applied, and what do they already know?
- What is the teacher trying to achieve with the instruction? Clearly define goals and objectives and relevant content.
- What skills, attitudes and knowledge are you trying to develop?
- How will content be structured?
- What strategies might be used?

These examples of design principles may enhance the learning experience and maximize the potential of multimedia technologies.

**Constructivist Learning**

Leidner and Jarvenpaa (1995) categorize learning models into several categories: objectivism, constructivism, collaborative learning, cognitive information processing, and socioculturalism. Among them, the leading theory of today’s learning is constructivism, which is the idea that learning actually occurs when learners actively try to understand material that is presented to them. They engage in constructivist learning by deeply and actively processing the material that is to be learned in an attempt to understand it. This process can also be called knowledge construction because learners create their own knowledge, apply, and coordinate it to their own cognitive processes while learning. This learning is also traditionally known as meaningful learning or learning by understanding (Mayer, 2003).

The constructivist view of teaching and learning is a commonly accepted framework for developing appropriate strategies for designing multimedia learning environments in ways which will promote student-centered learning environments (Goldman & Torrisi-Steele, 2002). According to Savery and Duffy (1996), effective instructional design of multimedia interactivities may be based on eight constructivist principles. They are:

- Anchor all learning activities to a larger task or problem.
- Support the learner in developing ownership for the overall problem or task.
- Design an authentic task.
- Design the task and learning environment to reflect the complexity of the environment that students should be able to function in at the end of learning.
- Give the learner ownership of the process used to develop a solution.
- Design the learning environment to support and challenge the learner’s thinking.
- Encourage testing ideas against alternative views and alternative contexts.
- Provide opportunity for, and support reflection on, both the content learned, and the learning process itself (p. 3).
The concept of constructivist learning does indeed have important implications for the use of a variety of interactive instructional multimedia. It is aimed at fostering and guiding learning and activating cognitive processing that leads to understanding. “Under this conception of learning, instructional technology should serve as a cognitive guide to help learners on authentic academic tasks - such as comprehending a text, solving challenging mathematics problem, or conducting a scientific experiment.” (Mayer, 2003, p. 128)

Learning Styles

Learning styles are also a well-known area that impact on today’s technology-based instruction. As Kovalchick & Dawson (2004) state, “Learning styles are the diverse ways in which people take in, process, and understand information” (p. 418).

It is of importance to address the different learning styles of individuals. Litchfield (1993) indicated, “…matching learning style with design of instruction was important for both achievement and positive attitudes” (p. 5). Educators need to always focus on the fact that one size does not fit all when selecting teaching strategies or educational theories. One learner might learn best in a cooperative learning environment while the other may achieve similar learning outcome through self-study (Marlow, 2003). This does not at all mean that the teacher has to have classroom materials tailor-made just to satisfy one or two persons’ special needs. The educator should, however, be sensible and flexible to different individuals, and include a variety of methods to account for different learning styles. The use of interactive instructional media in education increases an instructor’s ability to propose and execute teaching strategies that cater to a variety of learning styles. The use of multimedia facilitates learning by providing a unique opportunity to notice and to adjust to the differences in every person. The use of computer-mediated communications tools like e-mail, discussion boards, and virtual chat provide many opportunities for interaction collaboration and discussion inside as well as outside of the classroom (Kovalchick & Dawson, 2004). Teachers can use interactive media to develop and deliver instruction to a variety of learners with diverse learning styles. E-learning, synchronous or asynchronous, that is conducted over the Internet, intranet, extranet, or other Internet based technology is another growing trend in schools today that takes learning styles into account (Abram, 2005).

Using a variety of educational media also provides a stage upon which numerous instructional approaches can be developed. This fact relates back to Howard Gardner’s theory of multiple intelligences. Gardner believed that each person has a different intellectual composition made up of verbal-linguistic (speaking, writing, and reading), mathematical-logical (reasoning skills), musical, visual-spatial, bodily kinesthetic, interpersonal, intrapersonal, naturalistic, and existential skills. People possess all the intelligences in varying amounts, and they may employ each one separately or jointly, depending on the learning situation. The variety of interactive media available today (such as PowerPoint®, e-learning, streaming video, the WWW, etc.) can easily be used to complement each individual’s learning style and multiple intelligence areas.

Meaningful Content and Interaction

Research (Esquivel, 1995) has shown that students enjoy instruction related to real life events. Multimedia learning can support instruction that is contextually relevant, interactive and meets the needs of the individual learner (Speaker, 2004). Multimedia can be made challenging and vary in degree of difficulty, yet the content should be relevant to student’s study (Marlow, 2003). Appropriate multimedia such as audios, visuals, and text will aid successful knowledge construction if the instructional designer has taken the curriculum and learner’s ability level into consideration.
Multimedia can be in different types of interaction. Schwier (1993) categorizes interaction as reactive, proactive or mutual depending upon the level of engagement experienced by the learner. Hannafin (1989) identifies five functions interaction can serve in independent learning materials. They are confirmation, pacing, inquiry, navigation and elaboration. Each function is expressed differently during instruction, depending on the level of interaction, and Schwier (1993, p. 168) provides one example of interaction obtained at each functional level of the taxonomy (see Figure 1).

Multimedia instruction needs to provide meaningful content for student learning. Teachers need to provide content which makes sense to the student. Effective learning relies on meaningful interactions between content and learners. Meaningful interactions require the learner to access that meaningful knowledge in order to relate it to new information (Zazelenchuk, 1997). As a result, instructors can help learners access the appropriate knowledge and integrate it with the new information being presented by designing meaningful content and providing the right interactions.

### Learner Control

Learner control is another important element to be considered when integrating multimedia into instructions. Doherty (1998) refers to learner control as the level of self-determination that the learner has in making decisions about his/her learning, and more specifically defines it as “the degree to which individuals control the path, pace, and/or contingencies of instruction” (¶ 3). Lepper (1985) indicates that learner control may increase feelings of competence, self-determination, and intrinsic interest. Since multimedia can help present information in a nonlinear or random access format, students can not only select what information to access and how to sequence the information in a manner that is meaningful to them (Lawless & Brown, 1997), but also make decisions about their own pacing and sequencing and follow through the interactive material during studying sessions (Sims & Hedberg, 1995).

Kinzie (1990) indicates that “exercising control over one’s learning can be in itself a valuable educational experience” (p. 6). Lawless and Brown (1997) emphasize that “learners within a multimedia environment must not only understand the information presented, but must also be able to identify what information will further enhance understanding, and how to access this information” (p. 121). Literature (Ross & Morrison, 1988)
reveals that allowing learners to select text density and problem themes can have a positive effect on both performance and the perception of learner control. In addition, allowing the users free access to information may meet the needs of the learner and also positively impact attitudes about using the medium, or allowing the students to follow a specified path of information, choosing to revisit the information or to proceed onto the next step (Lawless & Brown, 1997).

Lawless and Brown (1997) indicate that learner control can positively influence effectiveness and efficiency of learning. They summarize five basic author imposed control levels: browsing, searching, connecting, collecting and generating. They also indicate that these are hierarchically ordered on the basis of learner control and level of learner interaction. For example, browsing offers the least learner control and is least interactive, because generally learners browsing through a multimedia environment lack specific intention or a defined goal, while generating allows students to go beyond controlling and sequencing the instruction to contribute to the instructional database.

While some learner control can motivate students, too much can be confusing (as cited in Litchfield, 1993). Learner characteristics such as prior knowledge and attitude can have a profound effect on knowledge acquisition in learner controlled environments (as cited in Lawless & Brown, 1997). Snow (1980) indicates, “Learner control cannot be expected to overcome the persistent fact that individual characteristics not under the control of the individual will determine to a significant extent what and how much that individual will learn in a given instruction setting” (pp. 152-153). Hazen (1985) suggests that the optimal degree of learner control should be determined by learner characteristics, the nature of the content, and the complexity of the learning task.

Some students may not be able to make effective use of learner control. In order to help learners make decisions over their own learning and build effective learning strategies, Jo (1993) provides the following recommendations: for learner control to be integrated into the design of instruction:

- Control options should be clearly labeled to help learners use control options effectively.
- Immediate feedback, continuous advice on learners’ on-going progress and summaries of their uses of control options should be presented to help learners make “informed decisions” about their own learning.
- Basic requirement over important instructional components should be provided to learners in order to assure that they do not bypass the components.
- Prior to instruction, pre-training should be provided to learners to help them become familiar with the novel learning system with control options, perform conscious cognitive information processing, and understand objectives, procedures and values involved in building their own learning strategies (as cited in Jo, 1993).

EMERGING TRENDS AND ISSUES FOR MULTIMEDIA INSTRUCTION

The innovation of information and communication technologies (ICTs) has challenged traditional teaching and learning models and practices. The concept of e-learning has been growing rapidly and has greatly impacted on our educational system. E-learning fundamentally refers to educational processes that utilize information and communication technologies to mediate asynchronous as well as synchronous learning and teaching activities (as cited in Jereb & Smitek, 2006). The term of e-learning is often used interchangeable with computer-mediated learning, distributed learning, online education, web-based learning, virtual learning, networked learning, and distance learning (Jereb & Smitek, 2006). Since e-learning depends heavily on the digital platform
of multimedia to present the information, the use of multimedia technology is critical for the application of e-learning strategies. E-learning pedagogical strategies have a profound impact on how educators approach and engage students in the process of teaching and learning. Planning effective multimedia instruction in e-learning represents a major challenge for instructors to ensure that the media match the content and delivery of e-learning successfully.

Educational uses of multimedia cannot go unnoticed in today’s classrooms. Multimedia instruction provides excellent opportunities for creating engaging learning environments, and new technologies and more and more educational websites become available every day. New media such as Web 2.0, blogs, wiki, YouTube, and podcasting have become pervasive, and are becoming an integral component of learning environments. New media can help students acquire creative, critical, communicative, and collaborative skills. The growing popularity of these new media suggests that educators will need to conceptualize these new possibilities of emerging technologies and incorporate them into the teaching and learning environment. But much of the new media, like the Internet, are not strictly regulated, and much of the content may not be suitable for classroom setting. Guidelines that are controlled and age-appropriate must be used for the selection and introduction of unregulated media; this task becomes the responsibility of individual educational institution and individual teachers. But unless the media is a meaningful and beneficial addition to the educational environment, it should not be used.

CONCLUSION

Horng, Hong, Chanlin, Chang, and Chu (2005) indicate that multimedia use is one of the most important strategies of creative instruction. Multimedia not only has enormous potential for enhancing the learning, but it also provides learners with varying levels of interactivity. To benefit from multimedia technology, teachers have to actively engage students in the presentation of information, and not just let the students become passive observers. Because teachers are the key to providing quality computer and interactive instructional media experiences for students, the instructional materials they develop have to make the best use of multimedia technology within the framework of educational theories and learning principles. Lawless and Brown (1997) emphasize, “We have to be more cautious not to make the instructional system fit the technology, but make the technology fit the instructional systems and formats that have been demonstrated to be effective. Technology is not effective learning in and of itself, but only provides a forum for effective learning” (pp. 127-128).

Although today’s multimedia technology provides exciting possibilities for creating quality learning experience and outcome, there will only be a minimal change impact if multimedia cannot be integrated with curriculum. Good teaching and real learning have thus become more important. Biggs (1999) states, “there is no single all-purpose best method of teaching. Teaching is individual.” (p. 2) Multimedia can permit greater individualization if learning principles and strategies can be applied effectively. As the use of multimedia grows in education, multimedia pedagogical strategies will have a profound impact on how educators approach and engage students in the process of teaching and learning. This chapter highlighted some of the principles and strategies for integrating multimedia into the instructional setting, and provided some guidelines for teachers using multimedia instruction in the classroom. The demand for making good use of multimedia to the best advantage for more effective and meaningful learning is continuously challenging educators because of the rapid evolution of multimedia technology. Despite the dynamic nature of the instructional environment and the rapid growth of multimedia technology, the impact multimedia
technology will have in the educational environment depends on how well it is integrated to complement an excellent curriculum and excellent teaching based on sound educational theories and teaching pedagogy.

REFERENCES


Revisit Planning Effective Multimedia Instructions


**KEY TERMS AND DEFINITIONS**

**Multimedia**: The use of innovated technology to integrate text, graphics, animation, video and audio to transmit information.

**Multimedia Instruction**: Computer-based guidance that involves the use of diverse types of media, such as presentations, web-based guides and online tutorials, in order to convey an instructional message.

**Simulation**: An interactive multimedia application device intended to imitate a real life situation and permit the user to partake and experience in a risk-free environment.

**Virtual Reality**: An interactive computer-based technology that allows the user to execute/perform actions in Multi-dimensional setting.

**Synchronous**: A method of two-way transmitting data in which the parties present in the same time and space. An example of synchronous communication is a Chat room.

**Asynchronous**: A method of two-way transmitting data in which the parties present in the different time and space. An example of asynchronous communication is e-mail.

**Computer-Assisted Instruction (CAI)**: Primarily refer to the use of computer(s) to present instruction to students. CAI is designed to help students learn new materials through interacting with the computer and students can progress learning with their own speed.

**E-Learning**: E-Learning is the use of network technology (broadly, the “Internet”) to design, deliver, select, administer, and extend learning. Components of Internet-enabled learning can include content delivery in multiple formats, management of the learning experience, and a networked community of learners, content developers and experts.
## APPENDIX A: NATIONAL EDUCATIONAL TECHNOLOGY STANDARDS (NETS)

### NETS for Teachers: The Comparison Chart of the 2000 and 2008 ISTE Technology Standards

<table>
<thead>
<tr>
<th>NETS for Teacher 2000</th>
<th>NETS for Teachers 2008</th>
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</thead>
</table>
| **I. Technology Operations and Concepts**  
Teachers demonstrate a sound understanding of technology operations and concepts. Teachers:  
A. demonstrate introductory knowledge, skills, and understanding of concepts related to technology (as described in the ISTE National Educational Technology Standards for Students).  
B. demonstrate continual growth in technology knowledge and skills to stay abreast of current and emerging technologies. | 1. **Facilitate and Inspire Student Learning and Creativity**  
Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments. Teachers:  
a. promote, support, and model creative and innovative thinking and inventiveness.  
b. engage students in exploring real-world issues and solving authentic problems using digital tools and resources.  
c. promote student reflection using collaborative tools to reveal and clarify students’ conceptual understanding and thinking, planning, and creative processes.  
d. model collaborative knowledge construction by engaging in learning with students, colleagues, and others in face-to-face and virtual environments. |
| **II. Planning and Designing Learning Environments and Experiences**  
Teachers plan and design effective learning environments and experiences supported by technology. Teachers:  
A. design developmentally appropriate learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners.  
B. apply current research on teaching and learning with technology when planning learning environments and experiences.  
C. identify and locate technology resources and evaluate them for accuracy and suitability.  
D. plan for the management of technology resources within the context of learning activities.  
E. plan strategies to manage student learning in a technology-enhanced environment. | 2. **Design and Develop Digital-Age Learning Experiences and Assessments**  
Teachers design, develop, and evaluate authentic learning experiences and assessment incorporating contemporary tools and resources to maximize content learning in context and to develop the knowledge, skills, and attitudes identified in the NETS. Teachers:  
a. design or adapt relevant learning experiences that incorporate digital tools and resources to promote student learning and creativity.  
b. develop technology-enriched learning environments that enable all students to pursue their individual curiosities and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress.  
c. customize and personalize learning activities to address students’ diverse learning styles, working strategies, and abilities using digital tools and resources.  
d. provide students with multiple and varied formative and summative assessments aligned with content and technology standards and use resulting data to inform learning and teaching. |
| **III. Teaching, Learning, and Curriculum**  
Teachers implement curriculum plans that include methods and strategies for applying technology to maximize student learning. Teachers:  
A. facilitate technology-enhanced experiences that address content standards and student technology standards.  
B. use technology to support learner-centered strategies that address the diverse needs of students.  
C. apply technology to develop students’ higher-order skills and creativity.  
D. manage student learning activities in a technology-enhanced environment. | 3. **Model Digital-Age Work and Learning**  
Teachers exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society. Teachers:  
a. demonstrate fluency in technology systems and the transfer of current knowledge to new technologies and situations.  
b. collaborate with students, peers, parents, and community members using digital tools and resources to support student success and innovation.  
c. communicate relevant information and ideas effectively to students, parents, and peers using a variety of digital-age media and formats.  
d. model and facilitate effective use of current and emerging digital tools to locate, analyze, evaluate, and use information resources to support research and learning. |
<table>
<thead>
<tr>
<th>NETS for Teacher 2000</th>
<th>NETS for Teachers 2008</th>
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<tbody>
<tr>
<td>IV. Assessment and Evaluation</td>
<td>4. Promote and Model Digital Citizenship and Responsibility</td>
</tr>
<tr>
<td>Teachers apply technology to facilitate a variety of effective assessment and evaluation strategies. Teachers:</td>
<td>Teachers understand local and global societal issues and responsibilities in an evolving digital culture and exhibit legal and ethical behavior in their professional practices. Teachers:</td>
</tr>
<tr>
<td>A. apply technology in assessing student learning of subject matter using a variety of assessment techniques.</td>
<td>a. advocate, model, and teach safe, legal, and ethical use of digital information and technology, including respect for copyright, intellectual property, and the appropriate documentation of sources.</td>
</tr>
<tr>
<td>B. use technology resources to collect and analyze data, interpret results, and communicate findings to improve instructional practice and maximize student learning.</td>
<td>b. address the diverse needs of all learners by using learner-centered strategies providing equitable access to appropriate digital tools and resources.</td>
</tr>
<tr>
<td>C. apply multiple methods of evaluation to determine students’ appropriate use of technology resources for learning, communication, and productivity.</td>
<td>c. promote and model digital etiquette and responsible social interactions related to the use of technology and information</td>
</tr>
<tr>
<td></td>
<td>d. develop and model cultural understanding and global awareness by engaging with colleagues and students of other cultures using digital-age communication and collaboration tools.</td>
</tr>
</tbody>
</table>

| V. Productivity and Professional Practice                  | 5. Engage in Professional Growth and Leadership                                         |
| Teachers use technology to enhance their productivity and professional practice. Teachers: | Teachers continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community by promoting and demonstrating the effective use of digital tools and resources. Teachers: |
| A. use technology resources to engage in ongoing professional development and lifelong learning. | a. participate in local and global learning communities to explore creative applications of technology to improve student learning. |
| B. continually evaluate and reflect on professional practice to make informed decisions regarding the use of technology in support of student learning. | b. exhibit leadership by demonstrating a vision of technology infusion, participating in shared decision making and community building, and developing the leadership and technology skills of others. |
| C. apply technology to increase productivity.              | c. evaluate and reflect on current research and professional practice on a regular basis to make effective use of existing and emerging digital tools and resources in support of student learning. |
| D. use technology to communicate and collaborate with peers, parents, and the larger community to nurture student learning. | d. contribute to the effectiveness, vitality, and self-renewal of the teaching profession and of their school and community. |

| VI. Social, Ethical, Legal, and Human Issues               |                                                                                       |
| Teachers understand the social, ethical, legal, and human issues surrounding the use of technology in PK-12 schools and apply those principles in practice. Teachers: |                                                                                       |
| A. model and teach legal and ethical practice related to technology use. |                                                                                       |
| B. apply technology resources to enable and empower learners with diverse backgrounds, characteristics, and abilities. |                                                                                       |
| C. identify and use technology resources that affirm diversity. |                                                                                       |
| D. promote safe and healthy use of technology resources.   |                                                                                       |
| E. facilitate equitable access to technology resources for all students. |                                                                                       |
Chapter 9
Applications of Second Life

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ABSTRACT

Second Life is a massive three dimensional online virtual world with a complex and realistic digital landscape where individuals create and author avatars that interact with one another. Recognizing the potential of this virtual reality, the applications of Second Life are being examined by the business and educational communities. The following chapter will provide readers with a better understanding of Second Life; the applications and implications of Second Life for teaching, learning, and professional development training; project examples; best practices; a model for the development of education and/or training projects in Second Life; pitfalls and potential problems; how Second Life can offer a link- age between education, professional development training, and organizational development; and future directions for Second Life.

INTRODUCTION

The current impact of technological innovation extends farther and deeper than at any other time in our history and these advances have altered the very constructs of space and time and have changed visibility, making it global in scope (Buzzetto-More, 2006). Social networking has become a phenomenon and online socialization and virtual worlds are posed to continue to play a major role in Web 2.0 (Buzzetto-More, 2007) whereas social networking is becoming increasingly more intertwined in the lives of people with many individuals in society considering them as important and meaningful as face to face interactions (Buzzetto-More, 2008). As a result, and whether you are a user, the impact of online social networking cannot be ignored.

Online social networking is engendering a redefinition of the term community as the social software movement promotes virtual spaces which emerge as zones for information-sharing, collaboration, exploration, and community formation and exten-
Applications of Second Life

They are altering the human fabric of the World Wide Web and are quickly becoming the digital equivalent of hanging out at the mall for the millennium generation (Bell, 2006). Suter, Alexandar, and Kaplan (2005, p.49) explored the various dimensions of social software as including: “tools for augmenting human social and collaborative abilities; ...a medium for facilitating social connection and information interchange; and an ecology for enabling a system of people, practices, values and technologies in a particular local environment.”

Multi User Domains, better known as MUDs, have existed for well over a decade; however, this new generation of MUDs are complex three dimensional virtual worlds. They are a place for expression and imagination which still incorporate norms and practices that often mirror those of the material world (Crowe and Bradford, 2006). They have taken many shapes over the years and today have evolved into realistic and sophisticated realms often involving game play, the two largest being World of Warcraft® and Second Life.

World of Warcraft® is a type of MUD that is categorized as a massively multiplayer online role-playing game (MMORPG). All MMORPGs are skill based games that require players to control an avatar within a fantasy game-world that includes quests, interactions and/or fighting monsters. World of Warcraft® is a pay-based subscription service and as of October, 2008 World of Warcraft® had 11 million subscribers making it the world’s largest MMORPG (Blizzard Entertainment, 2008).

Currently, the focus in the virtual reality arena is Second Life, an advanced online virtual world where individuals create and author avatars. It is being presented as a highly immersive medium that can serve as an authentic, self directed, personal, and flexible means for delivering online education and professional development training (Conklin, 2007). It differs from MMORPGs like World of Warcraft® because it is does not present a competitive gaming environment. As a result, the usage of Second Life extends into business and educational pursuits. While many suggestions for the use of Second Life as a tool exist the question remains: Is Second Life merely a fad or is virtuality posed to have a permanent impact that changes the way we understand and define e-Learning and e-business?

WHAT IS SECOND LIFE?

Second Life is an expansive online world that first opened to the public in 2003. Growing exponentially, as of June 2008, it was inhabited by 14 million individuals from across the globe with approximately 500,000 resident logins a week and around 900,000 logins per month (Second Life Statistics, 2008). Second Life is privately-owned, partly subscription-based and resides in a large array of over 1,000 servers that are owned and maintained by Linden Lab which provides its users, which are known as residents, the various tools to create and modify their own identities as well as the world and economy around them.

According to Linden Lab, the creators and hosts of Second Life, (Linden Lab, 2008a) the Second Life world is best described as an immense digital landscape that is populated with interesting people, entertainment avenues, unusual experiences, and where opportunities abound. Residents can walk or fly, drive, or teleport to various places; communicate with others; participate in events; create, buy, sell, market, and trade objects with other residents; build real world-like facilities and environments; attend lectures and classes; and engage in experiential learning. Second Life supports an economy with a common currency (known as the Linden Dollar) in an open market (Linden Lab, 2008a). Residents can participate in the economy in a variety of ways including owning, building, and selling property as well by creating entrepreneurial endeavors. As of June of 2008, the total Linden Dollar L$ supply was $5,045,956,125 and there were approximately...
Applications of Second Life

Figure 1. Second Life Avatars (Image Courtesy of Second Life)

950,000 million square meters of land owned by residents.

Second Life offers 3-D modeling tools for the creation of virtual objects; however, residents can also import animation and sound, built using external software. Second Life supports a scripting language called Linden Scripting Language used to add autonomous behavior to objects such as birds or doors. An effective example is the island of Svarga, where the island’s ecological systems function continuously (including clouds, rain, sunshine, bees, birds, trees and flowers). Additionally, Linden Lab uses and supports a variety of open source languages including Apache, MySQL, and Squid.

The residents of Second Life are the digital representations of real people known as avatars. Avatars have been defined by Gerhard, Moore, and Hobbs (2004, p.5) as “user embodiment in a collaborative virtual environment.” Avatars first emerged in the 1980s and, in recent years, have been growing in popularity increasingly being used in ecommerce, social virtual environments, education, and even for dynamic geographically separated workplace meetings (Schroeder, 2002).

Avatars promote telepresence which is the feeling of “being there” in a virtual world (Schroeder, 2002, p. 3). A number of studies have shown that telepresence is an influential factor in online interactions that enhances the social, professional, communication, and educational experiences provided by collaborative virtual realities (Peterson, 2006; Gerhard et al., 2004). Additionally, the usage of avatars is promoted as a means to overcome the limitations of text-based computer mediated communications by providing users with a means to display, in real time, non-verbal communication cues and emotional states that normally act as regulators and facilitators in face to face interpersonal interactions (Peterson, 2006). This enables avatars to provide a means for individuals communicating virtually to identify, recognize, and evaluate others using familiar visible anthropomorphic elements (Nowak & Rauh, 2005). Furthermore, Roed (2003) found that people behave differently when communicating online compared to face-to-face situations displaying fewer inhibitions, less social anxiety, reduced self-awareness, increased honesty, and a greater willingness to divulge personal information. When Crowe and Bradford (2006) examined how young
people construct and maintained identities within virtual systems they found that the boundaries between the virtual and the material domains are porous. They explained that while virtual reality is a place for expression and imagination, it still incorporates norms and practices that often mirror those of the material world.

Second Life supports a variety of communication channels. In addition to the nonverbal communications that can be expressed by the avatar, there is semantic communications in the form of local chat, global instant messaging, email, and voice over internet chat. An additional means of communications in Second Life is through the arts. Residents can create statuettes, paintings, and drawings and the modeling tools included can support art forms that cannot exist in real life. Finally, prerecorded messages and musical performances are increasingly becoming a commonplace means of expression whereas residents stream live or recorded information over Second Life in a means that is similar to a Web cast.

Movement in Second Life is designed to be dynamic and engaging. While the most common means of moving is by foot which includes walking, running, jumping, and dancing; residents can also fly; ride in vehicles; and teleport. The view in Second Life is a third person perspective where movement is controlled by either mouse scroll or by using arrow keys.

When a new avatar is born in Second Life they are sent to Orientation Island to learn how to talk, walk, fly, teleport, and interact. Soon after joining, residents will begin receiving emails and instant messages inviting them to join groups and attend meetings many of which will include a link for teleporting.

As a highly immersive environment, Second Life can allow us to explore the surreal; for example the Virtual Hallucinations Project is a scary, educational immersion into the mind of a schizophrenic. The National Oceanic and Atmospheric Administration uses the Meteora Sim to replicate the reality of a tsunami, and Luctesa the home of the Van Gogh Virtual Starry Night allows residents to enter the canvas of this famed painting. Parsons (2008) likened Second Life to a series of virtual vacation destinations after she visited such exotic locations as ancient Rome where avatars where togas, sail on Cleopatra’s barge, visit Caligula’s palace, or explore the temple of Apollo.

For individuals interested in belonging to a community, there are over 222,000 groups to join including Buddhists; vampires; peaceniks; necromancers; gay surfers; friends of chaos and beauty; groups for Obama, Clinton, and McCain; Socrates café; and support for healing (Parsons, 2008). Essentially, if you can imagine a group, it probably already exists, if not, you can create it yourself.

The presence of religion is also rapidly growing in Second Life. In 2007, Life Church, a real world Christian ministry, started holding virtual meetings in Second Life by opening Experience Island. It was followed that same year by the building of an Anglican Cathedral. In 2008, Islam Online purchased land in order to create a place where both Muslims and Non-Muslims can perform the ritual pilgrimage of Hajji in virtual form and quickly saw 7 million visitors (Sky News, 2008).

Governments from across the globe are building a presence in Second Life beginning with the Maldives which was the first country to open an embassy, on Diplomacy Island. Other Countries that have opened embassies include Sweden, Estonia, Columbia, Serbia, Macedonia, the Philippines, Albania, and Malta. Additionally, Serbia began building Serbia Island which will feature the Nikola Tesla Museum, virtual information terminals of the Ministry of Diaspora, the Guča trumpet festival and the Exit festival (Wikipedia, 2008).

A number of public service organizations can be found in Second Life. For example, the United States Centers for Disease Control and Prevention’s uses Second Life to deliver podcasts on a range of health topics, for access to the CDC’s health library and for interviews with CDC researchers on sensitive topics such as HIV/AIDS.
Live sports entertainments has become popular in Second Life where residents are able to watch or participate in a variety of popular sporting events. Leagues have been introduced for football, soccer, boxing, and auto racing. Wrestling has even found its way into Second Life whereas one of the largest live entertainment organizations is Second Life Championship Wrestling puts on weekly shows, as well as daily exhibitions for spectators (Wikipedia, 2008).

Second Life (SL) has been propagated as a unique and flexible platform for educators and business professionals interested in e-learning, cooperative work, intercultural communications, experiential learning, simulation, new media studies, and corporate training acting as a globally networked virtual space (Education UK Island, 2008). SL can facilitate global alliances as well as provide a socially inclusive space for individuals with real world disabilities (Education UK Island, 2008).

Receiving its first major honor, in 2008, Second Life was acknowledged at the 59th Annual Technology & Engineering Emmy Awards for advancing the development of online sites with user-generated content.

BUSINESS APPLICATIONS OF SECOND LIFE

Second Life provides a unique forum for organizations to showcase and promote their efforts while reaching a diverse global audience, using means that cannot be conveyed using such traditional modes of communication as catalogues, brochures, and static websites. Additionally, the Second Life Grid supports a mechanism for experimentation with minimal risk. As a result, opportunities for organizational development abound in Second Life.

Meaningful information acquisition of customer information is a major stimulus to organizational engagement in Second Life. According to Turrow (2006), the type of activities occurring in virtual communities and social networking sites are excellent predictors of consumer behavior as well as for offer the means for the customization and personalization of marketing initiatives. Savage and Burrows (2007) added that these communities serve as data repositories that can be used by organizations for gathering readily accessible and highly valuable information about their populations.

The Second Life Grid is actively being explored by a number of prominent businesses as a forum for meetings and conferences, direct engagement with customers or constituents, presentations, product development, sales and marketing, recruiting and interviewing, customer research and feedback, product demonstrations, and corporate training and professional development (Linden Labs, 2008b). Additionally, there are a number of entrepreneurial enterprises operating within Second Life including: travel agencies, banks, retail outlets, event planning services, tattooing services, radio stations and magazines, car dealerships, news reporting services, tour guide operators, therapists, marketing firms, architectural design firms and etcetera resulting in a marketplace that supports millions of dollars in transactions monthly.

Currently, there are many examples of companies using Second Life and a variety of interesting success stories; however, for the purposes of this book, this chapter will explore projects that promote training, recruitment, and/or professional development. Some noteworthy examples include:

- AHG, a corporate training company, which has developed training simulations in Second Life using smart robots. These simulations cover such topics as communication /sales and working under pressure.
- The World Bank, attempting to reach a large global audience, and educate the public on

- The FutureWork Institute, a diversity training company, created an island in Second Life using it to make their presentations more interactive and entertaining. Audiences who have used FutureWork Island for corporate training include several Fortune 500 companies in industries ranging from network infrastructure, to defense and banking.

- Intel Corporation holds at least one event each week in Second Life which includes such activities as developer classes and presentations. Additionally, Intel uses Second Life as a forum to hear suggestions from users and to discuss various problems and propositions with the public.

- TMP Worldwide uses Second Life in order to give virtual tours to recruit potential employees where they are able tour the building and meet employees.

- US management consultancy Bain and Company invites potential MBA student interns to meet senior staff at online recruitment events.

- IBM Corporation uses Second Life to connect with business partners by hosting networking events, virtual conferences, training in their virtual innovation center, demonstrations, and announcements of news and updates (Linden Labs, 2008b).

Whether engaging in organizational or professional development training, the issue at hand is targeting, reaching, appealing to, and engaging people. Some tips for business organizations using Second Life include:

- Strategic targeting,
- Experimentation,
- Asking the right questions,
- Gathering meaningful feedback,
- Not letting the gaming element overshadow the professional agenda,
- Keeping things moving with minimal downtime,
- Encouraging and maintaining participation,
- Having well trained moderators and facilitators, and
- Creating experiences that do not overwhelm the low tech user and that, at the same time, engage the technophile.

EDUCATIONAL APPLICATIONS OF SECOND LIFE

The ivy covered walls that once marked the exclusive boundaries of academia have begun to crumble as a result of networked digital technologies. Technology has shown us that the focus of learning does not need to be confined to the realm of physicality but rather has become globally focused (McClintock, 1999).

In the area of teaching and learning, Second Life provides an alternative environment to support teaching and learning as well as formative and summative assessment enabling teachers to accommodate students with varying learning styles (Buzzetto-More, 2008). Learners in Second Life can be given opportunities to co-design, manage, and access curriculum in different ways as the nature of the Second Life offers students an opportunity to become more actively involved in designing and carrying out their own learning showcasing their work in an interactive 3D environment (Education UK Island, 2008).

Using Second Life to supplement traditional classroom environments provides new opportunities for enriching existing curriculum through authentic and flexible non linear learning experiences (Buzzetto-More, 2007). According to the Delphi Center at the University of Louisville (2008) the benefits of Second Life are that:
Applications of Second Life

- “Students are digital natives whose motivation may be boosted with technology
- Simulations are realistic and can provide difficult-to-create experiences
- Learning communities can be created to build social networks
- Links to resources both inside and outside of Second Life are available
- Peers from other educational institutions are already in Second Life
- Meetings and learning experiences that are fun and engaging are easy to conduct in Second Life” (2008).

Second Life can be used to promote international learning communities which open up a world of educational possibilities replete with symbolic interactions that cross geographic borders enabling educators and learners worldwide interact in experiences that cross cultural divides, encourage collaboration, develop broader perspectives, and foster intellectual discourse (Buzzetto-More, 2006).

Currently, Second Life usage can be found from middle through graduate school levels. At the college level, Stanford University and the University of Southern California use Second Life to explore human social interactions and how virtual worlds impact human interaction. Nottingham University explores the grieving process and the University of Maryland Eastern Shore explores issues of racial and gender bias. Exploring the virtual court room environment, Harvard Law School teaches its class, “CyberOne: Law in the Court of Public Opinion,” at Harvard and Berkman Island in Second Life simultaneously. Taking advantage of the simulation possibilities of the available free market economy of Second Life, the University of Houston’s Money and Design class tests their product development and entrepreneurial skills. The University of London in the U.K. and The University of Sunshine Coast in Australia are using Second Life to display the artwork of their students. Used for qualitative research, Ithaca College uses Second Life to meet with professionals in the fields of journalism, media, public relations, and advertising holding small group discussions, lectures, and receptions in an environment that has been entirely student built. Several institutions, including the Dublin Institute of Technology and Ohio University, use Second Life to give virtual tours. Virginia Tech has built a virtual library and Texas State, Montana State, and Ohio University have virtual universities offering online courses in Second Life.

In a partnership, the Princeton Review and Ohio University have teamed up to offer SAT review sessions in Second Life. Finally, interested in the pedagogical possibilities of Second Life, St John’s University and Huddersfield University are both exploring the use of virtual worlds for teaching and learning (Linden Labs, 2008c).

For educators teaching young students, Teen Second Life is the area specially geared to younger users offering both open and closed access estates. Teen Second Life supports a collaborative community of real life educators seeking to support, inspire and train other teachers interested in using the Teen Second Life interface to educate students, ages 12-17, focusing on issues of pedagogy and assessment (SimTeach, 2008). When examining the Second Life grid, there are a number of excellent and successful educational projects. EdBoost is a project where students script the contents of the island and adults teach computer programming and the Eye4YouAlliance gives opportunities to teens and approved adults to create and collaborate through a variety of educational events. An early pioneer, Suffern Middle School in New York, has helped over four hundred students use Teen Second Life for several unique projects including a virtual museum project and mock trials in a model courtroom. Global Citizenship in a Virtual World is a middle school project that encourages kids to create exhibits and interact with other teens from around the world about pressing global issues. Also sponsoring youth communities linking young people from across the globe and encouraging them...
to explore social and world issues are Global Kids Island, Metaversa Island, and Skoolaborate. Connecting kids from different countries through the arts is Kidz Connect Island and Project Cabrillo fostering such activities as digital storytelling, theatre, streaming video, architectural design, digital imagery, and etcetera. PacRim X is a unique collaborative project between two school districts, one in California, and one in Japan. Catering to English language learners the British Council Isle project is a representation of Great Britain purposed to encourage teens to congregate and engage in a range of activities including games, quests, and treasure hunts based on linguistic clues (SimTeach, 2008).

While the ideas for the usage of Second Life seems limitless, an investigation into current practices and capabilities indicates that the best projects are pedagogically thoughtful, taking into account what the medium has to offer as well as the specific population of learners. Because of the complexity involved with the usage of Second Life, the author suggests that educators, before entering into an endeavor, begin by becoming a resident of Second Life engaging in their own educational scavenger hunt.

Some best practices for using Second Life as an educational medium include:

- Making good of the dynamic aspect of Second Life
- Fostering exploration and critical inquiry
- Encouraging reflection
- Making experiences dynamic
- Collecting and learning from feedback
- Adherence to sound pedagogical techniques
- Creating learning experiences that speak to the targeted learning population
- Responding to things that do not work and making changes as needed

Global Kids Incorporated (2007) produced a best practices document which, although geared towards Teen Second Life users, has implications to the larger educational community. The report addressed four areas of best practices: working with teens, bringing a youth development model into Second Life, using Second Life for real-world education, and bringing content into Second Life. These suggestions are summarized below.

A. Best Practices For Working With Teens
   1. Use real world content to address real issues
   2. Build to the audience
   3. Use multiple locations
   4. Have activities both in and out of Second Life
   5. Use multiple communication channels
   6. Encourage students to start communicating without waiting for others (it is ok to be first)
   7. Have all the tools ready

B. Best Practices For Youth Development
   1. Think globally, act locally.
   2. Customize content to what will engage the young
   3. Create your own culture
   4. Support young leaders.

C. Best Practices For Real World Education
   1. Use performance based assessment
   3. Taking advantage of the benefits of Social Networking
   4. Have Teachers act as a facilitator giving students authority
   5. Use to encourage peer mentoring
   6. Scale projects to fit resources, time, and other constraints
   7. Look for and take advantage of meaningful Second Life resources
   8. Have alternative plans in case of technology failure

D. Best Practices For Second Life Activities
   1. Interactive workshops
Applications of Second Life

2. Photo shows
3. Scavenger hunts
4. Quizzes
5. Building contests
6. Guest speakers
7. Movie screenings
8. Role playing
9. Architectural Development
10. T-shirts and accessories
11. Panel discussions and debates
12. Inventions (Global Kids Incorporated, 2007)

POTENTIAL PITFALLS

Virtual Worlds are not without their deterrents. As early as 1997, Sherry Turkle warned us about the potential pitfalls of virtual worlds where she has explained that these venues can serve as valuable spaces for identity play with minimal risk for those who are shy or afraid of intimacy. At the same time, Turkle (2004) said that the possibility of losing one’s sense of ‘self’ within cyberspace is a major concern (Turkle, 2004). Furthermore, lonely and depressed individuals may develop a preference for online social interaction or be susceptible to cybercrime, which can result in negative outcomes (Caplan, 2003).

A variety of cybercrimes have been reported in Second Life including child pornography, prostitution, stalking, rape and/or assault, and various forms of fraud (Harrison, 2007). While much of the crime in Second Life is quietly dealt with by Linden Lab, the handful of child pornography cases has been highly publicized and included both real life photos and virtual simulations. As a result, child pornography combined with the plethora of erotic entertainment and virtual prostitution has become a major concern to parents.

Issues of fraud in Second Life are not uncommon with a number of residents being victims of pyramid schemes. Furthermore, instances of tax evasion, gambling, prostitution, and organized crime and money laundering are fairly common (Harrison, 2007). Trying to clean up its act, Second Life has banned some forms of gambling and unregulated banking.

Additionally, many are questioning the educational efficacy of Second Life proclaiming it to be an environment with too many distractions; too little educational resource; accessibility and reliability issues on school, university, and many business computer networks; too many risks and pitfalls; and where quality assessment is difficult (Buzzetto-More, 2008).

SECOND LIFE DEVELOPMENT MODEL

To aide educators and trainers in the development of Second Life projects a model has been developed and offered in this chapter. The model is being offered in both simplified and expanded formats in Figure 2 and 3 respectively. In both formats, there are four states of the development process: Participate, Locate and Evaluate, Develop, and Implement and Support. The simplified model represents these four processes while the expanded model compliments the four processes with 20 sub processes.

The first process in the model, Participation, includes creating an avatar and joining the Second Life community as resident. When joining the community, it is crucial that the educator or trainer is open to the experience, is explorative, and becomes a social and communicative participant. After some time has been spent browsing and participating in the larger community, the educator/trainer should engage in a training/education scavenger hunt where they explore the grid for projects of interest noted in this chapter as well as for additional projects.

During the second process, Location and Evaluation, individuals interested in developing projects in Second Life should gather noteworthy project examples. To the extent possible they
should try to participate in the projects that they discover. To get the fullest picture possible as well as to learn from the experiences of others, it is important to contact individuals who are engaged in the selected projects in order to solicit advice and/or guidance and to target successes, failures, planned and unforeseen outcomes, and discoveries. Projects should be critically and strategically evaluated with documentation of the evaluation. Finally, whether any of these projects can be joined or reused should be determined.

The third process is **Project Development**, and is the largest and longest process in the model including nine sub steps. The development should begin with some initial identification which begins with determining the specific purpose of the project supported by the development of performance based outcomes which can be measured and assessed. With the purpose and outcomes in mind the developer should analyze the future audience for the project which must include: age, technology backgrounds, technology skill levels, computer and internet access, interests, prior experiences with Second Life, and familiarity with content being taught. With the audience and outcomes in mind the concept should be developed which must be engaging, accessible, and appropriate for the content, audience, and outcomes. Because Second Life is global in nature and lends itself to partnerships and also to help ease the burden of creation, it is a good idea to seek partners who are interested in collaborating on the conceived project. With or without partners, the concept should be used to engage in concept mapping which should link planned activities with the identified outcomes and which will influence the design of the program. After the curriculum is designed the rubric which will be used to evaluate individual performance in the project, providing meaningful feedback to participants, should be created. With the curriculum and rubric in place, the actual experience in Second Life should be developed. This may, or may not, involve building a virtual space, preparing web casts, developing learner processes, creating maps and/or teleport, leveraging existing resources, finding
and selecting locations for events, and etcetera. Whatever the project, supplemental materials will need to either be gathered or created and a support mechanism should be put into place so that participants feel adequately supported and to minimize frustration.

The fourth and final process is **Implementation and Support** which involves pilot testing that includes the collection of, and response to, feedback; project promotion to desired potential participations; implementation with participants; continuous support; and the ongoing collection and response to feedback to support continuous program improvement. Although not noted in the model but in the spirit of the Second Life community, is the documenting and sharing of one’s experiences with the hope that one is able to inspire future projects.

The model offered has not been designed to deter, but rather to support individuals on their Second Life development journey. Far too many educational endeavors have gone abandoned in Second Life, often because the process was rushed and or common pitfalls were ignored. The model offered in this chapter is purposed to articulate and illustrate the processes and sub processes that should be followed in order to increase the likelihood of persistence and success.
HOW SECOND LIFE CAN OFFER A LINKAGE BETWEEN EDUCATION, PROFESSIONAL DEVELOPMENT TRAINING, AND ORGANIZATIONAL DEVELOPMENT

As a shared globally networked medium, Second Life presents a unique means for bridging gaps between education, professional development training, and organizational development. This must be an interchange with the ability for corporate trainers, professional development practitioners, and organizational developers to learn and seek guidance from one another. For organizational developers, Second Life provides access to communities of learners who can be incorporated into the organizational development process as a learning experience. Professional development practitioners can elicit information on the needs of emerging organizations from organizational developers as well as incorporate organizational development activities into training experiences. Perhaps most importantly, professional development practitioners have the opportunity to learn from the pedagogical concepts and experiences developed by educators who have an expertise in the creation of meaningful real world learning experiences as well as performance based assessment. At the same time, the professional community should be sharing created resources and the talent of experienced developers with educators, forming partnerships as well as encouraging the participation of teachers and learners in appropriate projects. Currently, the question is how do we create, develop, maintain, and fund these interchanges?

FUTURE DIRECTIONS

While Second Life is developing exponentially and garnishing tremendous interest across the globe from both the educational and professional sectors, the development of projects has been somewhat scattered and inconsistent making the search for quality exceedingly difficult. At the same time, unique and interesting projects can be located, some of which offer a new paradigm for the way we think about teaching, learning, organizational growth, and professional development training.

People wonder whether Second Life represents the future of the Web? Nino (2007) explains that virtual worlds like Second Life will not replace the Web but rather offer us something that the Web currently cannot offer just as the traditional Web offers things not inherent to virtual worlds. In the future, the usage of avatars and virtuality will become more commonplace in the Web; however, Nino (2007. p. 1) predicts that “As time goes, the two will become inevitably increasingly bridged together, extending and enhancing each-other, but there’s no sign that either one is going to eat the other…”

REFERENCES


Applications of Second Life


Applications of Second Life


**KEY TERMS AND DEFINITIONS**

**Avatar:** Digital representations of real people interacting in a virtual environment.

**Massively Multiplayer Online Role-Playing Game (MMORPGs):** Skill based games that require players to control an avatar within a fantasy competitive game world.

**Multi User Domains (MUDs):** Virtual spaces where individuals design a virtual persona (avatar) designed for information-sharing, collaboration, exploration, and community formation and extension.

**Second Life:** An advanced three dimensional online virtual world with a complex and realistic digital landscape (known as the grid) where individuals create and author avatars (known as residents) that interact with one another.

**Social Software:** Software that is designed to facilitate human communications and socialization.

**Teen Second Life:** An alternative version of Second Life designed for users 13-18.

**Telepresence:** The feeling of presence in a virtual reality that is promoted by an avatar.

**Virtual Reality:** A simulated online realm that incorporate practices that often mirror those of the material world.

**World of Warcraft©:** The world’s largest MMORPG with over 11 million paid subscribers.
INTRODUCTION

Like other types of learning, complex learning poses considerable challenges to learners due to its high demands on cognitive resources, prior knowledge and information processing (Grice, 1987; Schwartz & Bransford, 1998; Zheng, McAlack, Wilmes, Kohler-Evans, & Williamson, 2009). For many, prior knowledge activation resonates with meaningful learning (Surber & Schroeder, 2007; Winberg & Hedman, 2008). However, Schwartz and Bransford (1998) pointed out that learning can be “problematic if students do not have the relevant prior knowledge to begin with” (p. 475). Thus, how to effectively develop learners’ prior knowledge becomes a focal point for many researchers who explore the issues from the perspectives of cognitive structures (Kinchin, Hay, & Adams, 2000) and memory related instructional pedagogies (Lee, Plass, & Homer, 2006). Par with the prior knowledge research is the focus on cognitive resources in complex learning. Since complex learning requires a high degree of
element interactivity and there is a limitation to human capacity in dealing simultaneously with multiple elements (Baddeley & Hitch, 1974; Sweller & Chandler, 1991, 1994), it becomes critical that instruction address the issue of how to optimize learners’ cognitive resources in complex learning, particularly using modern learning technologies such as multimedia and hypermedia. Recent studies have successfully proved that appropriately designed multimedia instruction can significantly reduce learners’ cognitive load, hence enhance their abilities in complex learning (Mayer & Moreno, 2003; Zheng et al., 2009).

Among the efforts to improve learners’ abilities in complex learning is the application of concept map which is used as a tool to facilitate prior knowledge construction and activation as well as to optimize cognitive resources for deep learning. For example, Puntambekar and Goldstein (2007) observed learners who applied concept maps to science learning and found that learners who learned with concept maps were able to navigate better through the content and engage in deep learning. In a separate study, Roberts and Joiner (2007) used the concept map as an educational strategy to help a group of autistic students learn science. Results showed that students with concept mapping condition outperformed those without. Despite the fact that concept mapping has displayed proven educational benefits for learners, its use in schools and classrooms does not seem to be widespread (Kinchin, 2001). Kinchin concluded that school ecology (i.e., the existing curricular structure and the underlying philosophy of curriculum) as well as teachers’ epistemology may hinder the use of concept map in schools. Existing literature focuses on cognitive features, cognitive styles and differences between instructor provided and student generated concepts (Roberts & Joiner, 2007; Puntambekar & Goldstein, 2007; Shmaefsky, 2007). However, little is known about the effects of concept maps as a cognitive tool to influence learners’ learning, specifically before and after the learning takes place. This chapter offers a discussion of general research in concept mapping and theories that support such instruction. The chapter starts with defining the concept map and describing the status of practices and research in concept mapping, followed by a discussion on complex learning and cognitive issues involved in complex learning. Review of cognitive learning theories will be made with emphases on working memory theory (Baddeley, 1986), dual-coding theory (Paivio, 1986) and cognitive load theory (Sweller, 1988). Finally, an empirical study will be presented with discussions and suggestions for future research in concept mapping.

DEFINITION OF CONCEPT MAP

What is a concept map? The answer varies depending on how one looks at the role of concept maps. For some, it is an outline for understanding the content covered/to be covered. For others, it represents a network of knowledge for learning. According to Wikipedia.org (2008), “concept mapping is a technique for visualizing the relationships among different concepts. A concept map is a diagram showing the relationships among concepts” (¶1). Wang and Dywer (2006) defined concept map as “graphic representations of knowledge of a domain. A concept map consists of a set of nodes representing concepts, objects, or actions connected by directional links that define the relationships between and among those nodes” (p. 136). Based on the above definitions, we define the concept map as:

Concept maps are graphical ways of working with ideas and presenting information. They reveal patterns and relationships and help students to clarify their thinking, and to process, organize and prioritize. The visual representation of information through word webs or diagrams enables learners to see how the ideas are connected and understand how to group or organize information effectively.
Over the last ten years research on concept mapping has been varied. They include cognitive structures, cognitive style, and instructional delivery strategies. Although concept mapping has been explored as an assessment tool (Hay & Kinchin, 2008; Hough, O’Rode, & Terman, 2007), an instructional design tool (Novak, Ponting, & Bhattacharya, 2007), and a research tool (Van Zele, Lenaerts, & Wieme, 2004), for the purpose of this chapter we focus primarily on research relating to cognitive structures, cognitive style, and instructional delivery strategies. A discussion of each area follows.

**Cognitive Structures**

There has been a long history of interest in understanding human cognitive structures or typologies of thought. The ancient philosophers attempted to understand how humans think by introducing syllogism to capture the logic of thinking. Socrates’ famous rhetoric questions serve as another piece of evidence in which humans endeavored to understand the logic or structure of their thinking. It was not until 19th century with the usher-in of modern psychology then we began to understand the unique aspects of our mind and were able to explain such phenomenon as dreams, conscious and unconscious worlds. Modern medicine in 20th century greatly enhanced our knowledge of brain functions. Meanwhile, our understanding of human behavior advanced from explaining the external behavior to the internal working of the mind. Of sundry cognitive theories, Kinchin’s study on cognitive structures (see Kinchin & Hay, 2000; Hay & Kinchin, 2006) bears strong relevance to the concept mapping research.

According to Kinchin and Hay (2000), human thinking can be categorized as spoke, chain, and network which they called the cognitive structures of human thinking. Spoke thinking reflects a central to peripheral node relationship in which simple association exists with no understanding of processes or interactions. It is marked by a low level complexity. An example of spoke thinking would be recalling the concept of a table. The learner would think of the concept of table (i.e., the central node) by recalling its parts such as the legs and surface of the table (i.e., peripheral nodes). Oftentimes, an addition or loss of a peripheral node (e.g., one table leg) has little effect on the overview. Chain thinking shows a temporal sequence with logic relations between the nodes. It is hierarchical and accumulative. Thus, loss of one link can lose the meaning of whole chain. An example of chain thinking would be learning the auto assembly line in a large auto company. Network thinking has the highest level of complexity. It is marked by a high level of element interactivity where nodes are related in multiple ways. In network thinking, missing one link has little consequences as “other routes” through the network thinking are available, thus can compensate for the missing link. One important feature of network thinking is constant reorganization, a process that refines, organizes and prioritizes information. Complex learning reflects network thinking process in which the learner encounters high level element interactivity in learning and in which he/she analyzes, synthesizes and evaluates information through association and connection.

Kinchin and Hay (2000) proposed that instructional strategies should match cognitive structures. They asserted that concept maps can be used to reflect various types of cognitive structures in thinking and therefore promote learners’ learning. Based on the cognitive structures identified, Kinchin and Hay suggest three types of concept maps which bear the same nomenclatures as the cognitive structures: spoke, chain, and network. Figure 1 illustrate three types of concept maps described by Kinchin and Hay.

**Cognitive Styles**

One of the issues pertaining to research in learning is whether learners learn differently. It has been widely recognized that people are different in their
Using Concept Maps

Kirby (1979) conducted a review study on cognitive styles and found nineteen different cognitive style constructs: field-dependent/independent; analytical/non-analytical conceptualizing; impulsivity/reflectiveness; risk taking/caution; perceptive receptive/systematic intuitive; leveling/sharpening; cognitive complexity/simplicity; scanning/focusing; constricted/flexible control; broad/narrow category width (equivalence range); tolerance for incongruous or unrealistic experience; conceptual articulation (conceptual discrimination); and conceptual integration/integrative complexity. Recent studies indicate that individual difference significantly accounts for the variance in learners’ achievement (Cook, 2005; Danili & Reid, 2004; DeTure, 2004). In a study on student success in online distance education, DeTure found that self-efficacy and cognitive styles combined account for 29% of variances for student success. Similar findings were obtained by Bishop-Clark, Dietz-Uhler and Fisher (2006-2007) who concluded that personal type significantly predicted learners’ performance in web-based distance learning.

Research on the relationship between cognitive styles and concept maps is emerging. In an early study Lin and Davidson (1994) investigated learners’ performance in hypermedia learning. They examined the effects of field dependence/independence (FDI) and linking structure on learning. The linking structure resembles concept map with concepts, events, organizations, and people connected in a hypertext network. Results showed that 14.5% of the variance of performance was explained by linking structure type, FDI, and their interaction. Graff (2005) examined the relationship between concept mapping and analyst-intuition cognitive style in a hypertext learning environment. The author argued that concept maps reflect the way in which individuals process information and therefore it is possible that cognitive style might influence concept map drawings produced by hypertext users. The above research points to the fact that the study of concept mapping should take cognitive styles into consideration as they are likely to influence learners’ information processing in learning.
Instructional Delivery Strategies

As an instructional tool, the effects of concept mapping on learning have been studied, particularly the differences between concept maps provided by the instructor and generated by students (Jo, 2001; Smith & Dwyer, 1995; Wachter, 1993). Smith and Dwyer studied college students (n = 81) who were randomly assigned to three instructional treatments. The participants then interacted with their respective treatment and received individual criterion tests. Results revealed positive but not significant results for student use of the instructor prepared concept maps. In a later study by Wang and Dwyer (2006), the researchers examined the effects of three concept mapping strategies to facilitate student achievement which included concept matching, proposition identifying, and student self-generated concept mapping. The findings indicated that different concept mapping strategies had different instructional effects on student learning. The concept matching is effective in facilitating learning at a factual and conceptual level whereas the student generated concept mapping shows the highest demanding in learning.

Taken together, research on instructional delivery strategies in concept mapping has been primarily focused on the role of concept maps as being provided by instructor and generated by students. Results show that instructor provided concept maps can be effective in terms of helping students understand the relationships among facts, concepts, rules and principles. On the other hand, student generated concept mapping can be demanding but may enhance deep learning since such learning requires knowledge construction on the part of learners. As discussed elsewhere, existing research on concept mapping instructional strategy zeros in on the differences between instructor provided and student generated concept maps. Few studies have been done to investigate the effects of concept maps on prior knowledge construction and cognitive resources associated with complex learning. Before addressing this issue in detail, we will first provide an overview of the theoretical frameworks related to complex learning.

WHAT HAPPENS IN COMPLEX LEARNING

Complex learning involves the activation of multiple elements to comprehend rules and principles, understand relationships among various entities and solve problems. It differs from simple learning in that it requires a high level of mental effort. Consider two examples in which complex learning differs from simple learning with respect to element activation and mental effort induced. Learning vocabulary is an example of simple learning because the elements of the material to be learned do not interact with each other. For example, the words of train, run, and tracks are each an element. They can be learned in isolation from other elements. Thus, the mental effort involved in acquiring the above words is low. However, if the above words are learned at the syntax level such as the train runs on tracks, the elements of information that must be learned may be difficult to assimilate, because they cannot be acquired in isolation. In this case, elements may be the syntactic and semantic relations of each word to every other word. In the latter example, the mental effort involved in acquiring the above words is high. Let us look at yet another couple of examples to compare the differences between simple and complex learning. The first task is to learn the color of each plane (Figure 2a). In this learning task, there is no interaction between the elements. Each color can be learned in isolation. Thus, a low mental effort is required. The second task is to solve a complex problems in which learners have to consider multiple conditions simultaneously before a solution could be reached (Figure 2b). There is a set of conditions that restrict the
order and parking positions of airplanes. The learner has to consider all the conditions and then decided which flight would park at which gate without violating the conditions. Obviously, the second task is marked by a high level of element interactivity. It requires more mental effort and cognitive resources in learning.

The above examples reveal an important truth in complex learning, that is, the effectiveness and efficiency of complex learning is dependent on the proper management of cognitive resources in working memory. To better understand how cognitive resources are distributed and managed in the working memory, a review on relevant theories will be made with a focus on working memory (WM) theory, dual-coding theory, cognitive load theory and prior knowledge.

**Working Memory**

Baddeley and Hitch (1974) introduced working memory theory that explains how instant learning occurs in relation to memory capacity. They claimed that the WM consisted of three components; a central executive that is responsible for controlling active information and controlling attention and, controlling the two slave systems, the phonological loop and the visuo-spatial sketchpad. Baddeley’s WM theory provides a theoretical base for further exploration of how information is processed in learning. For example, Paivio’s (1986) dual coding theory and Mayer’s multimedia learning theory are both based on Baddeley’s model to illuminate human information process and related mental representations.

**Dual-Coding Theory**

Paivio (1986) suggested that the input information is processed through multiple sensory channels. For example, the verbal information is registered through the verbal channel whereas the nonverbal information such as images is registered through the nonverbal channel. According to dual coding theory, there are three levels of processing pertaining to incoming verbal and nonverbal information: representational, associative, and referential. The representational process refers to the connection between external object and internal representation of the object. The associative process means the activation of the information stored within the long term memory. Depending on the input stimuli, the activation process can be either in the verbal or nonverbal (e.g., visual) system. The referential process is the cross-reference process between the verbal and nonverbal systems. Research on dual coding practices suggests that pictures can be coded both visually and verbally, whereas words are believed to be far less likely to be coded visually (Paivio, 1991; Rieber, 1994).
Cognitive Load Theory

Although dual coding theory describes the cognitive process in terms of information encoding, it fails to address a very important issue in information process: human capacity to handle incoming information. In other words, how much incoming information should be delivered at the moment of learning? What is the optimal way to deliver the information so that the learner can efficiently encode the incoming information?

Studies show that working memory is very limited in both duration and capacity. Van Merrienboer and Sweller (2005) observe that working memory stores about seven elements but normally operates on only two or three elements. They also find that working memory can deal with information “for no more than a few seconds with almost all information lost after about 20 seconds unless it is refreshed by rehearsal” (p. 148). When working memory becomes overloaded with information, learning can be adversely affected (Paas, Tuovinen, Tabbers, & Gerven, 2003; Sweller & Chandler, 1994; Marcus, Cooper, & Sweller, 1996). According to Cognitive Load Theory (CLT), three types of cognitive load exist: intrinsic load, extraneous or ineffective load, and germane or effective load. The intrinsic cognitive load refers to cognitive load that is induced by the structure and complexity of the instructional material. Usually, teachers or instructional designers can do little to influence the intrinsic cognitive load. The extraneous cognitive load refers to the cognitive load caused by the format and manner in which information is presented. For example, teachers may unwittingly increase learner’s extraneous cognitive load by presenting materials that “require students to mentally integrate mutually referring, disparate sources of information” (Sweller & Chandler, 1991, p.353). Finally, the germane cognitive load refers to cognitive load that is induced by learners’ efforts to process and comprehend the material. The goal of CLT is to increase this type of cognitive load so that the learner can have more cognitive resources available to solve problems (Brunken, Plass, & Leutner, 2003; Marcus, et al., 1996).

The difficulty of a subject area is determined by both the number of elements that must be learned and the extent to which they interact. According to Sweller and Chandler (1994), the cognitive load imposed by the intrinsic nature of the material is determined solely by element interactivity, not by the total number of elements that must be assimilated. For instance, in science learning the learner not only must learn the concepts but also must understand the relationship between the concepts. The cognitive load associated with learning the concepts is low because the elements of the materials to be learned do not interact with each other whereas the cognitive load involved in learning the relationship between the concepts can be high because the learning not only taxes our limited processing ability but also our ability to assimilate large amounts of information into long-term memory over relatively short periods (Lee et al., 2006). Sweller and Chandler (1994) pointed out that materials with high degree of interactivity that would impose high intrinsic cognitive load are particularly susceptible to any extraneous cognitive load imposed by the manner of presentation. The extraneous cognitive load is imposed purely because of the design and organization of the learning materials rather than the intrinsic nature of the task. However, if the intrinsic element interactivity and consequent cognitive load is low, the extraneous cognitive load caused by instructional design may have little consequence on learning. In contrast, extraneous cognitive load is critical when dealing with intrinsically high element interactivity materials (Sweller & Chandler, 1991, 1994).

Prior Knowledge

Many adults must learn new and complex information throughout their lives. However, it can be difficult to teach them new skills when these adults
have very little prior knowledge; students need some prior knowledge when learning new concepts. Without prior knowledge, learners are limited in their ability to construct new knowledge (Potelle & Rouet, 2003). As a result, learning new concepts can be very difficult and very tiring (Novak, 1998). Schwartz and Bransford (1998) conducted a series of studies to show that learning suffers when there is a lack of prior knowledge. In three classroom studies, college students analyzed contrasting cases that consisted of simplified experimental designs and data from classic psychology experiments. The authors discovered that college students performed poorly when they had little knowledge about the psychological phenomena highlighted in the experiments. Two groups were formed: experimental and control groups. The experimental group was provided with lectures to give college students adequate prior knowledge before they analyzed contrasting cases. An interaction effect was obtained for the group, favoring experimental group. Wylie and McGuinness (2004) examined the relationship between text structure and prior knowledge. They defined the text structure based on a ranking by the authors and independent raters, which included compare/contrast, sequence, classification, enumeration, and generalization. They hypothesized that students’ ability to deal with different text structure could be compensated by their prior knowledge. Learners’ performance was measured by recall tests. Results showed that recall was high when texts were well structured and readers had high prior knowledge. The authors thus concluded that readers benefit most from texts that challenge pre-existing mental representations (i.e., prior knowledge).

The fact that prior knowledge has significant influence on learning (Potelle & Rouet, 2003; Schwartz & Bransford, 1998; Wylie & McGuiness, 2004) promotes researchers to further investigate the role of prior knowledge that is facilitated at different stages of learning. Brunye, Ditman, Augustyn, and Mahoney (2008) investigated relative efficacy of providing final stage diagrams for an assembly task before and after the assembly sequences. The purpose was to find out which would be more effective for learning: providing a schema as a foundation for later learning or reviewing the content learned by providing a diagram as schema reinforcer? Brunye et al. found that receiving a final-state diagram at the end of a sequence provided the most effective learning results as measured by free recall and order verification tasks. Brunye et al.’s study is significant in that (1) their study is one of few that examined the order of prior knowledge facilitation. That is, before and after learning; (2) their study challenges the traditional practice where prior knowledge is built and facilitated before new learning starts. Nonetheless, further research is needed to understand the specific role of prior knowledge facilitation in various learning situations. An extended example would be to examine the facilitation role of concept maps pertaining to prior and post learning.

**CONCEPT MAPPING REVISITED**

Research suggests that when new information is linked to relevant, pre-existing aspects of cognitive structure, learning becomes meaningful and effective instruction occurs. Ausubel (1968) proposed that the most important issue influencing learning is what the learner already knows that can be associated with new learning. He promoted the use of advance organizers to bridge the gap between prior knowledge and new knowledge. Using an advance organizer helps learners organize upcoming learning topics; this, in turn, gives the learner some meaning and the beginnings of a knowledge schema about the new concepts. Advance organizers introduce subsuming concepts that scaffold and enhance integration of new concepts (Ausubel, 1960). As one form of advance organizers, the concept map has gained attention and been widely applied in instructional and learning situations.
Using Concept Maps

Over the past several decades there has been substantial interest among educators in the use of concept maps and knowledge maps (Novak & Musonda, 1991). Concept and knowledge maps are spatial diagrams showing interrelationships among concepts as node-link groupings. They are visual advance organizers where concepts can be connected and associated with each other. The visual representations of concept maps are meant to represent the schema structures in the human mind. The benefits of concept maps have been well documented. In a recent meta analysis by Nesbit & Adesope (2006), it was found that studies comparing learning from concept maps to learning from text passages show that studying concept maps offers gains in learning outcomes averaging an effect size of 0.4. Moreover, significant effect size was found for concept maps that facilitate retention and knowledge transfer in learning. They ascribed the success of concept maps in learning to the unique instructional benefits that the concept mapping has brought to its learners, namely, conjoint retention, load reduction, and the connection between prior knowledge and new learning.

Conjoint Retention

Concept maps facilitate cognitive representation of the information in both verbal and visuospatial memory. The concepts and the relationship between concepts are visualized through relational indicators (e.g., texts, entity boxes and arrows) which enable learners to encode the incoming information through verbal and non-verbal sensory registers. According to Paivio’s (1986) dual coding theory, verbal knowledge and mental images reside in separate but potentially interlinked memory codes. Links between verbal and non-verbal (i.e., visuospatial) codes provide additional retrieval paths for both type of information. In other words, instructional tool like concept mapping facilitates information retention and retrieval through its unique information encoding processes.

Load Reduction

Since concept maps convey information using both visual and verbal formats, learners would be less overloaded in information processing. Studies show that one can easily become cognitively overloaded if the information is presented through a single channel, say, verbal channel (Mayer & Anderson, 1991; Mayer & Sims, 1994). Presenting the same amount of information through verbal and nonverbal channels would alleviate the load on the verbal channel and thus increase cognitive resources for learning. Additionally, the placement of nodes and their relationships may facilitate the load reduction “by reducing the visual or memory search required to distinguish or associate similar concepts” (Nesbit & Adesope, 2006, p. 418).

Connection between Prior Knowledge and New Learning

Meaning is derived from how people think, feel, and act through experiences. Meaningful learning involves activating sufficient prior knowledge that allows the learner to add existing meaning to new knowledge. Ausubel (1968) stated, “the most important single factor influencing learning is what the learner already knows. Ascertain that and teach him accordingly” (p. 34). The concept mapping bridges new material with prior knowledge by presenting a map that delineates the relationship among propositions, principles and events which resemble the knowledge structure existing in learners’ schemata (Kinchin & Hay, 2000).

In short, the concept map as an instructional tool is undergirded by several cognitive and learning theories. It represents the complex relationships in learning with visuals which enable learners to process information more effectively and efficiently. It creates a meaningful structure which alleviates the cognitive load induced in complex learning and onto which learners are able to map their prior knowledge. However, the cognitive benefits of concept mapping have yet
to be further tested, particularly with respect to the facilitating role of concept maps in learning. Although similar studies have been conducted to observe the facilitating role of prior knowledge in learning (Brunye et al., 2008), research on the facilitating role of concept maps is rare. The next section presents an empirical study that studied the facilitating role in concept maps in complex learning by observing the effects of concept maps before, during, and after learning.

**THE STUDY**

**Purpose of the Study**

The study was to investigate the effects of concept mapping on learners’ complex learning. It involved learning concepts and relationships in Type I diabetes. During the learning, learners had to associate and connect multiple elements to understand the relationships. Thus, a high level of cognitive load was induced. To reduce the cognitive load involved in complex learning, concept maps were introduced to visually present the relationships among the concepts. A hierarchical networking concept map was created. It was proposed that learners would learn more effectively with concept maps as opposed to learning without concept maps. Based on the literature reviewed, the following research questions were proposed as the basis for the study:

**Question 1.** Will students who learn with concept maps outperform those who learn without?

**Question 2.** Is there a difference among concept mapping that is provided before the text and after the text?

**Question 3.** Is there an interaction effect between the treatment (i.e., before, after and non-concept mapping) and gender?

**Participants and Procedure**

Twenty seven participants were recruited from a large Research 1 university. Of 27 participants, 48% \((n = 13)\) were males and 52% \((n = 14)\) were females. The participants’ age range expands from 21 to 69 with a mean of 40.07 \((SD = 13.99)\). Participants were first asked to fill out a demographic sheet containing information such as gender, age, and so forth. To control the variable of prior knowledge, participants were given a prior knowledge test. Those with high prior knowledge were excluded from the study. The remaining participants \((n = 27)\) were randomly assigned to three groups: the group that were provided with the concept map before reading the text, hereinafter called the *before* group; the group that were provided the concept map after reading the text, hereinafter called *after* group; and the non-concept map group, hereinafter called the control group. In the *before* group participants were given a concept map that described the relationship among the concepts and were expected to apply the concept map while reading the text about the diabetes. In the *after* group participants read the text first and were then provided with the same concept map as the *before* group. The control group received no concept map support. At the end of the learning unit, participants took a test that measured their comprehension. The entire study took about 10 to 30 minutes to complete. Each participant was given a consent form to sign before s/he participated in the study.

**Instrumentation**

A science text on the topic of diabetes was created by the second author. The text was reviewed by a focus group. Changes were made based on the feedback of the focus group. Further, comprehension questions were derived from the text and were again reviewed by the focus group. A color-coded, grouped concept map was created in an effort to help adults understand the concepts by creating
Using Concept Maps

Figure 3. A sample of concept map for Type I diabetes

![Concept Map]

the prior knowledge necessary for learning the new subject (Figure 3).

Results

All data analyses were performed with SPSS version 14. Two independent variables were identified: gender and group. The gender has two levels: males and females. The group has three levels: before, after and control groups. The dependent variable was the scores of comprehension test. The means and standard deviations of test scores for the three groups are presented as follows (Table 1).

Overall, groups with concept mapping treatment (before and after groups) outperformed the non-concept group (control group) (see Figure 4). That is, participants who saw the concept map after the text and participants who saw the concept map before the text did better than those who did not see the concept map. Interestingly, the before group outperformed the after group. This finding is consistent with the findings of Lee et al.’s (2005) study in which schematic prior knowledge was provided to help students learn complex content in science. It also supports Schwartz and Bransford’s (1998) proposition that providing prior knowledge before new learning improves overall efficacy and efficiency in learning.

Table 1. Means and standard deviations of test scores for three groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Scores</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>6.60(1.07)</td>
<td>5.74(1.85)</td>
</tr>
<tr>
<td>After</td>
<td>5.80(1.75)</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>4.42(2.29)</td>
<td></td>
</tr>
</tbody>
</table>

The analysis revealed a marginal significant difference among the groups, $F(2, 27) = 2.83, p = .08$. No significant difference was found for gender, $F(1, 27) = .56, p = .46$. Nor was there an interaction between gender and group, $F(2, 27) = 2.49, p = .11$. 

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**DISCUSSION**

Teaching complex learning can be challenging, especially learning requires multiple connections and associations to understand the relationship among the concepts, rules and principles. In this study, the difference between concept mapping and non-concept mapping was examined. Further, the idea of delivering concept maps before and after learning was tested. The following discussion focuses on the research questions proposed earlier.

**Concept Mapping vs. Non-Concept Mapping**

Results show that the concept mapping groups had higher mean scores in comprehension test than the non-concept mapping group. This confirmed research question one that learners who learned with concept mapping outperformed those who learned without concept mapping. This finding is consistent with literature which reports a general positive effect of concept mapping on learning (Hilbert & Renkl, 2008; Puntambekar & Goldstein, 2007; Tumen & Taspinar, 2007). The differences between the concept mapping and non-concept mapping groups can be explained by the cognitive load, cognitive resources and cognitive structures involved in complex learning.

Due to its visual representation of abstract concepts and relationship between concepts, concept mapping is believed to alleviate the cognitive load induced by complex learning. More importantly, the visual and text information presented by concept maps facilitates mental representation of the concepts. The similarity between concept maps and cognitive structures provides a viable path to access and comprehend complex information in learning (Hay & Kinchin, 2006; Kinchin & Hay, 2000). In this study the hierarchical network concept map was used to help learners understand the complex relationship illustrated in the learning material. It can thus be presumed that the visual presentation of the complex relationship as well as the mapping of concept maps to cognitive structures helped reduce the cognitive load involved in complex learning. They enabled learners to effectively allocate their limited cognitive resources to understanding, analyzing, synthesizing and evaluating the information rather than focusing on information rote memorization.

*Figure 4. Results of comprehension test for before, after and control groups*
Using Concept Maps

Concept Mapping Before and After the Learning

Research question two asks whether there was a difference between providing concept maps before and after new learning. The results of the study indicated that providing concept maps before new learning is more effective than providing them after the learning is completed. The difference may lie in the different functional roles the concept map plays before and after new learning. When the concept map is provided before new learning, it is used to build prior knowledge to bridge with the new learning. Thus, the role of concept maps is to make learning meaningful through a construction of prior knowledge. On the other hand, when the concept map is provided after new learning, it essentially functions as a summary of what has been learned. Although summary can be a powerful tool in reinforcing what the learner has just learned, it may become less functional if the learner did not capture the content in the first place.

Interaction between Treatment and Gender

Research question three examines the interaction between the treatment and the gender. It examined the difference between males and females, and whether such difference would affect the different strategies used in concept map learning. The results indicated a non-significant interaction between gender and treatment, \( F(2, 27) = 2.49, p = .11 \). Nonetheless, by looking at the trends in Figure 5, we observed an interaction for gender and treatment in control and before conditions. There was no interaction for the treatment and gender for both before and after conditions. However, males performed better than females in both before and after treatment conditions. The findings suggest that in many complex learning situations where traditional methods are used and where male students frequently fail to meet the requirements, concept mapping perhaps is an appropriate tool for improving their thinking process in complex learning.

Interestingly, both male and female students’ performance was improved after receiving the

Figure 5. Interaction between gender and treatment
treatment in which the concept map was provided before new learning. But they both performed less well when they received the concept map that was provided after new learning. The above findings indicate that effective learning occurs when concept maps are provided to build prior knowledge and schema before the new learning takes place.

FUTURE TRENDS

Concept maps as an instructional tool holds great promise for teaching and learning. This study presents initial evidence about the cognitive and instructional role of concept maps in learning. Further research is needed to understand the relationship between cognitive load and concept mapping by applying measures of cognitive load to learner performance, which enables us to determine the change of cognitive resources associated with concept map and non-concept map learning. Future research should investigate the relationship between individual differences (e.g., field dependent/independent) and concept mapping to understand how concept maps can be optimally used to meet the needs of all learners. Finally, it is suggested that researchers should examine the role of different concept map structures in learning in terms of matching with cognitive structures, reducing cognitive load, and meeting the needs of learners of different learning and cognitive styles.

CONCLUSION

Concept maps is considered a powerful tool to enhance learners’ learning through (1) matching cognitive structures with the structure of concept maps, (2) reducing cognitive load, and (3) increasing cognitive resources for much needed critical thinking in complex learning. The current study examined the instructional effects of concept mapping and non-concept mapping in complex learning. Results show that concept mapping can help improve learners’ learning. The findings of the study also reveal that providing concept maps before learning is more effective than providing them after learning. The study examined the gender and treatment interaction and found that males and females differed in the non-concept mapping and concept mapping before learning treatment. No interaction was found for concept mapping before and after learning treatments for both male and female students.

The study has contributed to the research of concept mapping by increasing our understanding of the role of concept mapping in various learning situations. It went beyond traditional research which primarily focuses on student-generated and instructor-provided concept maps by examining the instructional function of concept maps such as providing concept maps before and after new learning. Additionally, the study investigated the effects of concept mapping on individual learners from the vintage of gender and treatment. Educational practitioners may benefit from the findings of the study by developing their unique instructional strategies to use concept maps to meet the needs of their individual learners. Despite its initial findings, the study has several limitations. First, the study suffered from a lack of statistical power (i.e., small sample size) which led to statistical insignificance for the research questions. Next, the study showed a limited variability in subjects’ social and economic status which may constrain the generalizability of the results. Future research should increase its sample sizes with a more diverse population so the results become generalizable beyond existing findings. It is suggested that future study be extended to examine the pedagogical as well as cognitive aspects of concept maps, so that a more comprehensive and systemic approach can be taken to effectively integrate concept maps in teaching and learning.
REFERENCES


Kinchin, I. M. (2001). If concept mapping is so helpful to learning biology, why aren’t we all doing it? International Journal of Science Education, 23(12), 1257–1269. doi:10.1080/09500690010025058


**KEY TERMS AND DEFINITIONS**

**Concept Map:** Are graphical ways of working with ideas and presenting information. They reveal patterns and relationships and help students to clarify their thinking, and to process, organize and prioritize. The visual representation of information through word webs or diagrams enables learners to see how the ideas are connected and understand how to group or organize information effectively.

**Cognitive Structures:** Refer to patterns of human thinking processes which, according to Kinchin and Hay (2000), can be categorized as spoke, chain, and network. Spoke thinking reflects a central to peripheral node relationship in which simple association exists with no understanding of processes or interactions. It is marked by a low level complexity. Chain thinking shows a temporal sequence with logic relations between the nodes. It is hierarchical and accumulative. Thus, loss of one link can lose the meaning of whole chain. Network thinking has the highest level of complexity. It is marked by a high level of element interactivity where nodes are related in multiple ways. In network thinking, missing one link has little consequences as “other routes” through the network thinking are available, thus can compensate for the missing link. One important feature of network thinking is constant reorganization, a process that refines, organizes and prioritizes information.

**Complex learning:** involves the activation of multiple elements to comprehend rules and principles, understand relationships among various entities and solve problems. It differs from simple learning in that it requires a high level of mental effort. For example, learning vocabulary is a simple learning process because the elements of the material to be learned do not interact with each other. The mental effort involved in simple learning is low. However, if the learning involves syntax, the elements of information that must be learned may be difficult to assimilate, because they cannot be acquired in isolation. In this case, learning gets complicated which requires high level of mental effort due to its high degree of element interactivity.

**Cognitive Load:** According to Cognitive Load Theory (CLT), three types of cognitive load exist: intrinsic load, extraneous or ineffective load, and germane or effective load. The intrinsic cognitive load refers to cognitive load that is induced by the structure and complexity of the instructional material. Usually, teachers or instructional designers can do little to influence the intrinsic cognitive load. The extraneous cognitive load is referred to the cognitive load caused by the format and manner in which information is presented. For example, teachers may unwittingly increase learner’s extraneous cognitive load by presenting materials that “require students to mentally integrate mutually referring, disparate sources of information” (Sweller et al., 1991, p.353). Finally, the germane cognitive load refers to cognitive load that is induced by learners’ efforts to process and comprehend the material. The goal of CLT is to increase this type of cognitive load so that the learner can have more cognitive resources available to solve problems (Brunken, Plass, & Leutner, 2003; Marcus, et al., 1996).

**Prior Knowledge:** Prior knowledge refers to the knowledge which includes facts, concepts, rules, principles, and relationship between con-
Using Concept Maps

ccepts, rules, and principles, in a specific domain. This type of prior knowledge is stored in an individual’s schema. Learning suffers if learners lack sufficient prior knowledge. Without prior knowledge, learners are limited in their ability to construct new knowledge (Potelle & Rouet, 2003). As a result, new learning can be very difficult and very tiring (Novak, 1998).

**Working Memory:** Working memory is a theoretical framework that refers to the structures and processes used for temporarily storing and manipulating information. According to Baddeley and Hitch (1974), the working memory consists of two “slave systems” responsible for short-term maintenance of information, and a “central executive” responsible for the supervision of information integration and for coordinating the slave systems. One slave system, the articulatory loop, stores phonological information and prevents its decay by silently articulating its contents, thereby refreshing the information in a rehearsal loop. The other slave system, the visuo-spatial sketch pad, stores visual and spatial information. It can be used, for example, for constructing and manipulating visual images, and for the representation of mental maps. The sketch pad can be further broken down into a visual subsystem (dealing with, for instance, shape, color, and texture), and a spatial subsystem (dealing with location). The central executive system is, among other things, responsible for directing attention to relevant information, suppressing irrelevant information and inappropriate actions, and coordinating cognitive processes when more than one task must be done at the same time. Studies show that the working memory is very limited in both duration and capacity. The working memory typically stores about seven elements but normally operates on only two or three elements.
Chapter 11
Interface Design, Positive Emotions and Multimedia Learning

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ABSTRACT

In social psychology, “what is attractive is good” means that a physically attractive person is perceived to be more favorable and capable. In industrial design, the interface is one of the three elements that influence users’ experience with a product. For multimedia learning, does the interface design affect users’ experience with learning environments? Does attractive interface enhance multimedia learning? Research in multimedia learning has not yet sufficiently investigated this issue. In this chapter, I propose that attractive interface design does indeed promote multimedia learning. This hypothesis is based on the review of the following theories and related empirical studies: 1) an interface impacts a user’s experience; 2) beautiful interfaces induce positive emotions; 3) positive emotions broaden cognitive resources; and 4) expanded cognitive resources promote learning. The Model of Emotional Design in Multimedia Learning is proposed to highlight how emotions regulate multimedia learning. Suggestions regarding designing attractive interfaces are provided.

INTRODUCTION

Multimedia learning refers to learning from multimedia design, which is the presentation of materials both in words and pictures. Multimedia design has been widely used in educational settings. Research on multimedia learning has been looking at how to design effective and efficient multimedia environments. For example, in The Cambridge Handbook of Multimedia Learning (Mayer, 2005), thus far the most comprehensive research on multimedia learning, 17 multimedia learning principles are presented, for example, spatial contiguity principle, temporal contiguity principle, coherence principle, modality principle, and redundancy principle. All of these principles are about the design of text, audio and video, each of which is assumed to be a multimedia design element that affects multimedia learning.
Interface Design, Positive Emotions and Multimedia Learning

outcomes. Unfortunately, the assumption is only partially true when the design is targeted for one group of learners. In reality, the idea of “One size fits all” probably never works. Besides the design of the multimedia learning program, it is critical to consider the roles of both multimedia designers and learners when talking about the quality of multimedia learning. Multimedia designers determine other aspects of interface design in addition to texts, audio and video.

Interface design refers to designing the interaction between a human and a machine (Raskin, 2000). The interface design induces certain emotions from users while they interact with the design. In other words, interface design is the visible surface that users experience while interacting with a design, while emotions are the underlying, invisible media between the users and the design. Research on emotions indicates that emotions play as important a role as cognition does in learning. It is widely agreed that positive emotions enhance cognitive activities, although the cognitive activities do not necessarily entail learning or multimedia learning. Therefore, when talking about the quality of multimedia learning, we must address the issue of how the interface design affects multimedia learning and should consider the emotions induced from experiencing the multimedia design. The discussion in this chapter helps to identify interface design and emotions as influences in multimedia design that is not subsumed by the influences on efficiency and effectiveness that have traditionally been investigated by multimedia learning researchers.

The following section explains the theoretical framework of how interface design affects users’ experience as well as their emotional states, especially how positive emotions influence cognition, and how changes in cognition regulate multimedia learning. Based on the theoretical framework, the Emotional Design Model in Multimedia Learning is proposed. Since positive emotions facilitate cognitive activities, as suggested by the theoretical framework, design features that intend to induce positive emotions are discussed. Future trends in research of emotional design in multimedia learning are also discussed.

BACKGROUND

Interface design is the first thing users experience when interacting with a multimedia design. Emotions are induced before initiation of cognitive activities to process in users’ brains. In other words, interacting with the interface design induces emotions and also activates cognitive activities from users. Emotional change is a rapid activity, preceding the cognitive activities. Norman (2004) proposes a theoretical framework to explain how interacting with an interface design affects users’ emotions, and also suggests that attractive designs induce positive emotions from users. Fredrickson’s (1998) positive emotion theory elucidates how positive emotions facilitate cognitive activities. The goal of multimedia learning research is to afford effective and efficient learning experience. The question we should ask is: Do positive emotions promote multimedia learning? Mayer’s cognitive theory of multimedia learning explains the general process of multimedia learning. One of Mayer’s assumptions is that working memory has a limited capacity, but he does not consider the possibility that positive emotions broaden cognitive resources. Does it mean that positive emotions promote multimedia learning by expanding the capacity of working memory? The discussion is illustrated in the following figure by connecting the four theories, which are combined to form the conceptual framework for the chapter. The details of each theory and the connections between these theories are explained in the following section.

How does interface design affect learners’ experience in a multimedia learning environment?

Norman (2004) proposes a framework to describe what happens when users interact with a design. According to Norman, a design presents three aspects to its users: the attractiveness,
usability, and the reflective images, each of which induces different emotions from users. Attractiveness is a result of the visceral level activity in the brain, users’ response to the appearance of the design, which results in taste-based emotions such as attractiveness or unattractiveness. Visceral design, the design of a product’s appearance, has been proposed to match the visceral activity in the brain. Usability is determined by the brain level that processes everyday behaviors, and induces goal-based emotions, e.g., satisfaction, distress, optimistic expectation, worry, relief, frustration, and disappointment. Behavioral design concerns how easy the design is to use. Research (Kurosu & Kashimura, 1995; Tractinsky, 1997; Tractinsky, Katz & Ikar, 2000) indicates that the interface aesthetics of a design positively impacts its perceived usability. The reflective image is the result of reflective activity in the brain, which induces standard-based emotions such as admiration, gratitude, pride, anger and resentment.

Ortony’s (2003) theory is similar to Norman’s in the sense that both are based on the framework that explains users’ emotional response when users interact with a design. The key difference is that Ortony puts more emphasis on the factors that induce users’ emotions. He points out that the designers’ motivation in designing a product also determines users’ emotions in addition to the users’ approach. He categorizes designers’ motivation as indifference, prevention, and promotion. When designers are indifferent, it is possible that no emotions will be induced from users, except perhaps by accident. Ortony does not include emotions induced by accident in his theory. When designers aim for prevention, the product will probably not induce emotions from users, as these are the result of design. It is when designers aim for promotion that the product is most likely to induce emotions from users, in this case by design.

In summary, both Norman (2004) and Ortony (2003) suggest that the interface design induces emotions from users. Experimental studies are available to support the argument (Klein, Moon & Picard, 2002; Kurosu & Kashimura, 1995; Lester et al., 1997; Tractinsky, 1997; Tractinsky, Katz & Ikar, 2000). For example, Desmet (2002) defines 41 design-related emotions and the factors that elicit these emotions. Attractiveness, one of the design-related emotions, is induced by one specific feature of the interface or by the overall appearance. The underlying assumption is that attractive interface induces positive emotions, which is consolidated in his later research.

**What is Attractive is Good!**

Attractiveness in daily language corresponds to aesthetics in philosophy, so a design that represents fun, cuteness, and includes color may be considered aesthetic if the user likes it. Since experiencing a multimedia design induces certain emotions from users, does attractive interface design induce positive emotions from users as suggested by Norman’s (2004) theory? LeDoux (1982) proposes a dual-processing theory for visual images. After a visual design registers in the brain, it is processed either in the format of unconscious emotions or in a detailed perceptual analysis. Both processes happen in two different regions of the brain, the thalamo-amygdala pathway and the cortical pathway. It means that a visual design induces both emotional responses
and cognitive activities in the brain. On the other hand, research on visual design indicates that users form the emotional state of like while considering a design as attractive. Like is one category of positive emotions. This phenomenon is supported by the implicit personality theory in social psychology (Schneider, 1973), which explains how human beings perceive other people. The assumption of the theory is that human beings are “naïve scientists,” actively perceiving their surroundings. The process of perceiving other people includes describing the attributes of personality that an individual believes others to possess, predicting the relations between these attributes, and explaining why one person behaves in certain ways. The prediction of the theory is that physically attractive people are believed to be more capable (Ashmore, 1981; Dion, et al., 1972; Eagly et al., 1991). It conforms to Norman’s (2004) proposition that attractive appearances induce positive emotions. In summary, the dual-processing theory for visual images, the research on visual design and the implicit personality theory, collectively indicate that attractive interface design induces positive emotions in users, which is supported by experimental studies. For example, Schenkman and Jonsson (2000) discover that people prefer aesthetically pleasing websites, which induce positive emotions from users. Yamamoto and Lambert (1994) investigate how a product’s aesthetics impacts users’ evaluation of it and find that the appearance of a product has a moderate impact on customers’ preference. Jordan’s (1998) study indicates that aesthetically pleasing products induce positive emotions; participants will use more aesthetically pleasing products than those unattractive ones. Lavie and Tractinsky (2004) predict that “the visual aesthetics of computer interfaces is a strong determinant of users’ satisfaction and pleasure” (p.269). Van der Heijden’s (2003) study concludes that the perceived visual attractiveness of the interface positively impacts users’ attitudes and intention towards a design, which positively impacts actual usage. Demirbilek and Sener (2001) review literature on product design and emotions and conclude that certain design elements, i.e., fun, cuteness, familiarity, metonymy, and color, induce positive emotions from users. These findings are confirmed in a later experimental study by Demirbilek and Sener (2003).

### Positive Emotions

Attractive design induces positive emotions from users, but how are positive emotions defined? And how do positive emotions impact cognition? Positive emotions are a category of emotions, sharing features identified by the cognitive theories on emotions. The cognitive perspective of emotions focuses on the role that thought plays in the process of emotions (Arnold, 1960; Frijda, 1986; Lazarus, 1991; Oatley, 1992; Oatley & Johnson-Laird, 1987; Zajonc, 1980). Smith and Lazarus (1993) propose a cognitive-motivational relational theory, which claims that emotions are preceded by appraisal, triggered by specific environments, and related to an individual’s experience. Positive emotions are not simply the opposite of negative emotions, for example, happiness and sadness are controlled by independent neural pathways (George et al., 1995). A growing body of empirical evidence shows that positive and negative emotions have qualitatively different information-processing models (Gray, 2001; Isen, 1999; Kuhl, 1983, 2000). Therefore positive emotions and negative emotions play different roles in cognitive processes, with positive emotions playing a particularly important role (Diener & Larsen, 1993). Fredrickson’s (1998) broaden-and-build theory of positive emotions provides a framework for understanding how positive emotions impact cognitive processes. According to Fredrickson, positive emotions broaden the thought-action repertoire. Specifically, positive emotions broaden the scope of attention, cognition, and action, as well as build physical, intellectual, and social resources. The outcome of the broadened thought-action reper-
the questions, let us first review Mayer’s (2005) cognitive theory of multimedia learning, which explains how multimedia learning happens.

**Mayer’s Cognitive Theory of Multimedia Learning**

Three assumptions are employed for the theory, i.e., the dual-channel assumption, the limited-capacity assumption, and the active-processing assumption. The dual-channel assumption states that the sensory modes for information input include two channels: ears processing verbal information and eyes for pictorial information. The limited-capacity assumption is closely related to the model of working memory by Baddeley (1986, 1992, 1999) and the cognitive load theory by Chandler and Sweller (1991; Sweller, 1999). The limited-capacity assumption states that the amount of information processed by each channel at one time is limited. According to Miller (1956), the average amount of information processed at each channel at one time is five to nine chunks. The active-processing assumption proposes how the human brain processes information, i.e., selecting information, organizing the incoming information, and integrating the information with other knowledge stored in the long-term memory. Based on the three assumptions, the cognitive theory of multimedia learning proposes that multimedia information is presented in two formats, words and pictures. Verbal information enters working memory through the ears, while visual information enters working memory through the eyes. In working memory, verbal information interacts with visual information, and the information is organized into either verbal models or pictorial models. The verbal models and the pictorial models are integrated with individual’s prior knowledge of the specific topic. In long-term memory, the integrated information from verbal model, pictorial model, and prior knowledge is formed as schemata and stored in long-term memory. The cognitive theory of multimedia learning is sup-

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the questions, let us first review Mayer’s (2005) cognitive theory of multimedia learning, which explains how multimedia learning happens.

**Mayer’s Cognitive Theory of Multimedia Learning**

Three assumptions are employed for the theory, i.e., the dual-channel assumption, the limited-capacity assumption, and the active-processing assumption. The dual-channel assumption states that the sensory modes for information input include two channels: ears processing verbal information and eyes for pictorial information. The limited-capacity assumption is closely related to the model of working memory by Baddeley (1986, 1992, 1999) and the cognitive load theory by Chandler and Sweller (1991; Sweller, 1999). The limited-capacity assumption states that the amount of information processed by each channel at one time is limited. According to Miller (1956), the average amount of information processed at each channel at one time is five to nine chunks. The active-processing assumption proposes how the human brain processes information, i.e., selecting information, organizing the incoming information, and integrating the information with other knowledge stored in the long-term memory. Based on the three assumptions, the cognitive theory of multimedia learning proposes that multimedia information is presented in two formats, words and pictures. Verbal information enters working memory through the ears, while visual information enters working memory through the eyes. In working memory, verbal information interacts with visual information, and the information is organized into either verbal models or pictorial models. The verbal models and the pictorial models are integrated with individual’s prior knowledge of the specific topic. In long-term memory, the integrated information from verbal model, pictorial model, and prior knowledge is formed as schemata and stored in long-term memory. The cognitive theory of multimedia learning is sup-
ported by numerous studies by Mayer and his colleagues (Hegarty, 2005; Moreno, 2005; Plass & Jones, 2005; Rieber, 2005).

According to Mayer (2005), the capacity of working memory and the capacity of both auditory and visual channels are limited. Fredrickson (1998) explains that positive emotions broaden the cognitive resources. However, she does not explain whether cognitive resources are related to the capacity of working memory. Further research is needed to verify whether positive emotions expand working memory capacities and whether positive emotions promote multimedia learning like that positive emotions do with other cognitive activities. One possible interpretation is that positive emotions increase the cognitive capacity and working memory capacity, which results in improved learning. The second possible interpretation is that the increased cognitive resources increase the amount of information processed in working memory, which finally promotes learning. In summary, the four theoretical perspectives indicate that an attractive interface should promote multimedia learning.

**MODEL OF EMOTIONAL DESIGN IN MULTIMEDIA LEARNING**

The four theories presented previously provide insight into the cognitive mechanisms underlying how attractive design affects multimedia learning through positive emotions. Based on the preceding discussion, I propose the Model of Emotional Design in Multimedia Learning, a framework for integrating emotions into a multimedia learning environment. Later the implications of the Model for multimedia design are discussed.

The Model of Emotional Design in Multimedia Learning is intended to highlight the impact of emotions on multimedia learning (see Figure 2). The model is built on the information-processing theory in cognitive psychology (Miller, 1956), the cognitive theory of emotions (Arnold, 1960), and the cognitive theory of multimedia learning (Mayer, 2001). The information-processing theory proposes that the structure of human cognition includes both information input and output systems. Information input includes learners’ input and environmental input. The environmental input refers to the multimedia design (Norman, 2004). Personal input includes emotions that are induced from multimedia design, individual/cognitive abilities, and prior knowledge. Arnold claims that the sequence of emotional processes is as follow: perception → appraisal → emotions. Appraisal refers to the process of judging how important an event is to a person. Emotions are induced when one person encounters an event and judges how important the event is to him or her, but if aesthetic enough, need not be important. In multimedia learning situations, emotions are induced when users interact with a multimedia design. As discussed previously, Mayer’s cognitive theory of multimedia learning explains how multimedia learning occurs through both verbal and audio channels, in working memory and in long-term memory. However, the amount of information processed by each channel at one time is limited. The capacity of working memory is also limited. Do positive emotions affect the capacity of the two information-processing channels and the capacity of the working memory? Further research is needed to answer the question.

The Model suggests a set of prescriptive propositions that are obtained from deductively and inductively established relationships between related concepts, theories, and empirical research in the field of emotions, aesthetics, learning, and multimedia design. Prescriptive propositions point out what should be done by the multimedia designers during design and what kind of strategies should be applied in order to elicit the desired emotional outcomes from the users.
There clearly exist individual and cultural differences regarding perceived attractiveness. However, common psychological mechanisms shared by all human beings underlie aesthetics that can be incorporated into multimedia interfaces. A review of research on aesthetics and graphic design indicates the design elements related to multimedia aesthetic, including color, graphics, text, audio, and video.

1. **Color.** Colors in graphics serve informational, compositional, and expressive functions that black-and-white designs do not possess (Zetll, 2005). Color energy refers to users’ aesthetic responses to a color. The energy of a color is determined by “(1) the hue, saturation, and brightness of a color; (2) the size of the colored area; and (3) the relative contrast between foreground and background colors” (Zetll, p.67). Saturation influences color energy most. High saturation means high energy, and vice versa. High-energy warm colors generally induce a happier mood on users than do low-energy cool colors. High brightness colors have higher energy than low brightness colors. The color combination of small areas of high-energy colors against large background areas of low-energy colors is perceived as pleasant. The most pleasant background hues are blue, blue-green, green, red-purple, purple, and purple-blue (Valdez & Mehrebian, 2005).

2. **Graphic.** Gestalt theory claims that different elements, when combined as a whole, reveal more information than elements viewed in isolation (Wertheimer, 1923). The practical implication of the Gestalt theory for graphic design is an emphasis on the relationships between different well-designed elements. The purpose of the design is to reflect abstract scientific concepts and relationships thereby helping users to create accurate mental models of them. The ratio between an element and its context should reflect the actual ratio so that the graphics portray relationships precisely. For example, the Earth and Sun’s relative sizes and separating distances should be accurately reflected in illustrated objects and their parts (Holliday, 2001). The details revealed by a graphic affect users’ interpretations of the graphic. Too much information distracts users from essential information because their eyes might not know where to go (Wittich & Schuller, 1967). In a pace-controlled learning...
environment, graphics with relatively small amounts of information such as simple line drawings tend to be more effective (Dwyer, 1972). Most computer displays follow a 3:4 aspect ratio so the screen area of a design should also follow an approximate 3:4 ratio. According to Zettl (2005), a 3:4 ratio ensures that the difference between height and width is not obvious and users will not emphasize one dimension over the other. Graphic conventions familiar to target audiences should be used.

3. **Text.** Borchardt (1999) creates a vision scheme for the design of texts. The scheme includes size, locale, proportionality, color, and contrast of texts. He points out that fonts should be legible and in proportion to the graphics. Zettl (2005) emphasizes the importance of continuity, which means that the text should maintain its colors and size throughout the instruction. Contrast between the colors of texts and their background should remain the same as the contrast between the graphics and background.

4. **Animation.** According to Holliday (2001), it is necessary to “highlight, reintegrate, reinforce, and rehearse” some parts of the graphic design to effectively explain a scientific phenomenon (p.8). For example, slow motion is used to highlight certain parts of an animation. To achieve slow motion, the motion is divided into more frames during the actual filming so that frame density is increased. In animation design, slow motion animation also runs through more frames per second than normal.

5. **Audio.** According to Borchardt (1999), factors that influence the quality of sounds include volume, pitch, timbre, attack and decay, rhythm, duration, velocity, acceleration, iteration, periodicity, familiarity, and predictability. Borchardt integrates these factors and creates an audio scheme to evaluate the quality of audio. He puts each of the factors on a spectrum. The left-hand side of the spectrum indicates low and the right-hand side for high. In general, when these factors are in the middle of a spectrum, the audio is most pleasant. Zettl (2005) proposes that sound aesthetics are determined by perspective, continuity, and picture-sound combination. Perspective means to match louder sounds with close-up pictures and far-away sounds with long shots. Sound continuity means that the sound retains its volume and quality. Another factor is picture-sound combination. A homophonic video-audio structure is recommended because multimedia learning is more effective when corresponding audio and video information is presented simultaneously (Mayer, 2005).

**FUTURE TRENDS**

Although interface design has been shown to impact multimedia learning through changing users’ emotions, there are many unanswered questions about how to define attractive interfaces and how to design attractive interface, that account for individual differences in aesthetic perception. Although common aesthetic criteria exist, individual differences are still important. Philosophers have researched aesthetics for more than two centuries, so extensive literature review on aesthetics should be conducted to enlighten the research of attractive interface design. In industrial design, designers have been trying to create attractive design for a long time and have proposed practical suggestions to make designs more attractive. Future research is needed to combine the results from aesthetics and industrial design and, in particular, to promote attractive design in learning environments.

Research on emotions, including the benefits of positive emotions, has also been conducted for more than one century. However, the mechanism underlying how positive emotions stimulate cognition is not yet clear. This explains the lack
of consensus among psychologists regarding the relationship between positive emotions and cognition. Fredrickson’s (1998) theory is theoretically sound, but not sufficiently supported by experiments, so her theory of positive emotions requires further exploration. More experimental studies specifically addressing the impact of positive emotions on learning particularly in the fast global Internet world are needed.

In education, students have been taught to understand and control their own emotions, and success has been achieved. However, educators have generally neglected to design learning materials and learning environments that promote positive emotions specifically to enhance learning. In multimedia learning environments specifically, none of these issues have been adequately addressed, especially with respect to immersive, innovative technologies. Future research should also consider other aspects of learning materials and environments that impact students’ emotions.

Research on how people learn indicates that the following elements impact learning, i.e., teachers, instructional strategies, learners, learning materials, learning environments, and learning strategies. As discussed in this chapter, interface design is a part of the learning environment that impacts users’ emotions, and emotions are believed to greatly impact learning. So what aspects in the above-mentioned elements will most significantly enhance learning? This more general and essential question should be addressed in the future research.

CONCLUSION

In his article “Multimedia Learning: Are We Asking the Right Questions?” Mayer (1997) noted, “At this time, the technology for multimedia education is developing at a faster pace than a corresponding science of how people learn in multimedia environments” (p.4). Now, ten years later this is even more true! It is essential for researchers to understand how people learn in multimedia environments. From the instructional designers’ perspective, it is also important to understand how different designs impact users’ emotions, and how the induced positive emotions promote learning. Multimedia development should be informed by theories tested by experimental research so that multimedia designs that predictably induce positive emotions and thereby promote multimedia learning can be developed.

REFERENCES


Interface Design, Positive Emotions and Multimedia Learning


KEY TERMS AND DEFINITIONS

Aesthetics: Both the study of beauty and the properties of a system that appeal to the senses, as opposed to the content, structures, and utility of the system itself (Budd, 1995).

Emotions: Refer to mental states (Cornelius, 1996). The cognitive perspective of emotions focuses on the role that thought plays in the process of emotions (Arnold, 1960).

Multimedia Design: The presentation of materials both in words and pictures (Mayer, 2001).

Multimedia Learning: Refers to learning from multimedia design, i.e., words and pictures (Mayer, 2001).

Interface Design: Refers to how the design presents information to users so that users can process information as required to complete a task (Raskin, 2000).

Positive Emotions: A category of emotions, sharing features identified by the theories on emotions. Positive emotions promote cognitive activities.
Chapter 12

Blogging Minds on Web-Based Educational Projects

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ABSTRACT

Weblogs are radically redefining the way people obtain information and the way they teach and learn. This chapter examines issues and problems of typical Web-based educational projects as gleaned from the literature. It then reveals the potentials and advantages of the Weblog for enhancing those existing Web-based educational projects. It also proposes a new framework which integrates the Weblog as a means for Web-based educational project design, development, and implementation. Finally, it presents a case study which incorporated Weblogs in a specific Web-based educational project - the development of a professional portfolio.

INTRODUCTION

Online information and communication is changing the way people interact and learn. Today, the Web is no longer just an information repository or a place to search for resources. Traditional Web applications typically consist of browsing and searching on the Internet and are essentially a reading operation. In contrast, the new Web (Web 2.0 or Read/Write Web) is a place to find other users, to exchange ideas and thoughts, to demonstrate creativity, and to create new knowledge. Web 2.0 applications, such as blogs, wikis, social bookmarking, and podcasts, have emerged in a rich, interactive, user-friendly application platform that allow users to read and also to write to the Web.

Among these Web 2.0 applications, “Weblogs were already so popular by the end of 2004 that the Merriam-Webster dictionary chose it as it ‘Word of the year for 2004,’ and the bloggers were ABC News’ ‘People of the Year’” (Richardson, 2006, p. 2). As Downes (2004) pointed out, “a February 2004 report published by the Pew Internet & American Life Project noted that at least 3 million Americans have created blogs, with similar numbers being seen worldwide. And schools have not been immune
from this trend. While nobody can say for sure just how many students are blogging, inside the classroom or out, it seems clear that their numbers are equally impressive” (p. 16). In fact the recent Pew Internet & American Life Project, *Teens and Social Media* (Lenhart, Madden, Macgill, &Smith, 2007), offered this description of this movement:

The number of teen bloggers nearly doubled from 2004 to 2006. About 19% of online teens blogged at the end of 2004, and 28% of online teens were bloggers at the end of 2006… Some 55% of online teens have profiles on a social network site (SNS) such as Facebook or MySpace and those who have such profiles are much more likely to be bloggers than those who do not have social network profiles. Two in five (42%) teens who use social networking sites also say they blog. And, in keeping with the conversational nature of social media, social networking teens are also interacting with others’ blogs. Seven in ten (70%) social networking teens report reading the blogs of others, and three in four social networking teens (76%) have posted comments to a friend’s blog on a social networking site (p. 3).

Although there is no official definition of a Weblog (also known as a “blog”), “in its most general sense, a Weblog is an easily created, easily updatable Web site that allows an author (or authors) to publish instantly to the Internet from any Internet connection” (Richardson, 2006, p. 17). Winer (2002) defined Weblogs as “often-updated sites that point to articles elsewhere on the web, often with comments, and to on-site articles. A weblog is kind of a continual tour, with a human guide whom you get to know” (¶ 2).

Despite of their huge popularity within our society, Weblogs are not widely and deeply explored in education. In fact, research suggests that blogs have not impressed educators. They doubt that Weblogs can promote thoughtful and measured response. Their view is that “blogging honors the impulsive, the careless, the superficial – anything goes: what matters is that you get a place to say whatever you like in public” (Ganley, 2004). As Downes (2004) indicated, “one of the criticisms of blogs, and especially student blogs, is that the students write about nothing but trivia” (p. 16). Hence, if the educational community is to accept blogs, it seems crucial to provide and share more constructive ideas on how the adaptation and implementation of Weblogs can impact real-world teaching and learning. For instance, it is necessary to question the effectiveness of using a Weblog as a vehicle for supporting Web-based project design, development, and implementation. This chapter examines issues and problems on some of the most existing Web-based educational projects as gleaned from the literature. It then reveals the potentials and advantages of the Weblog for enhancing such projects. It also proposes a new framework which integrates the Weblog as a mean for the Web-based educational project design, development, and implementation. Finally, it presents a case study which incorporated Weblogs in the professional portfolio development.

**ISSUES, TYPES, AND PROBLEMS OF EXISTING WEB-BASED EDUCATIONAL PROJECTS**

Throughout the history of technology integration, Web-based educational projects have played a central role in major educational innovations, including information literacy, inquiry-based learning, and performance-based assessment.

**Information Literacy via Webliographics**

Educators have long been concerned with increasing information literacy. The term information literacy was first introduced by Paul Zurkowski in 1974, which had been described as “people trained in the application of information resources to their work can be called information literates. They have learned techniques and skills for utiliz-
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ing the wide range of information tools as well as primary sources in molding information-solutions to their problems” (cited by Behrens, 1994). In 1989 the American Library Association (ALA) Presidential Committee on Information Literacy called attention to information literacy at a time when many other learning deficiencies were being expressed by educators, business leaders, and parents, and issued a Final Report (1989) for meeting information literacy needs. Particularly, as the Final Report noted, information literate individuals should be able to:

- know when they have a need for information
- identify information needed to address a given problem or issue
- find needed information and evaluating the information
- organize the information
- use the information effectively to address the problem or issue at hand

In an attempt to increase information literacy on Web-based resources, many educators have been either creating their own Webliographies for further study/reference, or requiring students to develop Webliographies as a part of learning process. Webliography is a short form of “Web bibliography”. Typically, a Webliography is a list of resources which can be accessed on the World Wide Web, relating to a particular topic or can be referred to in a scholarly work. One of the main purposes of the Webliography in education is that it allows educators and students to select and list Internet sources relevant to the topic or theme which can be used for the future references or projects. To fulfill this purpose, many educators suggest that a Webliography should be an annotated bibliography. Yang (2008a) suggested that like a typical annotated bibliography, a well developed Webliography should include completed bibliographic information about a source followed by a brief annotation of what the source contains. Bibliographic information includes author, title, URL address, publisher, and date of each item/source. The list of sources is usually arranged alphabetically or chronically followed American Psychological Association (APA) or Modern Language Association (MLA) citation style. The annotation itself includes a brief description to summarize the central theme and scope of the source, and a concise evaluative comment on: the authority or background of the author, the intended audience, relevance and usefulness of the source, and strength and weakness of the source, etc.

Understanding and developing a Webliography can greatly improve individual’s information literacy. As Engle, Blumenthal, and Cosgrave (2007) noted, the process of creating an annotated bibliography alone required the application of a variety of intellectual skills: concise exposition, succinct analysis, and informed library research.

Inquiry-Based Learning via Internet Field Trips and WebQuests

The inquiry-based learning approach has received the increased attention of many educators. Inquiry-based learning is a student-centered, active learning approach focusing on questioning, critical thinking, and problem-solving. According to Wells (2000), “[Inquiry] is an approach to the chosen themes and topics in which the posing of real questions is positively encouraged whenever they occur and by whoever they are asked. Equally important as the hallmark of an inquiry approach is that all tentative answers are taken seriously and are investigated as rigorously as the circumstances permit”. There are a variety of advantages to the inquiry-based learning approach. It is grounded in constructivist theory that builds on what students already know to form new understandings of the world which includes active engagement, building on prior knowledge, developing higher-order thinking, supporting developmental stages and different ways of learning, and considering
social interaction as an instrument of construction (Kuhlthau, 2001). Not only does the inquiry-based learning approach provide students with opportunities to learn with more freedom while reinforcing and imparting basic skills, but it also provides educators an effective way to coach, guide, and facilitate their students on “real-world” learning activities (Audet, 2005; Lamb, 2004; YouthLearn, 2003).

Internet field trips and WebQuests are two commonly used Web-based activities for the inquiry-based and active learning which provide the unique way to motivate learners by engaging them in their own learning. Both of them provide enormous opportunities for learners to pursue their own interests and questions and make decisions about how they will find answers and solve problems.

An Internet field trip, also known as a virtual field trip, is a journey taken via the Internet site without making a trip to the actual site. Foley (2003) defined an Internet field trip as a guided exploration through the Internet that organized a collection of pre-screened, thematically based Web pages into a structured online learning experience. Although Internet field trips cannot completely replace the sensory experience of actual field trips, they may sensitize a student’s sense of touch, smell and sight to the plethora of the stimuli to the encountered at the actual site (Bellan & Scheurman, 1998). Related studies have found that Internet field trips could provide a variety of advantages on teaching and learning. They can be accessed and repeated from place to place and time to time; can allow the teacher to focus on one specific aspect of the trip at a time; can give students great flexibility to learn at their own pace and explore things in as much depth as they wish; can take students to sites and subjects to which they would not otherwise go; can have an easier management and lower cost of production; can be safe and free of hazards; cannot be lost; can increase students’ information literacy; can improve technology integration; can provide integration of the multiple aspects of the field trip into a number of different curricular area and tap into more expert resources on a single topic; can allow for commonality of experiences by all participants; etc. (Hosticka, Schriver, Bedell, & Clark, 2002; Stainfield, Fisher, Ford, & Solem, 2000; Tramline, nd; Yang, 2008b).

WebQuests are probably the most talked-about and widely used Web-based activities in today’s classrooms (Starr, 2003). According to Dodge (1997), the founder of WebQuest, “a WebQuest is an inquiry-oriented activity in which most or all of the information used by learners is drawn from the Web. WebQuests are designed to use learners’ time well, to focus on using information rather than looking for it, and to support learners’ thinking at the levels of analysis, synthesis and evaluation”. A WebQuest usually includes six essential components: introduction, task, process, evaluation, conclusion, and teacher page. In this way, WebQuests allow the educators to make an easier transition into using Internet technology with minimal stress (Watson, 1999), and allow students to experience learning as they form their perceptions, beliefs, and values out of their experiences (Beane, 1997). For the last decade, teachers and students from K-12 schools have been creating and exploring their own WebQuests, and instructors at colleges have been teaching WebQuests in their courses (Peterson and Koect, 2001; Stinson, 2003; Waston, 1999; Yang, 2001; Yoder, 1999).

Performance-Based Assessment via Portfolios

Developing a performance-based portfolio has increasingly become popular in the field of education due to its numerous benefits: fostering self-assessment and reflection, providing personal satisfaction and renewal, providing tools for empowerment, promoting collaboration, and providing holistic approach to assessment (Costantino & De Lorenzo, 2002). The traditional portfolio
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is defined as a portable case for carrying loose papers or prints. *Port* means to carry and *folio* relates to pages or sheets of paper (Olson, 1991). For some time, pre-service and in-service teachers have attempted to accompany this definition of portfolio. Their portfolios were developed as paper-based folders. However, the approach of traditional paper-based portfolios has been challenged to capture the dynamic and complex process of teaching and learning (Aschemann, 1999). Related studies indicated that the traditional paper-based portfolio approach might increase the danger of paying too much attention on the final product rather than the process (Avraamidou & Zembal-Saul, 2006); difficulty in upgrading (Montgomery & Wiley, 2004); substantial photocopying and reproduction costs (Dollase, 1996); and storage and retrieval problems (Aschemann, 1999; Montgomery & Wiley, 2004). As a result, more recent studies have reported the uses of electronic portfolios also known as e-portfolios or digital portfolios in teacher education.

An electronic portfolio is defined as a portfolio that uses electronic technologies, allowing the portfolio developer to collect and organize portfolio evidence/artifacts in many media types, such as audio, video, graphics, text, etc. (Barrett, 2001). One commonly applied type of e-portfolios is the Web-based portfolio, which is specifically created for and placed on the Web (Watkins, 1996).

Comparing to the traditional paper-based portfolios, Yang (2008c) indicated that Web-based electronic portfolios have some notable unique advantages, such as: providing a means of storing multiple iterations over time and a mechanism for ease of editing and revisions; providing instant access to various audience from anywhere at any time; providing a structured presentation in which a viewer can choose to move contents from one section to another based on his or her need or preference; etc. A variety of studies indicated that the flexibility and convenience of Web-based portfolio supported pre-service and in-service teachers to reorganize, reevaluate, reflect, and result in new insights (Avraamidou & Zembal-Saul, 2006; Milman, 1999; Morris & Buckland, 2000; Pierson & Kumari, 2000; Watkins, 1996; Yates, Newsom, & Creighton, 1999).

Limitations of Existing Web-Based Educational Projects

In spite of significant benefits, the various potentials of Web-based projects on teaching and learning are yet to be completely realized.

Web resources are extremely abundant and dynamic. What is true today is often outdated tomorrow. Therefore, it is crucial for educators and students to periodically update their Webliographies in order to delete outdated or unavailable sources and to add new relevant sources. The updating process serves two purposes: first, it provides an opportunity for educators and students to reinforce the ability to locate, evaluate, and use effectively the needed information; second, it keeps a Webliography alive which can be used for the future references or projects. However, many Webliographies on the Web are on the reverse side - they appear inactive and abandoned (Yang, 2008a).

Related studies suggest that a valuable Internet field trip and/or WebQuest project should not simply be a fun game or a change-of-pace event for learners who have been pushed through homework assignments, lectures, and tests. It is imperative that this type of project is accountable and it incorporates high standards, rigorous challenges, and valid assessment methods (Yang and Pun, 2007). As Maddux and Cummings (2006) indicated, “simply because a lesson is cast in a WebQuest format is no guarantee that the lesson makes use of cooperative learning, advanced organizers, scaffolding, or problem-based learning, nor does it guarantee that these concepts and techniques are effectively, or even merely competently, applied in a way that consistent with the ‘huge literature based’ underlying each of them” (p. 121). In order to ensure the content of each
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Internet field trip and/or WebQuest consistent with the students’ characteristics and to avoid giving the students’ a hit-or-miss experience, educators need to help students develop the right mindset, engage students with the problem, divide activities into manageable tasks, and direct students’ attention to essential aspects of the learning goals (Ngeow & Kong, 2001). However, as March (2007) found, “scaffolding that attempts to foster an organic love of learning is frequently reduced to a series of hoops for student to jump through, losing the intended spirit of creative problem-solving” (p. 8). Specifically, for the existing WebQuests, “the dimension of age appropriateness appears to be the most neglected, resulting in WebQuest that look identical for use across a broad range of ages, grades, and individual differences” (Maddux and Cummings, 2006, p. 125). March (2007) urged that, “…scaffolding for the WebQuest must shift from discreet stages like Introduction and Task to more comprehensive approach that places the learner in charge of the learning. To this end, a new personal learning scaffold integrates self-directed learning to promote increases in student wellbeing and advanced cognition” (p. 8).

While electronic portfolios are expanding in teacher education programs, and the participants are mounting, the question “electronic portfolios for whom?” has also been raised. As Ayala (2006) argued, “the knowledge promoted under the guise of electronic portfolios is hardly student-centered. Very little research exists integrating student voices into the dialogue of electronic portfolios. The voices that are integrated are primarily those of administrators and some faculty” (p. 12).

To sum up, the literature suggests a reconsideration of Web-based educational project design, development, and implementation. There are some limitations of existing Web-based projects. On one hand, developing and publishing such a project on the Internet still requires educators and students to have the skills and knowledge of tools such as Web editing software and FTP clients, which can be daunting to them; on the other hand, the published Web-based project can only be read by other viewers and are incapable for them to leave reviews and feedback, thus, they are limited for Web-based interaction, communication, and collaboration. As a result, a typical Web-based educational project is seen as an end in itself when it is published on the Web (see Figure 1).

SOLUTIONS AND RECOMMENDATIONS

Weblogs are considered to be the means which could reduce the technical barriers to effective Web publishing significantly (Martindale & Wiley, 2005). Martindale and Wiley (2005) summarized some distinctive features of a Weblog such as: automatic formatting of content in the form of “headlines”, followed by “entries”, or “stories”; time- and date-stamp of entries; archiving of past entries; a search function to search through all entries; a “blogroll” - a list of other blogs read by the author(s) of the current blog; a section associated with each entry where readers can post comments on the entry; simple syndication of the site content via RSS (Really Simple Syndication); etc. These features make Weblogs very effective and attractive to users in two ways. First, a Weblog developer can edit or update a new entry without much knowledge of programming, formatting, and FTP. Second, a Weblog is constantly comprised of reflections and conversations from developer and viewers. It stimulates interaction (Downes, 2004; Martindale & Wiley, 2005; Richardson, 2006). As Ganley (2004) noted, “Weblogs, because of their flexibility, their public nature and their rich linking structure, can be a powerful tool in our pursuit of such a classroom. They allow us to visualize learning, contextualize course content, encourage meta-reflective practices, and practice collaboration.” Fiedler (2003) examined Weblogs as reflective conversational tools, and found Weblogs supporting aspects of:
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Figure 1. Projects on the read-only Web site

- Recording and representing one’s personal patterns of meaning or actions
- Reflecting upon the representations
- Reiterating the process of explication and reflection
- Shifting from a task-focused level to a learning-focused level of awareness
- Supporting the construction of a personal mini-language to converse about the process of learning
- Supporting a gradual internalization of the tool

Eide and Eide (2005) investigated Weblogs on brain structures and functions, and found that Weblogs could:

- Promote critical and analytical thinking
- Be a powerful promoter of creative, intuitive, and associational thinking
- Promote analogical thinking
- Be a powerful medium for increasing access and exposure to quality information
- Combine the best of solitary reflection and social interaction

Apparently, there are differences on presentation and communication between Weblogs and traditional read-only Web sites. These differences include the following: a Read-only Web site stops, Weblogging continues; a Read-only Web site is inside, Weblogging is outside; a Read-only Web site is a monologue, Weblogging is conversation; a Read-only Web site is thesis, Weblogging is synthesis… (Richardson, 2006). Weblogs, therefore, have shown a great deal of potential impact on Web-based project design, development, and implementation.

Accordingly, this chapter proposes a framework which incorporates advantages of both...
Weblogs and Web-based projects for teaching and learning (see Figure 2). This framework illuminates several of notable implications in Web-based project design, development, and implementation.

First, thoughtful and purposeful use of Weblogs is likely to minimize its “nothing but trivia” information overloading. In return, Weblogs can be the means to enhance and increase the quality of education. It appears that using a Weblog as a vehicle for supporting Web-based project design, development, and implementation, is effective and promising. Due to the high degree of stimulation, continuity, and interaction of Weblogs, students’ critical thinking, self-assessment, collaboration, and communication skills are constantly challenged and improved. Students must articulate their ideas and reflections for a relatively large group.

Second, when read-only Web-based projects turn to read-write interrelated projects, the existing limitations of ready-only Web-based projects can be greatly reduced. The principles for good practice on teaching and learning can be effectively embraced. Chickering and Gamson (1991) suggested that good practice is that which:

1. encourages contact between students and faculty;
2. develops reciprocity and cooperation among students;
3. encourages active learning;
4. gives prompt feedback;
5. emphasizes time on task;
6. communicates high expectations;
7. respects diverse talents and ways of learning (p. 63).

CASE STUDY: BLOGFOLIOS ON THE SENSE OF COMMUNITY

In order to enhance a sense of community and promote student-centered collaboration, assessment, and reflection, the author of this chapter incorporated the Weblog in an educational portfolio development course. To distinguish it from typical Web-based portfolios, a Weblog-based portfolio is usually called a “blogfolio” (Yang, 2008c).

Participants and the Course

The participants of this study came from a section of students (n = 14) who were enrolled in the course entitled Portfolio Development and Professional Synthesis, offered at a university in the northeastern region of the United States during the Spring semester in 2008. Most of the participants were part-time pre-service and in-service teachers located in the same geographical area, who were pursuing graduate level education programs in the content areas of literacy, biology, chemistry, earth science, mathematics, social studies, technology, etc.

The course provides an introduction for pre-service and/or in-service teachers to issues related to professional development especially in terms of personal portfolio development and other professional activities in an attempt to support them and contribute to the betterment of the filed field of education. In this process, portfolio development serves as the main measure of preparedness and readiness with class activities to support this process. Equal attention is given to professional development topics to be determined by student interest and need. Additionally, the course content gives attention to the department’s continuing commitment to social justice, mentoring, and building collaborative relationships.

Method and Procedure

A structure with four consecutive segments incorporating both portfolio development and Weblogging was designed and then implemented in the course. In the first segment, the concept and foundations for portfolio development were introduced. In the second segment, the features,
components, applications, and resources of educational Weblogs were demonstrated. In the third segment, guidelines, standards, requirements, and samples of developing a teaching blogfolio were discussed. In the last segment, students’ professional blogfolios were developed and accessible to their peers, where students engaged in continuous, thoughtful analysis of their learning on this course with reflection, evidence/assignments, and collaboration. During the class, each student was required to conduct two work-in-progress evaluations on other classmates’ blogfolios. By the final week of the semester, each student was required to complete a self-evaluation on his or her own final blogfolio and learning experience.

Data Collection and Instrumentation

To assess the effectiveness of the blogfolio approach on the sense of community for students’ collaborative learning and self-reflection, all 14 students from the course received Rovai’s (2002) Classroom Community Scale (CCS) survey at the end of the Spring semester in 2008. The CCS, which was used to measure the sense of community for students of this study, included 20 items based on two factors: connectedness and learning. Among the returned surveys, 13 out of 14 students’ responses (93%) were completed and usable. In addition, students’ working-in-progress evaluations on other classmates’ blogfolios and final self-evaluations on their own blogfolios and learning experiences were collected and examined.

Findings

It should be noted that the participants were selected by using convenience sampling because the researcher for this study was also the instructor...
of the course. The sample size was relatively small. Therefore, instead of any strict inferential attempts, the descriptive research design was utilized in this study.

**Connectedness**

Most of the participants indicated that the blogfolio approach had very positive impacts on their cohesion, community spirit, trust, and interdependence. On the connectedness subscale of the CCS, respondents overwhelmingly agreed and/or strongly agreed on items such as: “I feel that students in this course care about each other” (100%); “I feel connected to others in this course” (100%); “I trust others in this course” (92%); “I feel that I can reply on others in this course” (85%); and “I feel confident that others will support me” (100%). In addition, more than half of the respondents indicated that they agreed/strongly agreed on items: “I feel that this course is like a family” (100%) and “I feel that members of this course depend on me.” On the other hand, respondents overwhelmingly disagreed/strongly disagreed on items: “I do not feel a spirit of community” (100%); “I feel isolated in this course” (100%); and “I feel uncertain about others in this course” (85%).

Perhaps the accessibility of online portfolios and the feedback from peers were two main factors which influenced participants’ perceptions on the connectedness. In their final self-evaluations, most participants pointed out that blogfolios were credible vehicles of reflection, self-assessment, and communication for classmates which provided opportunities for reviewing peers’ works and revising their own projects. The following comments from the work-in-progress evaluation, which included classmates exchanging their ideas and feedback with Alexa (the name is a pseudonym) regarding her blogfolio, were typical examples during the process of the portfolio development:

[Comment 1] I like the format you used – it’s easy to read and to move to other standards. Nice use of photo too. Your use of artifacts is good – very relevant. My only suggestion is that you might want to expand to why you choose that artifacts in your narrative.

[Comment 2] I really thought your personal reflections on working with an autistic child added to the strength of your evidence.

[Comment 3] Good incorporation of inquiry based learning. The pictures look nice. I really like how you embedded the artifacts in the text instead of listing at the end. I’m going to steal this idea! Good use of artifacts – you used several in each standard. Nice job!

[Comment 4] You have included a lot of good information. My only suggestion is include a little more of an explanation of why you chose the artifacts you did, for a couple of your strategies.

**Learning**

Most of the participants indicated their positive and favorable feelings of community members regarding the degree to which they shared educational goals and experienced educational benefits by interacting with other members of the course. On the learning subscale of the CCS, respondents fully agreed/strongly agreed on items: “I feel that I am encouraged to ask questions” (100%); “I feel that I receive timely feedback” (100%); and “I feel that I am given ample opportunities to learn” (100%). On the other hand, respondents overwhelmingly disagreed and/or strongly disagreed on items: “I feel that it is hard to get help when I have a question” (92%); “I feel uneasy exposing gaps in my understanding” (85%); “I feel reluctant to speak openly” (92%); “I feel that this course results in only modest learning” (92%); “I feel that other students do not help me learn” (100%); “I feel that my educational needs are not being met” (100%); and “I feel that this course does not promote a desire to learn” (100%).

Self-evaluations from participants revealed that not only did the blogfolio approach increase social navigation and reflection, decrease social distance, and improve meaningful learning; but
it also strengthened their confidences on the final learning outcomes. As was evident in the following Alexa’s comments:

[Regarding the self-introduction] I feel I have done a really good job on reflecting who I am and what my teaching philosophy is throughout my entire portfolio. My introduction goes very personal into who I am and what my ideas of education are. [Regarding the documentation] All of my documents are significant to their standards and provide a lot of evidence and substance to my philosophy and educational experience. [Regarding the introduction and explanations accompanying artifacts] Narratives are very informational and make clear connections to each of their standard and teaching philosophy. [Regarding the reflective entries] Narratives I put are very clear and significant, demonstrating critical thinking and commitment to growth and learning. [Regarding the organization and appearance of portfolio] My goal in making my professional portfolio is to be able to actually use it when placed in the workforce. For this reason I want mine to be professional. [Regarding the overall learning experience] Overall I really enjoy this learning experience. My portfolio which developed through this course gives me the great flexibility to create, revise and reflect any components using the Weblog. The way in which our portfolios set up makes learning interesting, interactive and inviting. The issues and comments that my classmates raised force me to think critically. I did feel a great sense of accomplishment when the portfolio was completed. I have learned a lot and I feel my portfolio will be very helpful in the future…

CONCLUSION

Web 2.0 has transformed the Web into a global network community where every user is invited to create content. The Web is shifting from being a medium, in which information is transmitted and consumed, into being a platform, in which content is created, shared, remixed, repurposed, and exchanged. The unique feature of many Web 2.0 applications is that it harnesses the collective intelligence of users. Learners become part of a global human network in which they can harness the collective intelligence of people in the world that could have never been possible previously. Learners can interact with other learners, gain from their experiences, and then construct their own knowledge. The advent of Web 2.0 technologies allows teachers and trainers to empower learners and create exciting new learning opportunities.

As one of most widespread Web 2.0 applications, Weblogs have the capacity for educational institutions and corporations involved in training to extend the possibilities of learning. Weblogs provide new channels through which news and information are disseminated outside the conventional mechanisms of traditional new media (Kajder & Bull, 2004). As one of the Web 2.0 applications in education, the Weblog is still evolving. This chapter yields findings of previous research related to educational projects in the typical read-only World Wide Web environment and/or format, and indicates Weblogs with a variety of potentials and advantages should be considered and implemented for better user-oriented and interactive Web-based educational projects. It should be noted that much work remains to capture the dynamics that happen within Weblogs and related educational projects. Although the effectiveness of the blogfolio approach on student-centered collaboration, assessment, reflection, and their sense of community in one course, has been examined and confirmed in this chapter’s case study, caution in generalizing to other populations is also called for, as this study involves only a group of student in one course.

FUTURE TRENDS

Educators have long concerned with technology integration toward project-based learning. Why
the interest in project-based learning? Research shows that project-based learning can capture the complexities of real life situations. Not only does it provide an effective way for students understanding the connection of knowledge to the contexts of its application, but it also provides students with opportunities for self-reflection and a sense of agency. Essentially, project-based learning is based on tasks, groups, and sharing (Yang, 2001). It provides a practical method of combining many of the elements of authentic activities and collaborative learning (Wheatley, 1991; Grabe & Grabe, 1998). Rapid development and implementation of technologies often bring both opportunities and challenges to project-based learning. Obviously, the various potentials of Weblogs on student-centered teaching and learning are yet to be determined and fulfilled. Additional research should be undertaken to examine the long-term and board effects of Weblogs on related educational projects, especially in regard to Webliographies, Internet field trips, and Web-based portfolios on six aspects of the newly released National Educational Technology Standards for Students: (1) creativity and innovation; (2) communication and collaboration; (3) research and information fluency; (4) critical thinking, problem solving, and decision making; (5) digital citizenship; and (6) technology operations and concepts (ISTE NETS.S, 2007).

REFERENCES


Blogging Minds on Web-Based Educational Projects


Blogging Minds on Web-Based Educational Projects


KEY TERMS AND DEFINITIONS

Blogfolio: To distinguish it from typical Web-based portfolios, a Weblog-based portfolio is usually called “blogfolio”, which incorporates advantages of both Weblogs and portfolios.

Internet Field Trip: Unlike a typical field trip which is a group excursion to a place away from their normal environment for performing firsthand research on a topic, an Internet field trip, also known as a virtual field trip, is a journey taken via the Internet site without making a trip to the actual site.

Project-Based Learning: Project-based learning refers to a comprehensive approach to classroom teaching and learning that is designed to engage students in investigation of authentic problems or projects. There are two essential components of projects: they require a driving question or problem that serves to organize and drive activities; and these activities result in a series of artifacts, or products, that culminate in a final product that address the driving question.

Web-Based Portfolio: Web-base portfolio refers to the portfolio which allows the portfolio developer to collect and organize portfolio evidence/artifacts in many media types, such as audio, video, graphics, text, etc. and is specifically created for and placed on the Web.

Webliography: The term Webliography is commonly used when discussing online resources. It is referred to as “Web bibliography”. Accordingly, a Webliography is a list of resources relating to a particular topic that can be accessed on the World Wide Web, and can be referred to in a scholarly work.

Weblog: Weblog is refered as “Web log” or “blog”. A Weblog usually maintained by an individual with regular entries of commentary, descriptions of events, or other material such as graphics or video. Entries are commonly displayed in reverse chronological order. In addition, the information of a Weblog can be gleaned from other Web sites or other sources, or contributed by users.

WebQuest: The WebQuest refers to an inquiry-oriented activity in which most or all of the information used by learners is drawn from the Web. There are two types of WebQuest: short-term, which is completed in one to three class periods, and long-term, which is typically taken between one week and a month in a classroom setting. A WebQuest usually includes six essential components: introduction, task, process, evaluation, conclusion, and teacher page.
Chapter 13
Language Simulations for Fostering Language Acquisition and Communicative Competence in Adult Second-Language Learners

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ABSTRACT
Language teachers and students are making a mass exodus in theory and practice in the field of second-language instruction. They are leaving behind boring drills, nonsensical memorizations and endless strings of grammatical rules and are demanding a shift from traditional language learning to modern language acquisition. Language acquisition means being culturally literate and communicatively competent in a language (Byrnes, 2001). This change requires finding effective ways to facilitate this paradigm shift. This chapter will try to answer the following questions: Can language simulations foster language acquisition and communicative competence in adult second-language learners? It will also explore: what language acquisition is and how it is obtained; theoretical foundations of language acquisition; learning simulations and what makes them effective; language simulations – how and why they work; what simulations can do to promote communicative competence; a practical example; future applications and importance of language simulations; and what future research is necessary to fulfill this promise.

INTRODUCTION
How many of us can remember sitting through long, boring, tortuous, endless hours of drills and memorization for Spanish, French, German, Latin, or whatever the second-language requirement was in high school? How much of that language have we retained today? Were we acquiring language, or were we learning it? This chapter will investigate the role multimedia simulations can play in language acquisition and particularly in the development of communicative ability in adult second language learners.
BACKGROUND

The past few decades have seen a huge paradigm shifts in theory and practice in the field of second-language instruction (Larsen-Freeman & Long, 1991). Researchers and practitioners have moved away from language teaching and have shifted toward instead to language acquisition via communicative language teaching. The field of communicative language teaching stresses the development of communication skills over memorizing vocabulary and verb conjugation tables (Savignon, 1997).

Acquiring a language goes far beyond learning the names of things; it requires being communicatively competent in the target language. Communicative competence is defined here as a person’s ability to communicate in a target language in an appropriate way, (Hymes, 1972), which also may include non-verbal behavior. Teaching “language” has proven to be ineffective in attaining acquisition and fluency in second language learners (Horwitz, 1986). What research is now showing is that second language acquisition and communicative competence are best acquired in situations where learners are using language for communicative purposes, in realistic extra-linguistic, as well as verbal contexts (Garcia-Carbonell, Rising, Monero & Watts, 2001; Wesche, 1983; Krashen, 1982).

Crookall and Oxford (1990a, 1990b), feel that multimedia simulations may prove to be extremely effective in this in developing learners’ ability to communicate effectively in second languages. Simulations that incorporate effective instructional pedagogy can not only fun, which improves learner motivation, but effective as well (Aldrich, 2005; Prensky, 2002; Crookall & Oxford, 1990a, 1990b).

Contemporary applied linguists are inquiring into ways native speakers acquire first language, and are creating from these insights new models, methodologies, and practices for second-language acquisition. Babies do not acquire language through endless hours of vocabulary drills, memorization, and grammatical rule. As it turns out, current research is showing that second-language learners don’t either (Wesche, 1983). Researchers have discovered that second languages are acquired most effectively in meaningful, naturalistic environments.

MAIN FOCUS OF THE CHAPTER

Applied linguists are quick to point out the important distinction between language acquisition and language learning. According to Krashen (1982), language acquisition is a subconscious process. Children acquire language through interaction with their primary caregivers and the surrounding environment. The necessity to communicate their needs is what enables acquisition to take place. Babies are unaware of the fact that they are acquiring language. They are only aware of the fact that they are using language to communicate with those around them. It would be virtually impossible for babies and young children to memorize all the intricate rules and patterns inherent in all languages, and how to use them accurately.

Early behaviorists believed children linguistic outputs were a result of stimulus and response (Freeman & Freeman, 2004). This notion, however, has since been disproved. It is the through exposure to, and interaction with meaningful communication that first languages are acquired (Krashen, 1982). In terms of second language acquisition in children, the process mirrors that of first language acquisition almost identically. Teachers of these students tend to stress communication over correct form. Communication, rather than rules and pattern memorization is emphasized (Freeman & Freeman, 2004).

Unfortunately, in adult learners this practice has been traditionally set aside. Most traditional adult language courses accentuate grammar, patterns, repetitions, drilling, and rote memorization (Terrell, 1977). The majority of today’s adult language
Language Simulations for Fostering Language Acquisition and Communicative Competence

courses offer very little in the way of meaningful communication in the target language. In most cases teachers “teach” rules, present vocabulary words for memorization and worksheet exercises. This is not the way children acquire first or second languages. This method has proven to be ineffective in fostering second language acquisition and fluency in adult learners and therefore proven this is not how adults acquire second languages either (Horwitz, 1986). This is merely language learning, not language acquisition.

Language Acquisition Principles

According to Elaine K. Howritz there are five main language acquisition principles, but we will look only at the following.

First

“There is a non-conscious process involved in second language development which accounts primarily for second language fluency” (Horwitz, 1986, p.684). What this means is that second language learning, which is done through memorizing vocabulary and grammatical rules will never lead to second-language fluency. Second-language acquisition is the key to second-language fluency, and this is fostered through contextual language interaction, reading comprehension and listening.

Second

“There is no interface position with respect to the relationship between acquisition and learning” (Krashen, 1985, p. 38). Language learning is not communicative and only teaches learners about the language, instead of how to communicate effectively using it.

Krashen’s concept of acquisition clashes with the real-world perspectives and expectations.

Third

“You learn to talk by talking” (Horwitz, 1986, p. 687). In order to develop speaking fluency, learners must experience natural conversational interactions. When students use language in practical situations, and converse about topics that are of interest to them, speaking fluency increases (Horwitz, 1986).

Fourth

“Target language errors are a natural part of the language development process” (Horwitz, 1986, p. 687). For too many years, language teachers have looked upon language errors as a result of poor teaching. Errors are to be expected, and foreign language students should be corrected regarding the communicativeness of their speech instead of its structural correctness (Horwitz, 1986). Many times, learners learn as much from doing something wrong as they do from doing something right.

As Horwitz points out, second language acquisition is very different from second language learning. Acquisition requires true, practical, real-to-life linguistic and cultural interaction without the anxiety of embarrassment when errors occur. Traditional language learning environments lack some of the dynamic requirements needed for language acquisition.

Krashen describes language learning as a conscious process with the learned knowledge represented consciously in the brain. Krashen advocates that learned knowledge can never be morphed into acquired knowledge. Therefore, he states that there is “a no interface position with respect to the relationship between acquisition and learning” (Krashen, 1985, p. 38). Language learning is not communicative and only teaches learners about the language, instead of how to communicate effectively using it.
Language instruction should focus on fostering learners’ ability to communicate naturally and realistically. The goal is for learners to achieve communicative competence. The competence is not limited to grammatical competence, but includes sociolinguistic, discourse and strategic competencies as well (Savignon, 1997; Canale & Swain, 1980). The focus here is on using language in a meaningful context in order to communicate. Because Krashen holds that acquisition is unconscious, while language exists only in our conscious minds, causes contradictory clashes in this theory. Therefore, Canale, Swain, Savignon and others have taken Krashen one step further by moving his theory into the real world by focusing on the acquisition of an ability to communicate, and not necessarily just on the acquisition of a language.

**Hard-Science Linguistics Theory**

According to this way of thinking, language is a hodge-podge of mismatched parts; ancient abstraction of words, grammar and semantics. Yngve (1996), states that language does not exist on a physical plane and therefore cannot be an object of scientific inquiry. If linguists are to move into the realm of hard science, then they must abandon theories crouched in terms of philosophical ideas and begin to study language as it really exists in the real world (Yngve, 1996). He proposes the following:

Let us start with the illusion of language. The old foundations follow the tradition in assuming that utterances, words, sentences, and languages somehow exist in spite of the fact that at least since Saussure they have been recognized as illusory. Since the assumption of the reality of language and the objects of language is false, linguistics built on the old foundations leads us into the defense of error. It leads to the proliferation of additional false assumptions, as an examination of mainstream theory and other grammatical or semiotic theories will reveal.

The new foundations, however, recognize up front that language and the objects of language are illusory; that the relevant existing reality consists, instead, of the people who speak and understand, the sound waves of speech and other forms of communicative energy flow, and the real-world surroundings that often affect communicative behavior. A linguistics built on the new foundations needs no additional assumptions beyond the minimum standard assumptions underlying all science: that there is a real world out there, that it is coherent so we can find out something about it, that we can reason from true premises to true conclusions, and that from observed effects we can infer real-world causes (Yngve, 1996, p.2).

The shift in paradigm and practice comes in focusing on instructing learners how to communicate in real-world settings, instead of teaching them about the target language. In the real world, language and grammar do not really exist. These are mental constructs that are present only in our subjective experience and are not real-world objects at all (Coleman, 2005; Yngve, 1996; Saussure, 1959). Therefore, the research emphasis should be placed on learning how people actually communicate in their target languages.

Although proponents of this view claim that they have stepped outside the box of the traditional ideas about grammar – that grammatical competence is necessary for application not memorization – they still treat these objects as real-world entities instead of the mental constructs that they are (Savignon, 1997). Grammatical competence is the mastery of the linguistic code. It is the ability to recognize lexical, morphological, syntactical, and phonological features of a language and to use these features effectively to interpret, encode, and decode words and sentences (Savignon, 1997). Yet this notion is flawed, because studies have shown repeatedly that studying grammar does not improve learners’ ability to speak or write “correctly” in any target language (Freeman & Freeman, 2004).
At the same time, there are those who have no conscious grammatical knowledge, but are able to communicate quite effectively nonetheless. If we take Chomsky’s view of linguistic competence being “the knowledge internalized by a speaker of a language, which, once learned and possessed, unconsciously permits him to understand and produce an infinite number of new sentences” (Chomsky, 1975, p. 48-49), then this could be seen as rationale for the preceding phenomenon. The flaw, however, lies in the fact that it assumes that grammar is a physical object residing in the physical domain and that people have an inherent unconscious knowledge of it. Yet, as Yngve (1996) points out, grammatical features are objects stored in our mental lexicon, and exist only in our conscious minds. If this is the case, then this notion of “unconscious knowledge of grammar” is self-contradictory.

Therefore, we can conclude that successful communication in a target language does not stem from the knowledge of language features. The key to successful communication in second languages is to do as the natives do. Second language learners need to recognize, adopt, and acquire linguistic features and behaviors similar to those of native speakers in order to acquire true communicative competency and fluency. Multimedia simulations, where learners can use language realistically and contextually, may prove to be extremely effective in improving communicative ability in second language learners.

Simulations and Gaming Theory

According to Garcia-Carbonell, et al. (2001), changes in the behavioral, attitudinal, and cognitive realms due to experience is the main focus of simulation and gaming theory. The learning environment advocated is one where learners are active contributors to the process of constructing their own learning. In these learning environments, learners can experience feelings of success and failure and can witness the results of their own performance (Garcia-Carbonell, et al, 2001). The assertion set for by Kolb (1984), is that for there to be a true change in knowledge, behavior, or attitude, learning must be cyclical in nature. That is, there must be a time for concrete experience, followed by observation and reflection on that experience, followed by abstract conceptualization, followed by a new experience. The cycle continues until the desired results are obtained.

Early pedagogical practitioners such as Piaget, Dewey and Ausubel understood the need for real experience in learning. Later, elements of emotional input, focus, relevant feedback, and debriefing were added to the learning cycle (Garcia-Carbonell, et al, 200), to make it more complete.

Simulations and Communicative Acquisition - Learning Simulations

Simulation theory is based on learning theories that foster behavioral, attitudinal, and cognitive changes due to experience. A simulation is “an untaught event in which the participants have (functional) roles, duties, and sufficient key information about the problem to carry out these duties without play acting or inventing key facts” (Jones, 1995, p. 18). Aldrich (2005), states that simulations may be either classroom-based, or more recently, multimedia-based. In order for simulations to be educational simulations, there must be a convergence of simulation elements, game elements and pedagogical elements. Simulation elements allow for “discovery, experimentation, role modeling, practice, and active construction of systems, cyclical and linear content” (Aldrich, 2005, p.81). Game elements provide entertaining interactions and increase the enjoyment of the educational experience. This will make learners more willing to interact longer, and thus will in turn increase learning. Pedagogical elements are the “learning objectives, the reasons for building the simulation, and deciding what to simulate” (Aldrich, 2005, p. 88).
Language Simulations

Language simulations can be looked at as communication simulations because they are designed to foster communicative realities (Bambrough, 1994). They give learners exposure to a model of a real-life structure and contain unexpected events in which real communication can take place. Many follow a Piagetian perspective of symbolic games. Simulations and the use of language depend on rules, symbols, and codes. They involve models, representations, realities, and negotiated meanings. Negotiated meanings are the center of communication, and are therefore pivotal to establishment of social relations (Crookall & Oxford, 1990a, 1990b). Simulations also offer environments that encourage communication and cooperation. As Piaget pointed out, cooperation is an essential element of children’s play (Piaget, 1962). This same need to cooperate is present in language simulations, where students are placed in make-believe settings that involve assigning tasks and organizing activities that require interaction and make participants feel the need to communicate (Crookall & Oxford, 1990a, 1990b).

Language simulations are relevant to communicative acquisition in two ways. The first is via a “representational viewpoint” (Crookall & Oxford, 1990, p. 14). Via this perspective, simulations represent a real-world system, a symbol with a referent. This is exactly what happens in symbolic play; a representation is involved, and a symbol underlies the play (Piaget, 1962).

The second way that simulations are relevant to communicative acquisition according to Crookall & Oxford, (1990a) is through their portrayal of lifelike reality. During simulation instances, learners do not see their activity as a simulation, but as a real experience. This experience is enhanced because of the build-in layer of safety from errors. The price paid for making mistakes in simulations are considerably less than are those paid from errors made in the real world. Learners, therefore, are given a degree of freedom and confidence that frees up their thinking and encourages them to take more risks (Tomlinson & Masuhara, 2000).

Language Simulations and Communicative Competence

Hymes (1972) was the first to coin the term communicative competence. It describes a person’s ability to communicate in an appropriate way. Language goes beyond knowing how to say something, but knowing who to say it to; when to say it; and when it’s appropriate to say it. He did not merely focus on biology and performance, but added aspects related to culture and context. These competencies include: grammar competence, which includes knowing linguistic code and vocabulary; sociolinguistic competence, which includes knowing how to follow the norms and conventions of use; discursive competence, which relates to different genres of written or spoken texts; and strategic competence, which entails getting the message across effectively (Canale & Swain, 1980).

This shift in thinking that Hymes introduced has had a profound impact on language instruction. Today, as the onus is placed on communication, there is now a mass exodus from language learning to communicative acquisition. For it is only from true communicative acquisition that competency can be developed. Can language simulations foster communicative competence, and how can they do this?

According to Savignon (1972), language learners who spent an hour a week in simulation activities achieved higher communicative competence than those who spent the same amount of time in the language laboratory or in cultural activities. One reason cited for this finding is the fact that simulations tend to allow for authentic communication. Students are more involved in creating their own learning and experiences through simulations because they have a way of encouraging real-world communication (Sharrock & Watson, 1987).
Language simulations optimize the quantity and quality of exposure to language. Language learners who participate in simulations receive a lot of language input that is slightly above the learners’ current level. This allows learners to understand language using cues in the situation. This in turn allows language to emerge naturally and not as a result of direct teaching (Krashen, 1982).

A third factor in the fostering of communicative competence as a result of using language simulations is their effect in the affective domain. Affective variables, such as motivation, anxiety and self-confidence all act to facilitate or impede the process by which linguistic data are stored in memory (Krashen, 1982). Gardner (1985) also points to learner motivation as being a core element in the success of second-language acquisition. Language simulations are designed to create low anxiety environments that allow participants to try new behavioral patterns with a minimum of stress.

A final cause, but probably the most important, is that of interaction. Comprehensible input becomes so through interaction in which speakers clarify, confirm, repeat, paraphrase, or ask for information (Hatch, 1983). It is through this negotiating the exchange of meaning through conversation that learners achieve the understanding and the use of the language that is being acquired (Hatch, 1983). The key point that must be stressed is that although the environment is simulated, the behavior and participation of the learners are not.

**Language Simulations and Acquisition – How and Why They Work**

Language simulations characteristically all have the three elements necessary for a successful learning experience that Aldrich speaks about. Many follow a Piagetian perspective on symbolic games (Crookall & Oxford, 1990). Simulations and the use of language depend on rules, symbols, and codes. They involve models, representations, realities, and negotiated meanings. Negotiated meanings are the center of communication, and are therefore pivotal to establishment of social relations (Crookall & Oxford, 1990). Simulations also offer environments that encourage communication and cooperation. As Piaget pointed out, cooperation is an essential element of children’s play (Piaget, 1962). This same need to cooperate is present in language simulations, where students are placed in make-believe settings that involve assigning tasks and organizing activities that require interaction and make participants feel the need to communicate (Crookall & Oxford, 1990).

As discussed earlier, language acquisition is more than learning the names of things in a second language. The components that make language simulations work is not that they teach vocabulary and grammatical structure – which they do – but that they do much more than this. They’re task-based, culturally and contextually relevant, life-like and offer rehearsal. This approach to teaching foreign languages allows learners to focus on the knowledge of things, and how to complete relevant tasks. Language is then a means to achieving pre-stated goals (Salies, 2002).

In language simulations, learners can adopt context-specific roles, and rehearse language that is contextually and culturally relevant, similar to real-world encounters, but without the real world stress (Salies, 2002). Not only do simulations offer a fun and relaxed environment for learners to communicate in, they also foster the use of a variety of language functions. An aspect of general communicative ability is the ability to use language for a variety of functions. Roman Jakobson discussed language in terms of its function in various speech situations. He dealt with mostly language’s poetic function: its form rather than its meaning. But, he also held great discussions around other language functions to include referential, cognitive, and emotive. Language learning often stops at the referential level (the names of things), and leave out other functions.
that are necessary for communicative competence (Jakobson, 1987 [1960]).

In language simulations, students can express feelings, narrate facts or stories, and argue politely, all at very low risk and with guidance from instructors. These functions are at the heart of language use and can only be obtained when practiced in situations that mirror those of real-world experiences (Salies, 2002).

Let’s now look at an example of a language simulation that is being used by the United States military, which is accomplishing these very things in its users.

**Tactical Language Training System – A Practical Example**

The Tactical Language Training System (TLTS) is a simulation/game-based language learning environment that aims to assist learners to rapidly acquire mission-orientated communicative competence in spoken Iraqi Arabic (Johnson, Marsella & Willhjalmsson, 2004) (see Figure 1). It contains all the simulation, game and pedagogical elements that make it a superior learning environment for its users. In this language simulation, an intelligent agent tutors learners through lessons, assess learner progress, and provides custom feedback through learner modeling and speech recognition technology (Johnson, Wu, & Nouhi, 2004). Learners practice their language skills in an interactive, task-orientated, social simulation where they speak and use culturally appropriate gestures.

The simulation is based around completing common, everyday tasks. When learners correctly speak and interact with the computer-generated, autonomous, animated characters, they win the game. As a result, characters offer whatever information and assistance they need. These interactions are not scripted and are generated depending on the actions and speech of the user. If, however, the do not interact appropriately, the characters become uncooperative and prevents the learner from completing his or her task (Tactical, 2006). As has been shown, language simulations are proving to be extremely effective in both fostering language acquisition and communicative competence in second-language learners. But what does this all mean?

**FUTURE TRENDS**

Why do people seek to learn a second language? Why is it important in today’s world? What is the purpose of language itself? These are questions that lead us to the implications of our findings. Language is at the heart of human communication. It not only allows us to speak to each other,
but to empathize and to understand different world views. When we acquire language, we also acquire bits of that language’s culture, history, music, and literature. No longer are we English-speaking persons speaking French; we are French speakers. With global communication increasing daily, the demand for people who have the ability to communicate effectively in varying linguistic and cultural settings will also increase. The fact that language simulations are proving to be effective in the development of second language acquisition and communicative competence, will have a revolutionary impact on the way second language is taught, both here and abroad. Making the technology available and improving and adjusting the pedagogy is all that is required. This is, however, easier said that done.

Possible Push Backs

As with the adoption of any new technology, you will have your early adopter – those who will come on board early and enthusiastically, and on the other end of the pendulum you will have those who will dig their heels in and cling ferociously to the old ways of doing things simply because, “we’ve always done it this way.” And although those who oppose the use of technology in teaching for fear it will replace the role of the teacher, many would concede that technology, especially with today’s learners, has a vital role to play.

FUTURE RESEARCH

The true promise of technology in language instruction – actually in most instructional settings – is the lure of individualization. Unfortunately, we have not seen this particular seed grow and yield fruit beyond the self-pacing allowed to users as they navigate most technology-rich instructional materials. This does not mean, however, that the promise cannot be actualized; merely that it is an area that deserves more of our attention and research.

Research in this area has unfortunately been slow to middling. Many of it has been focused in the areas of gaming and simulations, and not much has looked into learning pedagogy, learner characteristics, or role of sound instructional design. As an instructional designer myself, it seems inconceivable to me that any type of learning could be crafted without sound instructional design theory and practice at its core. For language simulations to be truly effective, they must have sound design at their core.

The Needed Role of Instructional Design

Gaming and simulations involve the interplay of conceptual and procedural knowledge, in both the instructional content and the instructional environment. When constructing these language simulations, care must be taken to ensure that choices made are based on sound learning theory, instructional design practices, and instructional theory. Creating language simulations can’t be just about incorporating all the latest bells and whistles. It cannot be just about the technology, nor should it be completely technology driven. Instead, to ensure learning effectiveness, they should be grounded in language learning pedagogy and constructed using sound instructional design principles (Nichols, 2003). Therefore, anyone crafting language simulations should keep the following in mind as guidelines to ensure effectiveness. Know Your Learner. The learner is always at the center of any learning situation. It is therefore essential that language simulations be learner-centered and not content-centered. By conducting a thorough – not necessarily lengthy – learner analysis will produce the necessary information that will allow designers to create simulations that are based on learner characteristics, and not based on the content or the available technology. Define Learning and/or Performance Goals. Unfortunately, many learning games and simulations fail to identify learning and performance goals (Clark & Mayer,
If you don’t know where you want your learners to end up, how can you possibly map out the most expedient route to get them there? By not having performance goals or objectives leaves the learner in the dark as to what skills they are trying to attain or improve upon. This results in learning games and simulations that do not build knowledge or skill, and do not foster learning at all. **Pick Appropriate Instructional Methods.**

A consequence of knowing the learning and/or performance goals prior to beginning work on the design of a simulation is being able to select appropriate instructional methods. By selecting appropriate instructional methods, learning is accommodated. These methods may include learner-centered design, scenario-based learning, and problem-based learning. By utilizing the most appropriate instructional method for the predetermined learning outcomes, adult language learners will then be more likely to reach these learning and performance goals more effectively and efficiently (Clark & Mayer, 2003). **Use Appropriate Learning Theories.**

Learning theories endeavor to explain how learning takes place. For language learning simulations to truly be about learning or acquiring new skills, at the heart of them there must be the understanding of what is learning, how it takes place, and what research tells us about what factors lead to learning (Clark, 2002). By utilizing concepts from learning theories such as behaviorism, cognitivism, and constructivism appropriately will no doubt have a huge impact on their effectiveness. **Use Correct Instructional Theories.**

Richey (1997), explains that theory can either explain relationships among variables, or how to do a procedure. Seels (1997), on the other hand, says that theory is an explanation of phenomena that help us understand and deal with the world. Reigeluth (1997), states that theory is goal-oriented and tries to offer means for accomplishing a given end.

By following these guidelines, designers and developers of language learning simulations acquire the learning and performance results they are striving for. Implementing these practices will also help to assist learning and build knowledge and skills that learners will be able to use in real world settings (Clark & Mayer, 2003). Also, by implementing these practices, learning will be more effective and efficient for the learners. This will no doubt translate into a positive effect on learner motivation (Clark & Mayer, 2003).

By utilizing a systematic approach toward the interaction between instructional strategies, learning theories and instructional theories, more effective learning simulations can be produced. Instructors, designers and developers must adopt a “theory-into-practice” design framework in order to produce more effective learning simulations. Learning through gaming and simulations must be grounded in proper epistemological frameworks in order to be effective, like all other forms of learning (Bednar, Cunningham, Duffy, & Perry, 1991). Language instructors, linguists, media personnel, and the instructional designers they work with to create language learning simulations must develop awareness about the theories that support learning and instructional design.

Research into the role of instructional design and design theory in terms of language learning simulations so far has been very little. Due to its potential to impact use and effectiveness, however, we believe that more research will be conducted in this area in the near future.

The current technology that is being utilized to create language learning simulations is extremely effective, but tremendously costly. Are there similar technologies that can be used to control cost without sacrificing quality or effectiveness? How can research into this area move things along? Also, currently, most focus primarily on adult learners with some basic language skills. So, what about everyone else?

The role that language simulations are currently playing in language instruction is being pushed by-and-large by paradigm shifts within the linguistics community. Communication is now the emphasis, and as long as that remains so,
simulations will have a role to play. Also, language simulations are currently only being used for older language learners and those who have acquired some basic language skills in the new language. The current status quo begs for the following questions to be asked. Where do younger learners and those who have no second-language skills fit in this new paradigm? Can language simulations work in fostering second language acquisition and communicative competence in elementary school learners? What pedagogical elements would have to added or altered? Would and/or should these simulations be more game-based and why? What role does instructional technology research play in improving learner outcomes? And most importantly, can they be created in cost-effective ways so that they can be available to this particular learning community?

CONCLUSION

A new generation of language instructors and learners are ushering in new ways to acquire and use second language effectively. It’s being done in a way that is not boring or isolated from real-world experiences and cultural contexts. Language simulations are offering second language learners ways to play with language creatively and constructively. They offer learners dynamic, safe, real-to-life communicative experiences where they can stretch their verbal wings without the fear of real-world consequences. They foster language acquisition and competence, which is what being a full-fledged member of any language community is all about.

REFERENCES


Language Simulations for Fostering Language Acquisition and Communicative Competence


**KEY TERMS AND DEFINITIONS**

**Language Learning**: Language attainment via purposive instruction of language rules and structure.

**Language Acquisition**: A subconscious attainment of language which allows one to be culturally literate and communatively competent in a language.

**Communicative Competence**: A person’s ability to communicate in a target language in an appropriate way.

**Simulation**: An untaught event in which the participants have (functional) roles, duties, and sufficient key information about the problem to carry out these duties without play acting or inventing key facts.

**Theory**: An explanation of phenomena that help us understand and deal with the world.

**Linguistic Competence**: The knowledge internalized by a speaker of a language, which, once learned and possessed, unconsciously permits him to understand and produce an infinite number of new sentences.

**Grammatical Competence**: The mastery of the linguistic code. It is the ability to recognize lexical, morphological, syntactical, and phonological features of a language and to use these features effectively to interpret, encode, and decode words and sentences.
Chapter 14
Amateur Radio in Education

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ABSTRACT

The intention of this chapter is to increase capacities in educators for using computer- and communication-related technologies and to help them to acquire systematic knowledge in basic computer networking and communicating with their peers, other teachers, students and their parents. In form of introducing ‘packet-radio’, one of the most popular amateur radio computer-related communication modes, the mission of this chapter is to motivate teachers and students to use the amateur radio hardware and software for designing AMUNETs – the Amateur Radio University computer Networks – within their school buildings and around university campuses. The purpose of this chapter is to involve scholars to the world of amateur data exchange in an easy way by describing simple experiments related to networking simulations in local area networks. The goal of those experiments is to provide enough knowledge and experience with the amateur radio software before starting experimentations with real radio devices.

INTRODUCTION

The U.S.-based Association for Computing Machinery (ACM) regularly distributes its on-line newsletter ACM TechNews¹. During the last 4-5 years, this author collected a worryingly increasing number of TechNews headlines, as follows:

“IT-related degrees has [sic] fallen about 50 percent”,
“Australia is currently in the middle of the worst IT shortage in its history”,
“Is Computer Science Dying?”,
“U.S. students are falling behind in science, technology, and engineering”,
“Decreasing numbers of women in IT”,
“The number of computer science graduates in Canada continues to dwindle”
“Japan is starting to run out of engineers and is
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facing a declining number of young people entering engineering and technology-related fields”, and so forth.

It is obvious that the world of science and technology is going to face more and more similar stories. According to the titles listed above, it seems that from the beginning of the new millennium, the educational systems in (some of) developed countries keep failing to motivate young generations to choose their professions in information and communication technologies and electrical engineering areas. For that reason, it is imperative for educators and technology practitioners to search for new ways and methodologies of persuading young pupils and students that technical professions are not reserved for technological ‘geeks or computer ‘hackers’, which is a common prejudice these days. That means it is necessary to include alternative views and methods to show to the youngsters that electrical engineering and computer science are suitable for all, including women and minorities.

Amateur radio can have an important role in efforts to (a) attract more young people to the field of engineering, and (b) create a positive image of information technology in the minds of prospective students. According to Davidoff (1994), we should support the amateur radio in education because it may lead many young people to consider their career in science and engineering. We also share Davidoff’s viewpoint that “it’s economically advantageous to a modern country to have a significant number of citizens well trained in these [amateur radio] areas.” (Davidoff, 1994, p. 4/17).

The amateur radio is an old fine hobby from the days of inventing Morse alphabet and implementing telegraphy. Since the second half of the 19th century, millions of volunteers learned new skills in communications – while attending the amateur radio courses and successfully passing examinations; getting the first amateur radio licenses and transmitting signals to the spectrum. The electronics industry recognized the incoming ‘flood’ of the new communicating enthusiasts, coming from all over the world and predicted them to become a good market. The radio amateurs are capable to establish unusual radio paths via Moon and artificial satellites, to exchange voice transmissions with crews on the space ships, even to make an urgent search for medicines on the other continents. Today we have many opportunities to purchase sophisticated and computerized amateur radio ‘gadgets’ which include not only traditional but also fascinating brand new communication modes. Besides telegraphy and radiotelephony, there is a variety of computer-related possibilities to explore.

The amateur radio encourages teachers and students to learn various mechanical and electrical skills needed for constructing amateur radio repeaters (radio-relay devices), maintaining antenna towers, cabling systems, installing e-mail servers and exchanging practical experience with surrounding schools and universities. Dealing with computer hardware and software require from educators to acquire basic knowledge in electronics design and programming. Preparing technical equipment and establishing direct keyboard-to-keyboard contacts between students, teachers, or both - on one side of the link, with remote correspondents on the other side, produces a lot of excitement. In addition, wireless communications with the astronauts on space missions opens new horizons in physics, astronomy, biology and related disciplines. McLarnon (2008) clearly states that the major impediment to the use of amateur radio in distance education is the knowledge and effort required to establish the initial infrastructure, because it is not as simple as connecting a modem to a telephone line and running some software. The proficiency needed to build reliable antenna systems, repeatedly test radio link performance, install various kinds of networking software, and deal with unexpected problems that inevitably crop up, one can only gain through experience. That is why we want to add the amateur radio to the experiments in school labs.
As a result, all of that leads us to obtain much more technical knowledge than the every day’s usage of commercial systems in mobile or fixed telephony and the Internet. In addition, participants in the amateur radio networking systems increase their abilities to cultivate friendships with other students and educators from all around the world. If they get motivated enough to build their home amateur stations too, that case the school ‘never closes’ because after the classes the users remain capable to interact with the school’s bulletin board system, read and post new information and so on. In the same time, there is no need to pay extra costs for telecommunications because amateur radio frequencies are free! In opposite, increased telecommunications costs have always been an issue for schools’ networking projects (Lucas, 1997) and that is another reason why amateur radio should take place in educational environments.

The chapter gives more opportunities of digital amateur radio experiments in educational environment that are going to improve overall technological awareness in schools. To make it easier to implement real amateur digital radio in schools, we suggest a step-by-step approach in learning various features of some open-source and free ‘ham’ radio programs. According to the author’s personal experience with the amateur radio software, one of the main tasks for prospective ‘ham’ radio leaders in schools is to explore as many options of suggested computer programs as possible. First, an educator has to teach himself or herself about basic installing, configuring, activating and running those programs before he or she invites the students into the world of ‘ham’ radio.

BACKGROUND

The radio amateurs always liked to include some parts of their volunteering research and technical investigations to local educational systems. Many elementary, middle and high schools became targets of those attempts because we, the existing amateur radio enthusiasts, knew that young generations are the main source of newcomers of this hobby. It was not an easy task to involve teachers at first. Some of them thought that such a strange activity might give them additional requirements – besides their primary jobs of education. The others have already heard about the amateur radio communications but considered it as a non-attractive way to hold their students’ attention. Despite all those prejudices, the amateur radio hobbyists have formed several beginner groups within the schools and universities all around the world. In 2000, the American Radio Relay League (ARRL) started their Education & Technology Program, with two main challenges: “… to improve the educational experience by enticing students to greater participation in science, math, language arts and social studies, and ... to create a skilled technological workforce for the future” (Hill, 2002, p. 52). The program was very ambitious and its goal was to have 300 schools participating by 2006 with a budget of $1 million.

Many teachers realized that investments of time and energy returned with a plenty of joy and excitement within the schoolrooms. Those colleagues who were lucky enough to obtain specialized tech labs for the amateur radio experiments discovered that many students were likely to spend their free time – either between the classes or after the school hours – to establish some quick conversation with their friends down the road, in the other city, or both. In the same time, the young generations did a lot in promoting the hobby in their neighborhoods because the common use of fascinating new hand-held radios (‘walkie-talkie’) became more and more visible in the schoolyards and in the paths from schools to homes and vice versa.

As expected, the amateurs have managed to link their radio stations with home computers. In the early days of amateur radio computing, we used ancient Commodore™, Atari™, Amiga™
and similar models but the real excitement appeared with first IBM PC™ compatible machines, equipped with DOS operating system. Larger hard disks and more working memory allowed us to dedicate some of those computers for ‘store & forward’ facilities, which meant to deal with the amateur radio e-mail. As computing technology improved, so did the amateur radio programs. As a result, many variants of amateur communicating software for Microsoft Windows™, Linux and Mac™ environment became extremely popular.

Unfortunately, a significant decrease of interest in ‘ham’ (amateur) radio happened in parallel with exploding usage of cell telephones during the last decade. In addition, fewer students became interested in the amateur radio computer-related modes as soon as they discovered that they could use ‘fixed’ phone lines and the Internet for daily keyboard-to-keyboard communications – including the fact that neither telephony systems nor the Internet requires any course and examination. Interestingly, fewer educators have even realized that massive usage of commercial systems makes from their students technically illiterate consumers of technology, but not innovators what the radio amateur always were. As an example, is there anybody asking a fifteen-year old to explain how a cell base station works, or to explain what TCP/IP really means – before he or she starts with his or her SMS messaging or browsing the web sites?

Nowadays, many students are hardly able to make a distinction between a power cable and antenna cable in their households – which is uncommon for the radio amateurs. Besides that, we teach our young colleagues, the users of ‘ham’ radio systems to behave in polite manner and listen what is happening on a frequency before they start with their transmissions. It is something similar to take care in traffic and check (or not to check) if the road is clear before you leave your garage with your car. In addition and per default, the radio amateurs are well educated to read rather complex service manuals and fix small technical problems by their own before calling the service staff. Finally, the radio amateurs take various safety measures related to proper grounding of the equipment and antenna installations - particularly in the areas of frequent bad weather conditions.

The amateur ‘packet-radio’ – a known name for computer-related radio communication systems (see Figure 1) has been in wide usage for a long time now. Several books explain basic technical parts of the packet-radio equipment and offer some practical instructions and suggestions about ‘do’-s and ‘don’t’-s within the amateur radio experiments. Majority of those books seem to include too many engineering definitions and focus to ‘playing’ with technical parameters that are primarily interesting for engineering students who have technical background and possible experience with electronics but unfamiliar with people who do not belong to electrical engineering or computer science world. In addition, there is no real use of so-called ‘tweaking’ (fine-tuning) technical parameters within the amateur radio equipment, if you are not completely sure what you are doing and why. (This author has been practicing the packet-radio for more than a decade and a half, and during all that time, he changed his modem’s parameters only once or twice!)

Figure 1. The amateur ‘packet-radio’ – a computer-related radio communication system
Furthermore, the existing literature often lacks to give some ‘future views’ and suggestions about what ham digital beginners might do after their first keyboard-to-keyboard correspondences, or to distinguish the advantages of low-speed packet-radio vs. high-speed Internet connections which, in turn, could motivate more newcomers to implement alternative communication modes in their educational milieu. For example, dozens of poor pupils in various rural areas and developing countries might get used to exchanging amateur radio e-mail without fixed or cell telephony and without Internet connectivity, and even that way to be capable to communicate with their distant peers who are lucky enough to have a variety of (rather expensive) commercial services. As Diggens (1990) state, the amateur radio communication is a cost effective and reliable data transmission system for isolated communities and homesteads – particularly when an ‘isolated teacher’ is on vacation or is absent for possible visits to the city. In fact, the packet-radio stations that include high frequency (HF) outputs, or the amateur satellite capabilities for approaching long distances, or both, as well as the Internet gateway outlets, can offer worldwide connections with other continents and the astronauts on space missions at almost no cost for remote end-users!

A known amateur radio individual, Steve Ford, WB8IMY, offers an interesting explanation of the Internet gateways (Ford, 1995).

Nevertheless, the available technical literature has often underrepresented and poorly explained affordable hardware and software solutions for computer-related communications and amateur radio university computer networks – AMUNETs. One of the possible reasons for such approach is that majority of the book authors came from developed nations – well equipped with electronics market and better opportunities for assembling digital radio systems. In opposite, the amateur radio instructors should always focus their tutorials and seminars to inexpensive sources of both radio and computer hardware that saves us some moneys, including so-called ‘kits’ of prearranged electronic elements for home soldering and practicing in school assembling labs. Besides that, we should give much more efforts to popularize free and open-source software, which are often products of the amateur enthusiasts’ spare time hours and volunteering. One should keep in mind that giving credits to those individuals who gave us opportunities for using free programs (as well as to those who write free operating manuals) motivates those authors to continue with improving their valuable works. All of that contributes to the general technical literacy and increases the level of so-called ‘technical culture’ – both in a local community and globally.

Lucas, Jones and Moore (1992) found that the amateur packet-radio brings benefits for many individuals and groups who have tight connections with an educational environment. Those are people like pen pals; those who conduct cooperative laboratory experiments with sharing and comparisons of data, or those who co-author various reports or stories in analog and digital theory, social studies, mathematics courses or in combinations of all mentioned. In case of establishing connections by using the amateur radio satellites for data communications (so-called PACSATS), the school’s foreign-language classes would also benefit. We strongly agree that, generally speaking, “students need to be challenged, motivated, and given skills for the work force of tomorrow” (Lucas, Jones and Moore, 1992, p. 10).

The exciting networking opportunities for regional and global connections would not be possible without improvements in the regulatory environment. Some amateurs predict that the hobby might find itself in a difficult situation if we do not invent new opportunities to solve international legal issues, related to the mandatory manual Morse alphabet courses and examinations - that are nearly popular as many decades ago. The amateur radio community must face to these obstacles, which prevent more ‘fresh blood’ to enter the amateur radio community, because the
commercial systems keep pressuring regulatory bodies for the new parts of radio spectrum. If the earlier users abandon some portions of their amateur radio frequencies, it is obvious that the authorities might take them back - on behalf to the non-amateur services.

To summarize, despite visible and non-visible efforts of commercial service providers to remove any concurrency, it would be hard to imagine the society without valuable amateur radio knowledge and experience. Besides its important role in elementary education – as a motivating factor in new generations to continue with learning technology and engineering, the amateur radio has its humanitarian, scientific and professional roles. Many human lives and properties we could save thankfully to those who were technically capable to establish contacts with the first aid and other rescue services after tornadoes and hurricanes.

Educational Perspectives of the Amateur Radio

We believe that the amateur radio communications should take an important part of schools’ technical and social activities. After the classes, teachers and students can get together in their schools’ technical labs and discuss on future experiments. There is always enough room for new ideas and plans – related to the underrepresented amateur digital communication modes (HF packet-radio, Pactor, G-tor, Clover etc.). In addition, members of the school’s ham group can also practice with ‘traditional’ emissions, like radiotelegraphy, radiotelephony or radio teletype. A plenty of various amateur radio opportunities give a chance for everyone: Those who have talent for deciphering manual Morse alphabet would enjoy comparing their personal skills with the telegraphy operations included in high-end multi-mode data controllers. Foreign academic experience in the amateur radio shows that not only developed nations, like Cuba, have also been experimenting with the amateur digital radio, using VHF and HF radio frequencies, as shown in Figure 2. By using their VHF transmitters on 144.675 MHz and adding an amateur radio repeater in between, two Cuban universities have interconnected each other. In addition, they experiment with two HF channels, 14.107 MHz and 14.095 MHz², for establishing contacts with the foreign amateur stations (Skoric, 2005). In that manner, those academic institutions are capable to exchange amateur radio and related technical information with their amateur counterparts within and outside the country – without using commercial communication systems, like cell telephony or the Internet.

A fact that the academic community often misunderstand is that the computer-related amateur radio communications do not require additional expenses after the initial investments in basic equipment. That practically means that an established amateur radio communication with a remote correspondent can last for several hours but such long connection will not increase expenditures for telephony and Internet connectivity in the school. Another good thing in digital amateur radio communication systems is that the school can start with relatively small investments in beginner’s equipment and accessories – just to start with the experiments. Later, when the appetites grow, you can easily upgrade most of the existing packet-radio systems with new, faster modems and more channels for remote access at different radio frequencies and so on (see Figure 3). If your institution is equipped with computers of newer generation(s), there are technical possibilities to modify their computer sound devices in order to use them instead of dedicated modems. (For using the sound cards in the amateur radio, the users must switch computers on and leave them running – as long as any digital operation takes place.) In case of the external data controllers (modems), they feature some additional functions like personal e-mail boxes, which stay in full
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Regardless of type, computers attached to modems allow their operators to transmit and receive text files, programs, digitized images, and digital music and such activities became commonplace for computer users, especially for young people who have computers in their homes (Hudspeth and Plumlee, 1994).

After looking to the Figure 3, one can ask why we should introduce such specific, ‘closed’-like connection between local universities and, say, midlevel technical schools in an area. We think that such links bring new quality to both parties. The university enlarges its pool of potential ‘customers’ (student candidates, uncovered young talents etc.) and, in the same time, offers new opportunities to the midlevel teachers (technical coordination between the amateur radio system administrators at both academic and midlevel institutions; sharing knowledge between the educators including an eventual electronic access to the academic library for the midlevel teachers etc.). That means, during the on-line amateur radio interactions with their older ‘counterparts’, the schoolchildren could realize that on the other side of the radio link is something unknown and provocative enough to study in the future, which will increase their interest and motivation for studies. In parallel, the schoolteachers will communicate with their colleagues at the academic level and interchange didactical experience or so.

After the hours, students and teachers can attach to their local AMUNET and continue with making wireless contacts with their peers, colleagues at other schools and universities as well as with their parents by using their home or office computers and amateur radio stations (A, B and C in Figure 3).

The proposed innovative learning approaches with modern technology would not only increase the interest in students for eventual replacement of costly SMS-messaging with less expensive opportunities, but in offering their teachers new horizons in ‘alternative’ communications. For example, various natural disasters caused by earthquakes, tornadoes or like, often result in destroyed official communication systems. With implementation of amateur radio, schools’ officials would be capable to establish ad-hoc communicating systems to help to their local communities with exchanging data related to injured people, food and water supplies or so. In addition, whenever
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an educational institution has technically skilled personnel, including teachers and students educated for maintaining amateur antenna towers, or servicing accompanied cabling systems and radio devices, it is a better chance for helping to re-establish new routes of official communications and replace broken commercial systems. Before the ‘official’ technicians come, the local ‘ham’ enthusiasts can put together a laptop computer, a modem and a hand-held radio in a vehicle and establish an ad-hoc digital relay system from the nearest hill. In opposite to that - when the local community does not have skilled amateurs living in the area, the chances for bridging emergency communication gaps are going to minimize.

Technology integration & implementation have an important role within the amateur radio communications: Mechanical infrastructure of antenna towers and developing various antenna designs; different options in using amateur radio stations (some inexpensive radios we can use for both voice and data operations, but some specific radio designs are only intended for computer-related operations). In some cases, electronic modifications of cheaper radios are possible in a way to allow for faster data exchange, but sometimes the modifications are irreversible which means the voice modes are not possible anymore.

Besides their end-user stations, or in parallel with them, the educational institutions can develop specific radio-relay infrastructure (‘repeaters’) intended for satisfying the needs of local teachers and students as the end-users, as well as regional-wide facilities like the amateur radio BBSs (Bulletin Board Systems), already known and widely used in wired telephone networks. “The BBS … provides remarkable opportunities for collaboration among diverse groups of people, young and old, experienced and inexperienced, business and school people” (Hudspeth and Plumlee, 1994, p. 7). Blystone and Watson (1995) state that the bulletin board systems are mechanisms for improving communications among students, teachers, parents, as well as for school or local community administrators. They consider an electronic bulletin board as “an excellent way to get parents and community members more involved in school activities” (Blystone and Watson, 1995, page v). Blystone and Watson also realized that during the nineties it was not a problem for even family members to access the school’s boards to check for school’s activities, share information,
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read public messages, and similar. (At the time of writing this chapter, we have not found eventual updated reports of the authors cited in this section, so we can only presume that the progress in information technologies since the nineties brought even more bulletin board opportunities – including remote access over the World Wide Web etc.) Because of the mentioned ‘electronics’ activities and mutual interactions between the schools and homes, Blystone and Watson found that the educational institution that offers such an electronic public assess to its activities, may expect to acquire a better public image for itself.

Using the similar principle, all ‘hams’ who live in an area of coverage of the amateur radio BBS are capable to join the schools’ technical activities – regardless they are teachers, students, parents or not. In addition, if the local amateur radio infrastructure provide links to similar systems, located in surrounding school districts or university campuses – the opportunities for a scientific collaboration are even better. For example, with using the amateur packet-radio communications between a university and surrounding schools, the high-graders and their teachers might get useful information related to texts and documents that are available on the academic end of the radio link: new book titles in university’s libraries, affirmative options for prospective student-candidates, attractive openings to academic positions or like. With conducting intercontinental amateur radio communications, the students will learn more about the customs and cultures of others around the globe. If an educational institution continues with development and investments in the amateur radio satellite equipment – there is significant probability that its pupils will increase their interest in astronomy, spatial research or like. In addition, there are possibilities to interconnect the amateur radio infrastructure and the Internet, so the students could exchange e-mail messages with the Internet users.

A significant advantage of implementing amateur radio over commercial services is the lower cost because there are no long distance telephone charges for handling e-mail messages. The same goes for BBS-to-BBS e-mail exchange intervals with the amateur radio because they do not need to occur “[as the telephony-based systems do] … in very early morning hours when telephone rates are lowest” (Blystone and Watson, 1995, page v). Actually, the amateur radio bulletin board systems usually exchange their content every few minutes, which also means the data traffic does not have much delay – in global measures.

The implementation of the amateur radio computing in a schoolroom is a kind of developing, integrating, and delivering alternative e-learning solutions and ‘distance learning’. The students participate not only by reading and by writing messages but also by bringing their teachers new ideas for improving installed facilities, with commenting the features of those systems during the breaks and so on. In addition, the feedbacks that come from the broader ‘audience’ – the amateurs who live in the area, are useful for further development and upgrading those systems. There are also enough places for skilled radio amateurs to conduct instructional workshops for teachers, parents and students. According to Blystone and Watson (1995), we should upgrade the curriculums of computer science courses for educators with telecommunication topics as a way of promoting educational telecommunications. They have also found that “… students are not likely to experience something that their teachers have never experienced … [and teachers] … are not likely to push for instructional devices that they are unfamiliar with themselves” (Blystone and Watson, 1995, p. 11). That is an obvious reason why we should invite, at least, the high-school teachers in physics, technical education, or both, to attend amateur radio classes in the local ‘ham’ clubs and societies. After completing the courses and obtaining their first radio licenses, those teachers would become qualified enough to perform basic amateur radio operations in their schools, which means to adopt innovative instructional
technology applications and keep up with modern instructional methodologies.

One of the frequently asked questions relates to the most appropriate computer hardware and software for use in the amateur radio experiments. The answer is simple: The basic amateur ‘packet-radio’ works in clear text mode, so any kind of hardware and software, which is capable to produce readable lines of text on the screen, is completely suitable. There is no need to invest a lot of money into a brand-new computer equipped with Intel Pentium™ IV or similar central processor unit, because the older versions of PC-compatible computers would do the job. The same goes for modems and radio stations. Simple, inexpensive modems for either RS232 or LPT ports are suitable for basic 1200 bit per second connections to the nearest digital repeater or a BBS. If a distance between the school and the repeater is no more than, say, 10 miles or so, various hand-held amateur radio stations would satisfy basic needs. In addition, a cheap external antenna would help to reach a distant correspondent – rather than an investment into an expensive high-power radio amplifier. When it comes to specialized computer programs, we strongly recommend FBB, one of the most popular amateur radio programs for BBS operations that come in versions for Microsoft DOS, Microsoft Windows and Linux platforms. Various end-user programs are available for both IBM PC-compatibles and other types of computer. The majority of those programs are free for use in the amateur radio communications.

Lucas, Jones and Moore (1992) suggest the teachers to ask the radio amateurs who live in the local community to set up tests and demonstrations to determine required equipment because it is possible that additional investment in some equipment has to be done (antenna towers, rotors etc.) – if the educational institution is located in low-lying area or so. We agree with such recommendations because an ad-hoc digital system can be easily set up on site.

Some scholars express their concerns about security and privacy issues in the amateur radio computer networks. All ‘ham’ radio traffic has to travel in clear, which means no information may be scrambled or enciphered. Such legal requirement is in accordance with general educational point of view because all students could read what their other colleagues send and receive – so they could become aware of the ‘best practices’ in radio traffic. In addition, the radio amateurs have implemented various ways of protection of their ‘usernames’ from possible misuse by eventual amateur-radio ‘pirates’ (Skoric, 2008a).

**Samples of Educational Experiments**

Before an educator decides to ask his or her school’s principal for finances to invest into real amateur radio devices and accessories, it is advisable to perform as many experiments as possible in your existing environment. The good thing is that you can simulate many ‘radio’ activities – within your own local area network (LAN). The first scenario we are going to describe considers the ‘sysop’ (the system administrator) is the single user of the system. To be completely precise, in the experiment there is no active LAN required yet. As shown in Figure 4, all we need is an average office or home computer, which is capable to run FBB software. (You can temporarily disregard functions of the TNC’s – Terminal Node Controllers, i.e. amateur radio modems; radio stations and accompanied antennas shown in Figure 4.)

The situation described in Figure 4 is the best approach because it is a start of a beginner’s multiphase self-learning process. This is the simplest situation where the central part of the ‘game’ is the bulletin board system’s operator keyboard (a ‘console’). Practically, nobody but the system operator is involved in using that system. Besides the educator’s playground role, something like that is also suitable for various software test beds and isolated areas with no radio users. If techni-
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Figure 4. Scenario 1: An educator uses his or her office computer to try e-mail server programs in a ‘test’ mode (without real modems and radios attached)

Figure 4. Scenario 1: An educator uses his or her office computer to try e-mail server programs in a ‘test’ mode (without real modems and radios attached)

...choice is up to you.

After the teacher becomes a little bit comfortable with the new software, it is the right time for the next learning step, which is an extension of Scenario 1. So, in the second scenario (shown in Figure 6), we still do not need an active LAN, but this time we encourage the prospective amateur radio practitioner to try it all with Linux operating system, because if Linux is used – there are more possibilities to acquire experience in computer networking. The software we use is so-called LinFBB, the Linux version of FBB.

By performing experiments shown in Figure 6, the educator is able to simulate an incoming connection attempt to the server he or she administers – and all of that is possible to do at no cost, because the operating system is free and appropriate software for it is free for non-commercial amateur experiments. There is a variety of options: First, an xfbbd server has to be active and running. If the particular computer runs Linux in text mode, the xfbbC client program is available for the ‘sysop’. Be aware that xfbbC runs with full administrative privileges, which means it is intended for e-mail server administrator. In op-
Figure 5. Scenario 1: The educator’s computer, running WinFBB e-mail server program in a ‘test’ mode

Figure 6. Scenario 2: The ‘sysop’ explores and test extended networking options. This is an advanced learning step for a BBS system administrator who can experiment with intricacies of Linux and learn of both text and graphical environments in that operating system. The ‘sysop’ can also practice how to add or remove privileges to his or her future users.
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Figure 7. Scenario 2: The educator’s computer runs LinFBB e-mail server in a ‘test’ mode. The four consoles represent (from the upper left corner, clockwise): xfbbd ‘daemon’, xfbbc frequency monitoring utility, simulated incoming telnet request, and xfbbc operator’s console.

In Scenario 3 (see Figure 8), the local user access from the LAN is possible. Once again, the ‘sysop’ is responsible for proper maintaining of user permissions given to his / her customers – students, teachers and others who use the school’s LAN. One should take care of the correct assigning the young end-user privileges, in order to avoid posting messages by using inappropriate language or bad words, deleting something important within the e-mail server software or anything else that could compromise the whole system. When it comes to assigning the proper user permissions, we suggest starting with a ‘read-only’ level and increase the user capabilities incrementally – according to the communicating skill acquired, eventual assigning co-sysops or so.

The end-user software solutions (listed in Figure 8) come at no additional costs because they are either already included within the existing operating system (‘telnet’ command or its derivatives), or it is xfbbw – another free amateur radio software, intended for use with LinFBB. Before starting with their student experiments, the users on the school...
LAN should have elementary knowledge about computer networking and get some basic instructions like using ‘telnet’ command or so.

An example of the third scenario is shown in Figure 9. As we can see, the best beginner’s approach is the well-known ‘telnet’ command. It is nothing simple than that! The only parameter a user has to know is the server’s IP address (See the header of the window in Figure 9: In that case, the IP is 192.168.1.1).

Figure 9. Scenario 3: The students and teachers access their e-mail from within the LAN. The users can exercise their abilities to use ‘telnet’ command within their local Windows, DOS or Linux working environments.

Figure 8. Scenario 3: Students and teachers can access their e-mail from within the LAN and simulate a radio access to the BBS. The users can exercise their abilities to use ‘telnet’ command within their Windows, DOS, Linux and other working environments. The ‘sysop’ does not need to stay at the FBB console anymore: He or she is capable to monitor their users’ activities, by running xfbbW – an administrative client program for Windows.
The fourth scenario (shown in Figure 10) is a step further: Now the end-user access is possible by using the ‘telnet’ command that is included within some external amateur radio programs for MS DOS operating system. You could ask, Why to use DOS-based computers at all? The answer is simple: DOS has proven as a simple and reliable OS, particularly in educational environments where the users often switch off or reset their computers without proper closing active programs or so. Besides that, DOS is quite fine for the older generations of PC computers that many of us still have in our closets. For the sake of our experiments, we will use an ‘ancient’ PC machine equipped with CPU Intel 80286, operating system MS DOS v. 5.0 and amateur radio software Xrouter and JNOS. When using DOS-based computers for the local area networking, you have to activate your network card drivers before you run your main networking software (in this case Xrouter or JNOS).

Both Xrouter and JNOS implement the ‘telnet’ command in a similar manner the same command works elsewhere, so we could use it for accessing our bulletin board system that runs on the other, Linux-based computer. In addition, those of you who want to learn more about the variety of other amateur radio features implemented within Xrouter and JNOS, can do that before or after your ‘telnet’ session. (Both Xrouter- and JNOS-equipped computers we can use not only as ‘client’, i.e. end-user machines, but also as a kind of ‘gateway’ or ‘server’ computers for more complex amateur radio purposes that are beyond this primer.)

An example of using ‘telnet’ command in Xrouter software is described in Figure 11. As we can see, that end-user station is equipped with an old monochromatic black and white monitor, but that fact does not prevent the network participant to communicate with the e-mail server, by using ‘80 x 25’-line text mode. From the end user’s point of view, such a situation is completely the same as the one shown in Figure 9, because there is no difference in communicating with the remote party. After the successful connection, the user is
The fourth scenario involves our students and teachers into a pool of different amateur radio programs: FBB, Xrouter and JNOS. All of them have some things in common, but also have many differences and additional options to explore. For example, we might want to add packet-radio modems and radio stations to the end-user computers shown (the boy on the left and the girl on the right in Figure 10). In that situation, we extend working capabilities of those users: If it were an Xrouter-based computer, it would be possible to explore complex routing of TCP/IP data packets on top of the AX.25 (= ‘Amateur X.25, i.e. ‘packet-radio’) traffic. If it were a JNOS-based station, it would be possible to do the same, but with an added option of running a local (MS DOS) mailbox, a POP/SMTP server, a HTTP server and so forth.

The final step in our simulation tests is Scenario 5 that is an extension to the fourth one. As shown in Figure 12, now we are going to explore the usage of the ‘telnet’ command, but in the opposite direction. That means a user in the school LAN (that is the e-mail server’s ‘sysop’ in this particular case) is going to access a JNOS-based computer that runs in the mailbox mode. To allow incoming telnet access to JNOS mailbox by using the local area network, the sysop has to maintain appropriate...

Figure 11. Scenario 4: An old DOS-based computer, running Xrouter, produced this screenshot. The user has just initiated an outgoing ‘telnet’ connection to the FBB e-mail server. (A sample of bulletin list the user got after the successful logon is shown in Figure 16.)

Figure 12. Scenario 5: This option allows students and teachers to explore mailbox features of JNOS software, in the same way as if they access it by using the radio systems. That variant is suitable for further simulations of remote access to a BBS – without any radio station involved.
JNOS’ user privileges, similarly to those of FBB mailbox program, mentioned earlier.

Depending on the quality of a particular DOS + JNOS computer, you can expect faster or slower responses from your JNOS mailbox, like getting the lists of available messages within the mailbox or so. One of the reasons for the slower response is that every particular user connection has to be checked at the beginning of the next approach – in order to inform the user about his/her last connection, list of available (but not yet read) bulletins and so forth. It is also expectable to get slower response along with building a pile of newer and newer messages, which come to the JNOS mailbox database.

An example of the fifth scenario is shown in Figure 13. As we can see, a user of a Linux-based computer is performing a ‘telnet’ connection to the JNOS-based electronic mailbox in the school LAN. (Again, the incoming users have to be familiar with the particular server’s IP address, which is 192.168.1.2 now.)

**FUTURE TRENDS**

After performing the experiments described in the previous section, the next step would be to acquire the exciting experience and fun with establishing a real wireless exchange of the amateur digital data. Difficulties may appear with different radio regulations in various countries. Lucas, Jones and Moore (1992) reported that most categories of amateur radio licensing system require the candidates to be able to communicate using Morse code, despite a fact that the US Federal Communications Commission (FCC), as well as many other local (national) telecommunication authorities around the world, invented a special category of so called ‘codeless’ license that does not require knowledge of Morse alphabet. Nevertheless, the exam for this license does require basic knowledge of radio theory, electronics, regulations, station operation rules, operating etiquette, and so forth.

The main issue with the ‘codeless’ licenses is that they are mostly restricted to the VHF/UHF amateur radio frequencies. That means the holders of such licenses do not have permissions to enter the spectrum portions bellow 30 MHz – where the majority of international radio traffic is. To avoid these constraints, there exist ideas of completely abandoning the mandatory Morse code courses and examinations for all prospective radio amateurs. We can also implement an Amateur Digital License (ADL) system, which we planned for educating the candidates who are interested in data-only radio operations. With full implementing of the ADL ticket, newcomers who decide to attend appropriate courses and pass related examinations will be sure that they are going to use all data-only amateur radio frequencies and legally experiment with all available data-only communication modes (Skoric, 2004).

In order to promote amateur radio to the audience from the educational environment, it is not enough to present papers in scientific conferences and perform tutorials during such events. An emerging idea is to form an international summer (or winter) school on the amateur radio in engineering education. Such a school would be a place for teachers at all levels of education (elementary, middle, high and academic): To put them together...
and instruct about preparing basic packet-radio infrastructure. Besides the educators, that school would welcome participation of (under)graduate students and young researchers – provided they are licensed radio amateurs. Although it is not a mandatory requirement, the school could take place at a venue closed to university premises where social interactions could expand. “With careful planning and preparing, such activity could not only accommodate theoretical lectures and practical demonstrations within the school labs, but to include social, cultural and recreational activities for students” (Skoric, 2007b, p. 346). The main activity of such school would be to teach students and scholars to design, construct, and use the most suitable hardware (computers, modems, radios, antennas, power supply etc.) and software (server, client and repeater programs) for various implementations at home, school or work. The school might also host practical experiments conducted by skilled radio amateurs who live in the area around the school’s venue. The purpose of those experiments is to instruct the participants how to build electronic devices in labs at home or work; how to install specific computer programs and to regulate remote-access permissions. Figure 14 shows student-oriented amateur radio classes in southern Italy (September 2004).

Summer schools and similar events may trigger international experiments that are even more exciting and provoke eventual competitions for best technical designs or so. Future research opportunities in this area include not only improving the terrestrial ‘packet-radio’ infrastructure but also building amateur radio satellites, as students at the University of Melbourne, Australia, mostly undergraduate members of the Astronautical Society and Radio Club, noticed long ago (Davidoff, 1994). The viability of implementing the amateur radio communications within an educational environment

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*Figure 14. Tutorials, recreation time and history classes at the University of Calabria in Cosenza*
is not an issue as long as we have enough ‘critical mass’ of local radio enthusiasts fully equipped with good will. As Davidoff realized, a lack of experience had resulted in producing a relatively simple design of the amateur radio spacecraft made by the Melbourne students at the time, and we agree with Davidoff that such constraints should not decrease motivation for inventing new things because the amateur satellite program is not for the faint-hearted. Moreover, one of the most active academic research units is at the University of Surrey, England, whose each amateur satellite of so-called UoSAT family carries “… a collection of experimental payloads of interest to radio amateurs, educators and scientists … [by possessing a significant] … value for scientific studies, educational applications and disaster communications.” (Davidoff, 1994, pp. 4/6 – 4/7).

CONCLUSION

The scenarios described in Samples of Educational Experiments section should serve as an incremental, systematic teaching and learning solution that most of us can implement in our educational environments. As clearly shown the technical requirements are minimal so one can start with provocations of their students’ interest to wired and wireless communications at almost no cost – provided the particular institution’s local area network is fully functional. The goal is to expand teachers’ pool of opportunities for learning practical skills in computer networks and transfer that kind of knowledge to their students.

General approach to educational networking opportunities, including many useful instructions - related to planning, development and building schools’ technological infrastructure you can find in the Texas Center for Educational Technology’s (TCET) documents. One of them is entitled “Designing the Technology Infrastructure for Schools” by Hubbard, Lucas, Holmes, and Hons. An important note: All TCET documents we reference in this chapter are focused to the local environment and networking experience in the State of Texas and, sometimes, to the US schools in general. Having that in mind, we want to remind the readers that the valuable hobby of amateur radio is active in all other regions in the world – regardless their economic and otherwise global positions (as we mentioned for the two universities in Cuba).

The next thing is a fact that the majority of references related to possible connections between telecommunications in schools and the amateur radio resources appeared in the early nineties. They often and repeatedly discussed the basic principles of packet-radio protocol design and modem parameters. However, Lucas, Jones and Moore (1992) offered a rather comprehensive list of (then brand new) resources: papers, brochures and booklets explaining the basic activities for successful starting with “ham” radio. We advise the readers to keep in mind a fact that during the late eighties and the early nineties we did not have so many (if any) Internet services we know and use today (as well as the other commercial systems like SMS-messaging via cell telephony). A ‘competition’ between the amateur (wireless) radio and commercial (wired) systems led to the winning of the latter. Our intention is not to ‘compete’ with the commercial providers anymore but to focus to the features the telecoms cannot offer to the young generations, students, teachers and parents: The knowledge how the communicating devices work and a joy of self-producing your own infrastructure – independently from the ‘official’ systems we all pay for. In addition: “Amateur and packet radio contacts can enhance the perspective of students by providing a practical and realistic expansion of their world.” (Lucas, Jones and Moore, 1992, p. 10).

In this chapter, we wanted to direct our readers’ attention to the elements, which we did not find as reported enough during the last decade. In the same time, we did not want to go deeply into technological details that you can find elsewhere.
in the literature. Because of that, we would like to provoke the following discussions:

- **Possible improvements in laws and regulations that govern the amateur radio (Skoric, 2003):** Many national communications administrations keep practicing an old mantra that “only Morse-educated amateurs are good amateurs”, thus their regulations cannot motivate so many newcomers to join ‘ham’ radio community nowadays. The statistical numbers proved that young generations are not interested in Morse telegraphy as earlier, in spite of occasional intentions to ‘prove’ the opposite.

- **The so-called Amateur Digital License (ADL), as a way to bridge the gap between the number of prospective amateur radio digital enthusiasts and outdated rules and regulations (Skoric, 2004):** While we all have been waiting for abolishing the old-fashioned mandatory manual Morse code test, the ADL might be a transitional solution for prospective students and their teachers.

- **Availability of various types of radio modems (Skoric, 2006):** The most of works referenced in this chapter talk only about the modem family that has been commonly entitled as TNC (Terminal Node Controller). Despite main advantages of a TNC – it can serve as a personal radio mailbox while the computer is off, it can work as a fully qualified network node in parallel with its end user’s personal activity, and so forth – a fact is that various simple-design modems are significantly less expensive.

- **Using older generations of PC-compatible personal computers (Skoric, 2007):** Radio amateurs are technical enthusiasts who often cannot, or just do not want to, invest their finances in brand-new computers, because it is well known that they are always capable to perform most of their computer-related amateur radio tasks – using old computers equipped with x86-family CPU. The amateurs have performed many tests with the ‘ancient’ PC-compatible machines, which proved that there is no need to waste finances on expensive end-user stations. Besides that, whatever “state of the art” you already may have in your school’s computer rooms, you can easily attach some amateur radio infrastructure to the existing machinery. Using the widely known ‘telnet’ command within your school’s LAN, your students will have interesting opportunities to communicate with the amateur radio bulletin board system, as shown in Figure 15.

- **Security and privacy in computer-related amateur radio networks (Skoric, 2008a):** After paper and tutorial presentations, we often receive a couple of frequently asked questions (a) how to prevent potential misuse of identity in the amateur radio communications, and (b) how to fight against potential amateur radio ‘pirates’. The answer is that according to most local and international regulations, all amateur radio traffic must travel in ‘clear’ mode, which means no information may be ‘scrambled’. However, there are various ways to protect one’s credentials for accessing e-mail bulletin boards and hence we are capable to encipher or otherwise masquerade our passwords. Although there are not many cases of delinquent behavior in the ‘ham’ community, we encourage the newcomers to experiment with protective measures. That is particularly important task for the system administrators who are responsible for the content of their amateur radio e-mail servers.

We also want to remind the readers about the need for as much volunteerism in a community as possible. The amateur radio is an enthusiastic
hobby. Without all our practitioners devoted to the exciting amateur radio communications, there would not be enough ‘public’ resources for our pupils and other newcomers: Hundreds of bulletin board systems, innumerable radio-relay facilities and so on. Valuable information travel all around the amateur radio world and compose bulletin lists with contributions like satellite orbital parameters, weather forecast, amateur contest rules and announcements, and so on (see Figure 16).

Although the most of the resources are now in function thankfully to many ‘unsung heroes’ of amateur radio, including their personal finances, equipment and time – as long as those systems work, they provide countless opportunities and serve as public resources for the global amateur ra-

Figure 15. A non-expensive software test-bed in a local area network: The end-user station (far left) and the Linux BBS.

Figure 16. A sample list of bulletins a user in a school network can read and write
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The same goes for new educational and tutorial materials: We need more operating manuals that explain basic radio principles and good practices, interesting open-source software configurations and like (Skoric, 2008b).

REFERENCES


Amateur Radio in Education


KEY TERMS AND DEFINITIONS

BBS: An electronic Bulletin Board System; software that usually operates on a PC with one or more telephone lines, amateur radio stations and Internet connections to provide communication between remote users such as electronic mail, conferences, news, chat, files and databases.

Sysop: It is a short name for Systems Operator. That person maintains and runs a BBS. Some sources refer to the sysop as “system administrator”.

Gateway: A gateway is a computer that connects two different communications networks together. The gateway will perform the protocol conversions necessary to go from one network to the other. For example, a gateway could connect a local area network (LAN) of computers to the Internet. An amateur radio BBS might provide a gateway to a school’s LAN or vice versa.

Remote Access: The ability to access a computer from outside a building in which it is housed. Remote access requires communications hardware, software, and actual physical links. Different users can have different access rights (user permissions) associated with their account on a BBS or network(s) the gateway(s) can provide.

Repeater: In radio communications, a repeater is a device that amplifies or regenerates the signal in order to extend the distance of the transmission. Repeaters are available for both analog (voice) and digital (data) signals.

Duplex: Capability of radio stations, including repeaters, to transfer data in two directions simultaneously. That is often referred to as full duplex. When repeaters work in full duplex mode, amateur packet-radio traffic can travel more efficiently.

Bandwidth: Often used to indicate the data transfer capacity of media. It refers to the range of signaling frequencies that can be passed through the media. The channel bandwidth for standard 1200 bit per second amateur radio traffic on the 2-meter band is 25 kilohertz.

Microwave: Very high frequency radio waves. As the frequency of electromagnetic energy increases, the wavelength decreases. Microwaves have very short wavelengths since they are in the gigahertz (GHz) frequency range. Microwaves can transport more information; thus, they are capable of higher data transfer rates (higher bandwidth). They easily support data transfer at 10 Mbps or greater.

AMUNET: The abbreviation stands for the AMateur radio University computer NETwork, which is the proposed name for a wireless network of an amateur radio BBS at a local university, one or more amateur radio repeaters, and one or more end-user computers in surrounding schools’ computer labs, offices or homes.

ENDNOTES

1  http://technews.acm.org/
2  By transmitting HF radio signals at different frequencies, they (a) remove possibilities of mutual interference, and (b) increase their capacity for exchanging larger quantity of digital data with their foreign peers.
3  www.f6fbb.org
4  Most of the web servers and databases on the Internet run on various Linux platforms.
Section 3
E–Learning
INTRODUCTION

For more than forty years, information technology (IT) has been part of the infrastructure supporting schools and universities. Essential functions such as central planning, budgeting, scheduling, grading, and maintaining student records have drawn on IT resources, beginning with mainframe computers and migrating to other platforms. Now routine business tasks are distributed throughout the workplace. Individual departments and faculty members regularly use tools like word processing, spreadsheets, publishing tools, email, and the Web for their research and administrative needs. Now that technology is widely available on most university campuses (The Campus Computing Project, 2001), the integration of these technologies into higher education for teaching and learning practices have become more important. According to Schrum, Skeele, & Grant (2002, p. 258), professors use software tools, like word processors, but rarely use technology for teaching or require students to use it for assessment purposes. McKenzie (2001) and Parisot (1995) examine the standard practice of higher education institutions in which they buy the new and complex technologies and simply make them available to faculty members without any attempts to build an infrastructure to support faculty adoption practices. If higher education is to survive the onslaught of technology, then they have to devise plans to support the adoption of such innovation (Hagenson & Castle, 2003, p. 2).

Although studies have been conducted at K-12 school level and universities alike, few studies have inquired qualitatively into the end users experience during the technology adoption process in a higher education setting or to connect experiences to policy to support and develop faculty in their quest to adopt technological innovation. Just as educators in teacher preparation program have a special challenge in preparing pre-service teachers for the integration of technology into instruction, higher education have an obligation to prepare their faculty for the adoption and integration of technology into their instruction. While technology is used more often for administration and research purposes in the higher education setting, it is used less frequently for instruction (Spotts, 1999; Zhao
due to the fact that the integration of technology into teaching challenges the prevailing dominating traditional mode of practices of faculty members and universities (Anderson, Varhagen, & Campbell, 1998; Pope, Hare, & Howard, 2002). Through research and practice, we as critical researchers must critically analyze, understand, and critique all forms of practice that hinders full participation of faculty in their quest to use information and communication technology. Thus this article is to uncover the associated practices of how faculty use technology in the teaching and learning process. Since, few studies have inquired qualitatively in this phenomenon, the author seeks to explore the issues of technology adoption and its implication toward leadership and training and development based on the personal experiences of faculty involved in the process, while presenting some preliminary findings of a qualitative research project.

As more faculty in higher education begin to adopt technology, universities should begin to streamline faculty and training and development services relating to the adoption of these tools. In order to develop sound policies and procedures in addition to training and faculty development programs, technology professionals and administration must understand the faculty experience and then the factors that affect the technology adoption process and ultimately their implications for faculty quality teaching. Not only will this study inform the literature in the field, this study will assist universities and technology professionals in higher education, in developing policies, procedures, and support networks for faculty in their quest to adopt related technology to provide student with opportunities for quality teaching and active student engagement.

OVERVIEW OF THE LITERATURE

The investigation into the adoption of technology for the purpose of quality teaching for faculty in a higher education setting, not only draws upon academic foundations, but also advances practices aimed to explore the technical, cognitive, and aesthetic basis of signifying human interaction as mediated by technology. A number of theories have been used to address some basic elements that directly relate to faculty adoption of technology in teaching and teacher education programs. The Concerns-Based Adoption Model (Hall & Hord, 1987) and Rogers’ Diffusion of Innovations (2003) theory have been among the most used frameworks in many studies. Similar to Rogers’ theory, the Concerns-Based Adoption Model (Hall & Hord, 1987) is used to study the process of adopting innovations (Sherry & Gibson, 2002). In this model, Hall and Hord (1987) described eight different levels of use of an innovation: non-use, orientation, preparation, mechanical use, routine, refinement, integration, and renewal. While the Concerns-Based Adoption Model focuses more on the adoption process of an innovation, the Diffusion of Innovations Theory looks at both the adoption and the diffusion of an innovation. The emphasis is on this theory when examining both faculty adoption of technology and the issues that are experienced in the social environment during the diffusion of the innovation.

Further, as seen as consumer behavior, technology adoption can be measured in terms of units purchased or number of programs installed. This is consistent with behaviorist models: What users are thinking is secondary to their behavior. General surveys at the state or regional level become useful benchmarks of adoption levels over time (Becker, 1994). These demographic data then become valuable information in the hands of policymakers and administrators seeking to allocate resources in fair and effective ways.

In addition, adoption can also be seen as a process of information diffusion, culminating in a rational choice to use (or not use) the new technology. This perspective relies principally upon a view of learning as information acquisition (Mayer, 1992, 1996). A prospective user
engages in a process of inquiry concerning the technology (Hall & Hord, 1987; Rogers, 2003). After learning more about the pros and cons, the user (or group of users) commits to a testing, following by a full-scale adoption of technology. Finally, technology adoption can be seen as the assimilation of new cultural tools and practices. This view is consistent with theories that stress learners’ participation within communities of practice (Lave & Wenger, 1991). The focus is on socially constructed meanings and the sharing of those meanings through participation in purposive activities. The technology itself, in addition to its physical form and function, is also a social construction whose meaning is shared among community members. How the technology fits into existing social purposes and practices will largely determine its prospects for its appropriation and use by the community.

Further, the process of adopting innovations has been studied for more than 30 years, and Rogers’ model described in his book, Diffusion of Innovations, has been identified as one of the most popular adoption models (Sherry & Gibson, 2002). Much research from a broad variety of disciplines has used the model as a framework. Dooley (1999) and Stuart (2000) mentioned several of these disciplines as political science, communications, history, economics, and education, and defined Rogers’ theory as a widely used theoretical framework in the area of technology diffusion and adoption. Other studies have suggested that Rogers’ diffusion of innovations theory is most appropriate for investigating the adoption of technology in higher education and educational environments (Medlin, 2001; Parisot, 1995). In fact, much of the diffusion research involves technological innovations therefore Rogers (2003) usually used the word “technology” and “innovation” as synonyms. Although this is certainly not the first technology integration study to use Roger’s theory, it is the first study to be grounded within a qualitative context including, data collection, data analysis, and data sources.

The resulting methodology provides a model for other institutions seeking an approach to study faculty adoption and diffusion of technological innovation that leads to higher levels of adoption. However, these models presented in this review do not adequately address the end user’s experience during the adoption process nor the individual factors that may hinder or influence one’s decision or ability to adopt technological innovation qualitatively, thus drawing implications to make connections to organization policy or practice with technology.

**METHODOLOGY & RESEARCH APPROACH**

The preliminary narrative data included here were derived from the experiences of faculty involved in using technology for teaching and learning purposes. The quotations and narratives were drawn from a pilot study of a much larger study that included series of narratives that address these experiences. The principal goal of these narratives were to address the need for faculty working with in a higher education setting to provide ongoing discussion of their experiences, so that university administration can understand the multiple forms of resistance, hindrances, influences, and facilitators faculty encounter as part of their daily efforts in adopting and using technology to support quality teaching. This preliminary report focuses on faculty.

The narratives were autoethnographic in nature, with narratives solicited from authors on their personal experiences in adopting information and communication technology. Autoethnography is an autobiographical genre of writing that, according to Ellis and Bochner (2000), “make[s] the researcher’s own experiences a topic of investigation in [their] own right” (p. 733). Autoethnographers “ask their readers to feel the truth of their stories and to become co-participants, engaging in storyline[s] morally, emotionally, aesthetically,
and intellectually” (p. 745). I wanted the contributing authors to frame their experiences in their own terms and within their own personal frames of meaning and experience.

There was no previous knowledge of whether or not the authors used reflexive journaling before they wrote their narratives. The respondents were asked to reflect on three questions as they wrote their narratives: (a) How would you describe your experiences adopting technology for the teaching and learning process? (b) What barriers or facilitators do you find are critical that hinder or influence your ability to adopt technology? and (c) What recommendations would you offer to university administration based on these experiences to assist and support the use of technology at your university?

The twenty five contributing authors were solicited via the snowball sampling technique (Lincoln & Guba, 1985). I relied on referrals through my association with the Association for Information Systems and the Instructional Technology Forum at the University of Georgia, as well as from participants who recommended other for study. Autoethnography allowed for contextualization in that it afforded faculty and technology professions an opportunity to relate their life stories, thoughts, feelings, values, and beliefs as they pertained to their experiences as faculty and or technology professions in the technology adoption process in a higher education setting. In addition, it allowed an opportunity for these contributing authors to share personal accounts of their experiences with the rest of the higher education community and to express how, in many cases, they have been made to feel in the process.

ABOUT THE CONTRIBUTING AUTHORS

The twenty five authors represent various disciplines and positions including academic and technology leadership type positions. These twenty five contributing authors represent twenty five different institutions of higher education. Three held the position of Assistant Professor, two held the position of Associate professor, one held the title of Full Professor, one held the title of Instructor, and one held the title of Lecturer. Addition, one serves in the academic administrative capacity as the Associate Vice President of Academic Affairs who is also a member of the tenured faculty, two served as Director of Technology, three were educational technologist and performance consultants, six were Instructional Designers, one was an Associate Director of Research and Development, one served as an eLearning Manager, one was a Librarian, one served as a Director of the Language Lab who was also an instructor (on the tenure track) and one was an Information Manager. All contributing authors have been involved in various phases of the technology adoption process. Twenty three of the contributing authors are from research extensive universities, while one was from a liberal arts institution, and one from a community college.

THE NARRATIVES & DATA ANALYSIS

The contributors were asked, to write about their experiences adopting and using technology in the context of teaching and learning. I emphasized that they could focus on either a specific issue or a variety of issues for their narratives, however, they were instructed to keep in mind that the primary audience for the book would be administrators in higher education institutions, such as presidents, chancellors, provosts, deans, department chairs, educational technology administrators, instructional design and technology personnel, as well as university policy makers and trainers. The secondary audience is faculty, particularly new faculty interested in transforming their teaching practices with technology. I also encouraged the
authors to share any recommendations or suggestions for change based on their experiences. Of the twenty five narratives, ten narratives where from faculty while the remaining fifteen narratives were from various technology professionals who assisted faculty in their quest to adopt technology for teaching and learning. Since the focuses of this report is on the faculty experiences the fifteen non faculty narratives were removed from this study, leaving only the faculty voices to be heard.

The data analysis was carried out through content and narrative analysis; specifically using the inducted grounded analysis technique (Blasé & Blase’, 1999). Using this analysis technique, the following themes emerged (in order of significance as articulated from the content analysis): organizational support, resources, training, and leadership. Each experience provides an opportunity for analysis of what it means to adopt technology as an end user for the sole purpose of teaching. Further, it is important to note that there were no issues specific to anyone’s organization or any particular technology. As one takes into account the themes identified, we must also take into account the narratives that illustrate the end user experience adopting technological innovation.

**Organization Support**

The first and strongest theme that came through the analysis of the narratives was organization support. Many of the contribution authors wrote about their experiences within the difficulties on adopting technology related tools, specifically the challenge they faced in and outside classroom. These challenges included ill defined policies and procedures how to find support and help, lack of incentives or a policy for incentives such as release time, and inadequate resources to improve skills. Overwhelmingly, from the narratives faculty indicated that in order for them to use technological innovation within their teaching, there must be something in it for them and that the policies should help facilitate positive work interact and support instead of road blocks and barriers. Faculty indicated they were more likely to use technology if they had departmental and peer support, cross collaboration with other faculty using technology. Faculty also indicated that if there was a rewards program in place to attract and motive faculty, this would make it desirable as well. Others indicated that the organizational culture must be accepting of technological innovation and encourage amongst its end users. One of the contributors illustrated these challenges very clearly in his narrative.

**People do not want to change the way they do their job. People fear that technology will limit or eliminate their job. Institutional momentum hinders technology adoption. We often make the mistake of implementing a new technology while keeping the old system in place - thus doubling the work.**

In education, we too often make the adoption of technology optional. It cannot be optional. Indeed, you must create circumstance in which if is of dire need. For example, to get people to use e-mail we stopped posting paper based messages and memos. Likewise with electronic grade books, we required its use, but some people still used the paper based grade book as well. This year we are not purchasing any paper - based grade books

A narrative from an Assistant Professor approaching tenure:

**It would help motivate faculty if administration would offer some type of incentive for faculty who put in a great deal of time working with new ideas and innovations within the school. But this doesn’t exist. All administration wants is for faculty to work work work, with no reward at the end. This is why, I think twice before getting involved in new initiatives. The work is just too hard to catch hold to and there is no support or reward in the beginning or at the end. Maybe if**
these types of initiatives counted toward tenure and promotion, administration would receive a better turn out. Perhaps, however, as it stands now, there is nothing, but hardship working with technology.

Another contributor wrote about a similar experience relating to organizational support.

Sometimes there is a failure to adequately communicate the needs for a new technology. People often think that it is “just one more thing to do” rather than seeing it as powerful tool to help them do their job. Possibly, if we received a movie ticket or free lunch - or something that would help keep interest and show that someone actually cares.

A second perspective similar experience relating to organizational support.

I like to think that my college is good about support faculty when they venture into using technology in the classroom or developing an online course, but this is far from the ideal. Often time we get no support or consultation. We have to fend for ourselves. We have to purchase our own software after debating with the chair to use departmental funds. Then there is the whole IT Department, who tries to intimidate faculty thinking we have no clue about technology or purchasing needs. The IT Department around here is useless when it comes to supporting faculty in using technology and developing an online course. This just shows you how disjointed everything around here is. Once you decided where you want to use technology in the classroom or develop an online course you are bounced from the IT Department to the Academic Technology department.” Then if you have an idea to use the technology in an inventive way or outside of the knowledge scope of the staff, you are told it can’t be done. This really frustrates me. There is little support. Nothing is centralized. Support is critical.

Another important finding relating to organization support was that faculty did not adopt technology stemmed from a lack of organizational commitment from administration. This is illustrated from the following:

When we first embarked on using Blackboard, I felt overwhelmed, discouraged, and bewildered at the attempts to use technology tools in the classroom. There was little to no support from administration. There were no extra funds for training or professional consulting. Administration purchased the tools, but soon after where back in the shadows from which they came, leaving us as faculty who are in the trenches to suffer.” All we received was a memo stating we are now implementing a new LMS to be used to support face to face and online teaching.” There was no reason as to why we were moving in this director or what avenues were available to support faculty who were remotely interested. All of our concerns fell on deaf ears.

One contributing author shares an excerpt that speaks to the organizational support:

Unless policies and systems are designed to support the adoption of new technologies (and by implications new ways of working), then it is very difficult to embed their use and the new ways of working needed. As it stands now, the process is too convoluted and hard-pressed. For example, it is impossible to innovate (be this working with technology or otherwise) at program/course level if a group or individual are enthusiastic. However, over time it is my experience that as key individuals move posts or simply become exhausted with the “fight” (and it can be a real fight when trying to influence and change large institutions) then the innovative corners get rounded off so that the peg once again becomes round and fits nicely into the hole that the institution has designed for it. So as well as innovating at departmental/course level, you need to question and challenge the institu-
tion wide policies and systems that ultimately are so powerful in determining how sustainable any changes will be.

These narrative outlined suggests that an environment within the higher education institution must be present in order to provide faculty with support, but also reward and encourage faculty to and for venturing into the unknown with technology. Many of the narratives from the contributing authors revealed that they enjoyed teaching and learning new ways of teaching that would reach all students, however with the current environment for technology adoption, faculty would be less lively to actively participate and would find way not to. Other faculty noted that adopting technology was found to be stressful and difficult with little organization support often having their voices of concern left on deaf ears. For some, adopting technology was clearly a complex activity. However, the level of complexity is heighten when individuals did not see the ease of use and the perceived usefulness of the technological innovation and when the organization does not provide adequate support. If faculty are to adopt technology for teaching and learning practices, there must be organizational support, stemming both from local levels of administrative units as well as the over al university administration.

Resources

The second critical factor the authors indicated that affected the technology adoption process was the availability and quality of resources both in terms of technology and in human support. Analysis of the qualitative data revealed that resources included up to date hardware, current software, the availability of peripherals, technology support, instructional design support, time, funding, and positive reinforcement. Contributing authors indicated that in order to adopt technological innovation, administration had to provide and ensure them with a means of academic and technical support including instructional design services and technology support. While the contributing authors agreed that organizational support was important, it was the resources theme that ranked high among the results as being a major factor that influenced faculty ability to adopt technological innovation. This can be illustrated in the following narrative: “Many believe that education is not expensive and that it can make do with used books, computer, and software. Many university administrators share this idea. Worst yet, many faculty believe that they can not or should not ask for more materials, books, software, computers, etc. If they do ask, they ask for the minimum. This is because they have been turned down so many times in the past. Many faculty and some administrators believe their money isn’t available for technology so they don’t invest their time and efforts in it even when a technology program is being instituted. Whenever some feels like this. I tell them to look at the larger picture. For example, the building or transportation fund. The technology budget is more important than that. Without resources faculty are doomed to repeat the same cycles within the same harsh system” Further, authors also indicate a growing discontent with the technology support services and available resources. It was evident from the narratives that support came from the information technology department instead of an educational or instructional technology support department. The theme from the data analysis revealed that the faculty felt the information technology personnel did not serve the faculty well in regards to assisting and supporting them in the technology adoption process or in their efforts to learn the technologies for the teaching and learning process. Data reveals that information technology personnel often time lacks fundamental knowledge of academic organization practices, faculty instructional or curriculum needs, or knowledge of training. These issues compounded with issues of unresponsiveness to technology requests, or one on one training request, left faculty hindered in their quest to
adopt technology. This can be illustrated in the following narrative: “The temptation to leave it all to the “tech” guy. Often the problems are left with the tech coordinator who has been given little administrative authority. Administrators who view “technology” as one more thing to do and who have little understanding of the pedagogical power it has. Budgetary priorities. A kind of chicken of the egg thing. You can’t do things with technology unless you have the technology - you cannot get technology unless you have something to do with it. The best thing that has happened in Illinois is the state board putting everything in digital format and online. This has spurred technology improvement.” Another perspective illustration from an Associate Professor at a research extensive institution: “One thing is that we need are technology resources. How can you expect to adopt or use technology, when you don’t have the technology or the support person to help you when you need help? I find it sad quite frankly. It’s like trying to part the red sea to get someone from IT to help. They seem to be one dimensional drones who take orders from the upper echelon of the technology department. Things must work they way they are intended to or else the faculty can not work.” Nearly all of the contributing authors indicated that technology adoption was a time consuming process. With pressures to teach, research, service commitments, accreditation assessments, professional development, and meetings, the faculty stated that they simply did not have enough time for anything extra and thus participating in technological innovation is seen as ancillary. If technology doesn’t work the way it is intended or not at all, available personnel must be readily available upon request. However, this reality is nonexistent.

Training & Development

The third critical factor the data from the narratives indicated that affected the technology adoption process was training and development. Contributing authors concluded that in order for them to implement the technological tools, the end user needs to know how the technology works and how it could be used, and appropriate places it can be used, thus the need for quality training and faculty development. Training and development is the planned process of developing an individual or organization to be more effective in accomplishing its desired goals. In this case the goal is to facilitate quality teaching and active student engagement though the use of technological innovation. The narratives indicated that there must be training that taught faculty how to use the technology and then training that taught faculty to integrate and teach with the technology. This revealed two different types of training faculty needed to be successful. Faculty from the narratives also indicated that they would adopt technology tools, if they were given guided practice, examples, and remedial support in using the tools. However, the dream to receive quality training is often non existent. The data reveals that the contributing authors are not pleased with the current state of training as part of their support system. This can be illustrated in the following the narrative:

Overall, software training stinks. This is by its very nature. When you train someone how to use software, they rarely have a frame of reference upon which to construct a knowledge base. Due to the expense of training, we often try to cram in as much as possible (the same approach we use with our students). The best solution I have found is to:

- Design software training that covers only the basics. After the basics are covered then have another session that focuses on what is possible with the software - without concentrating on how to do it.
- Schedule software training as close to implementation as possible so that faculty can immediately begin using it and practicing what they have learned.
My Experience Tells the Story

• Provide follow-up training and support to answer questions and needs as they arise.

Not only does training and development have to be timely, relevant, and of high quality, it also has to be related to the faculty’s teaching area. A perspective illustration from an Associate Professor at a research extensive university:

In short, faculty have a difficult time applying technology skills in the classroom unless there is a direct linkage with the curriculum, teaching strategies, or improvements in achievement. Professional development tends to have a stronger impact when it is framed and intertwined in the teaching and learning process associate with the faculty. This is when training comes into play – to show faculty the possibilities of what can be done. This process has not only helped me become a better teacher, but a technologist.

If we are to optimize the adoption of technology to benefit students in a higher education setting, faculty must have opportunities for high quality, intermitted training that is aligned with the organization policies and procedures and is readily available and assessable. Further based on the qualitative data, training must not always be given by technology personnel, but rather by faculty in their perspective disciplines and areas. Research has found that peer coaching, mentoring and training is an effective tool in preparing faculty to learn and use new technologies. Training must be sharp, clear, and tailored to the faculties needs.

Leadership

The fourth critical factor the contributing authors indicated that affected the technology adoption process was leadership. Contributing faculty narratives indicated that there had to be strong leaders to not only lead in the uses of technology, but also show what the technology possibilities could be. This can be illustrated by a faculty member who was a tenured Associate Professor:

There has to be a leader with a vision of what is possible through the uses of technology, and be able to work with others to achieve the vision. Without this vision, and the translation of the vision into action, lasting effects of technology would be almost impossible. Everything falls back on leadership. If there is weak university administration and leadership in working with faculty on adopting technology, then you will have weak usage of technology. Its quite simple, we need strong technology leaders who understand the position and responsibilities of a faculty, aspects of curriculum, instruction, pedagogy, as well as the technology. The folk from the IT Department don’t cut it. There has to be leadership in the sense that someone can guide and inspire faculty to move and push forward and model technology use for us.

Narratives of the contributing authors indicated that administration often times do not have clear cut policies or guidelines on the use of technology nor did administration provide such policies that supported the mission, vision, and goals of the university. Faculty found it difficult to adopt the technology in the educational setting without a proper framework or procedural guidelines that were unified and adopted from administration. This can be illustrated from a perspective illustration from a Full Professor at a research extensive university:

When a major technology purchase takes place, faculty are never consulted, yet we are expected to use such tools. The Vice President of Information Technology is not a faculty member, what does he know about our needs. The Director of Academic Technology is not a faculty, what does she know about the needs of the faculty. No one involves
the major stakeholder the faculty and when we choice not to use the technology, we are looked at in a negative light.

The narratives of the contributing authors reveal that leadership is key to the success of faculty adopting technology for the teaching and learning process. With leadership comes effective communication. Contributing authors felt that communication and leadership go hand and hand when trying to support faculty to adopt new technologies. However, authors who contributed their narratives found that the leadership in their respective institutions added an extra dimension by university administration when it came to adopting technology through poor communication, ill defined processes and not listening to their concerns. If we hope for faculty to adopt technology, university administration must seek ways to provide effective communication and leadership during the process in order to receive full support and buy-in from their intended end users, mainly the faculty.

**DISCUSSION & CONCLUSION**

The adoption of technology throughout a higher institution cannot be seen as separate from the learning process that all members of the organization go through as they learn about their new roles in relation to technology, as they struggle to transform their perspectives toward technology in general, and as they begin to appreciate the value that it can add to the teaching/learning process (Saade, Nebebe, Tan, 2007; Cushman & Klecum, 2006; Degada, 2005; Frank, Zhao, Borman, 2004; Sherry, 1998). Although the contributing author’s narratives were crafted from their experiences adopting technological innovations, all expressed that the process of writing their narratives was both a process of venting and therapeutic. This allows their voices to be heard, whether it is by other faculty, the researcher conducting the study, or by possible readers of this article, this study served as an outlet for such discussion. The excerpts presented here are to illustrate how each of the themes identified suggest important ways in which colleges and universities can work to create system that supports faculty in their quest to adopt technological innovation for teaching and learning purposes. In my review of the literature, I came across a descriptive study that explored technology acceptance that examined forty eight studies between the years of 1985 to 2003 (Choudrie & Dwivedi, 2005). Although the study was limited to examining the range of methods used in studying the technology acceptance model, its argument “that the story is not in the numbers” was a fitting commentary on what I learned from reading the narratives of the contributing authors. Individual stories are important. They provide qualitative data about oneself as part of a group or culture. They help us to understand and counter adversity, in this case technological innovation. More important, the narratives lead to a better understanding of the end user’s experiences within the process of adopting technological innovation. This is the essence of critical theory.

We can both learn from and break the silence on the experiences of faculty in the technology adoption process in a higher education setting, by connecting their voices and experiences to policy and decision making relating to processes and practices associated with the use and adoption of technology. As indicated earlier, I asked the contributing authors to offer recommendations based on their individual experiences. As I mulled over the recommendations offered across the themes of organizational support, resources, training development and leadership, it is clear that most of them had strong implications for training and faculty development as well as organizational leadership. In Appendix, I present these recommendations according to the four themes identified. I do so with the hope that they will spark further dialogue and lead to the development of more effective strategies to support faculty.
in their quest to adopt technological innovation for the teaching and learning process in a higher education setting.

For faculty to adopt technological innovation for teaching and learning practices, one must familiarize themselves with the technology, utilize the technology, integrate the technology into the classroom and daily living, transition to the reorientation phase of technology, where they realign their teaching and student learning outcomes with the technology, and finally become revolutionized in their teaching practices where technology usage is evident and the process facilitates the quality teaching.

As we reflect on the study and the narratives obtained, if higher education is to be successful in their attempts to optimize the use of technology, faculty must be given opportunities to share their voices of experience and in turn those voices must be connected and translated into the effective policies and practices aimed at supporting faculty and innovation adoption. Only then can higher education survive the onslaught of technology.

REFERENCES


**KEY TERMS AND DEFINITIONS**

**Qualitative:** Method that systematically examines a phenomenon using an inductive approach & exploration of meaning of phenomenon; purpose is to understand & describe human experience, explore meanings & patterns.
Information and Communication Technology: Information and Communication Technology is the term used to describe exciting and innovative ways to provide lifelong learners with global access to information, learning and support.

Adoption: Take up and practice as one’s own

Training: In the field of human resource management, training and development is the field concerned with organizational activity aimed at bettering the performance of individuals and groups in organizational settings.

Autoethnography: Autoethnography is an autobiographical genre of writing that makes the researcher’s own experiences a topic of investigation in [their] own right. Autoethnographers “ask their readers to feel the truth of their stories and to become co-participants, engaging in storyline[s] morally, emotionally, aesthetically, and intellectually.

Leadership: The activity of leading.

Organization: A collection of people working together in a planned deliberate social structure to achieve a common goal.
APPENDIX

Recommendations

Organization Support

• At the organizational level universities should first complete an organization pre-assessment in order to determine the state and culture of the organization and how technology best fits and serves the needs of its users. This can be completed through organization development strategies such as action research. The pre-assessment will determine if the organization has the proper equipment, support infrastructure, resources, human resources, and structure to adopt a technological innovation. It is important to conduct the pre-assessment before undertaking the adoption of a technology device.

• Develop a clear vision and policy for technology adoption. The strategic use of information or instructional technology starts with a vision about the organizations learning objectives and standards and how these entities are and can be aligned with the mission, goals, policies and procedures of the organization. A good technology vision parallels school wide and organizational practices. The technology vision should describe a future that is better than the present, yet be achievable in a reasonable amount of time. The vision must be clear, concise, and measurable.

• Take active steps in developing policy and procedures that relate to the technology that is to be adopted. Developing a vision and corresponding goals is important, but if the appropriate policies and procedures are not developed, the goals and vision will never become a reality.

• Conduct and analyze the technological needs of the organization. Organization administration will work more efficiently if members are knowledge about the important uses of technology in their particular organizations. Having a common understanding of research findings and best practices of the organization provides a foundation on which to plan the technology adoption.

• Identify the gap between the technology vision and policy and its present situation. Closing such gap will then become the focus of the planning for the adoption. Your needs assessments will provide data and a methodology for identifying and evaluating the goals identified in the mission, vision, policy, and procedural guidelines of the organizations policy. If the needs assessment is conducted effectively, one should discover not the strengths and weakness, but also opportunities and threats.

• Devise ideas is to start the communication and awareness process. This is accomplished by administration and members of the organizations waging a campaign of direct communication to those users who will be involved in the diffusion process. Administration must pay close attention to their communication medium, methods, and the frequency of the message given to the organization.

• Support and encourage the faculty in their endeavors by removing roadblock and barriers in the technology adoption process.

Resources

• Provide faculty with the relevant and current technology tools, best practices, and strategies when appropriate
My Experience Tells the Story

- Provide faculty with instructional design support personnel and timely technology support assistance • Hire instructional design or technology support personnel dedicated for specific college needs and departmental needs.
- Provide grant or supplemental funding to faculty • Keep and provide up to date hardware and software when available in several of the major languages
- Provide faculty with a help desk hotline, web site forum, and electronic step by step materials.

Training and Development

- Involve all stakeholder, faculty, administration, trainers, information technology personnel, and in some part the students. Training and development is very essential to the success and failure of technology adoption in higher education. When the technology being adopted is new and uncertain to the users who will be key user of the innovation, a series of professional development and training sessions are in order. With this idea, administration must provide support, encouragement, and extend resources to the continuous process of training and professional development. A key point to remember is that all training and development plans needs to be connected to the data obtained in the needs assessment. There has to be a constant connection between that which is planned and that which is to be implemented.
- Introduce users to the technology and the training and professional development plan that is to be implemented early and throughout in the adoption process.
- Hire trainers, with teaching, instructional design, curriculum and instructional experiences and not so much technology tool skills
- In order to effectively adopt technology for faculty use, administration must facilitate an environment to familiarize faculty with technology and its potential uses. This can take place in a brown bag luncheons, demonstrations, workshops, and in technology fairs.
- Given faculty the opportunity to use technology effectively. This step involves technology training, but also instructional training. A series of professional development related to the faculty’s subject domain must be initiated and carried out on a regular basis in order to ensure that technology is being learned, assimilated, and utilized by the teacher.
- Once technology adoption process is underway, shift the training to the mode of reorientation, where training and the faculty begin to rethink the educational goals of the classroom, departmental, college and of the university and realign the learning objects and those goals of the content curricular domain area with the technology to be used.
- Make sure the training is relevant and current, to the needs of the faculty.
- Don’t rely on online training, in some cases faculty need face to face interaction.

Leadership

- Regardless, of the technology or the environment leaders need to have strategies and practices for effective change management structures.
- Think beyond providing more hardware, software, and Internet connecting, but instead think about keeping universities and faculty well-informed and trained in the effective use of technology for educational purposes
- While the technology adoption process is in motion, administration should appoint an independent
body well versed in evaluation to evaluate the processes and outcomes of the initiative. The idea is to examine the implementation process for the technology being adopted as they relate to organization effectiveness, teacher training, and more importantly quality teaching and student learning. The purpose for evaluating the implementation process using in developing the adoption initiative is to get timely feedback and constructive criticism on any revisions, adjustments, or weaknesses in the process. Evaluation helps to ensure the adoption plan is aligned with the overall mission, vision, and organizational goals and procedures.

- Find technology leaders who have an understanding of both technology tools and processes and how they fit with teaching and learning practices. It would help if this person was a faculty or have previous pedagogy, curriculum, or instruction experience
- Establishes a process through which individuals from different levels in the organization can relate to each other in a safe and meaningful manner in order to explore and work toward a new educational future and to build relationships and find creative ways to continually improve their teaching, the organization, and the student.
- Facilitate a call for revolution. This process facilitates an environment for effective and complete technology adoption in the subject areas. This is the final process where we find faculty using technology as an integral part of the teaching and learning process. Encourage faculty to continue and expand their capabilities.
Chapter 16
Framing Pedagogy, Diminishing Technology: Teachers Experience of Online Learning Software

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ABSTRACT
This chapter explores frames and sensemaking as a means of understanding the experiences of teachers in higher education who are slow adopters of technology in settings where technology is also inflexible. Literature on teaching online emphasises the differences between online and face-to-face teaching over the similarities between them, and conceptualises this as a discrepancy in expectation between face-to-face and online teaching that requires teachers to remodel their approach to overcome it. Problems of low uptake of courseware systems by teachers are commonly identified as either problems of teachers' insufficient technical knowledge, or as problems of the nature of technology, however it is more useful to understand them as sensemaking problems where teachers deal with new technology using old frameworks. Two cases are explored in depth showing that some frames require less effort to produce good teaching. The paper suggests that teachers with inflexible frames must break them to adapt to online environments. However, a pre-existing pedagogically oriented frame already primed to seek out new settings for learning forms a minimally sufficient frame for sensemaking within an online setting even in the absence of strong technological skills.

INTRODUCTION
It does not take a great deal of contact with those using technology in teaching and learning within higher education to realise that while some are hugely engaged by the possibilities opened up by new media, a great number of teachers either do not engage or engage in a very limited way with new media and online learning.

The literature however tends to be written by and for early adopters. A large proportion of the writing on teaching with online technology is devoted to exploring, in both technology and in teaching practices, the further reaches of educative creativ-
ity made possible by the racing technologies of a networked world. Such enthusiasm suggests we are all cutting edge, and the curiosity for researchers lies in the manner of innovation. This I think is far from the truth. Most of us working in the field are stuck with technology which is aging, recalcitrant and ill-suited to adaptation, and many teachers are characterised by both technologists and educators associated with online learning, as well as by University policy makers as conservative, ‘resistant’ or unwilling to engage in the brave new world of online teaching. Further, not only are some teaching staff constrained in their use of technology, in many cases the technology itself is also constraining, such as the environment offered by Learning Management Systems (LMS’s) like Blackboard.

It is this rather unfashionable bunch of slow adopters grappling with ‘low’ technologies that constitute my interest. Is it possible that despite these barriers some teachers nevertheless teach well online? If so, why are they able to do so?

Whilst much has been done to analyse the comprehension and use of technology by online learners, less recognition is given to teachers’ experience of using technology to produce that learning. The literature that predominates is literature that by and large presents a normative account of teaching online – it instructs in new ways of using technology or proffers sets of criteria that should be met in the production of learning online. Little research has been undertaken to identify subjective experience particularly in the case of online teaching technological “laggards”.

There are exceptions in discussions of technology use outside of higher education teaching such as Klein (2005) who usefully divides characterisations of non-adopters of Digital TV into “refuseniks’ and “victims”, a distinction which appears to carry over to academia where policy makers infer an assumed split between academics who do not adopt because they are apparently “resistant” and students who do not adopt because they are “a group at risk of digital exclusion” (p 1).

There is also a large multidisciplinary literature on “Technological Adoption Models” (TAM) (Davis’s seminal article (Davis, 1989) is cited 4417 times by other authors according to Google Scholar). This literature concentrates on users, usefulness, ease of use and readiness (on the latter, see for instance Lin, Shih, & Sher (2007)). But use does not address the cognitive conditions brought by teachers to the transition from facility with one form of teaching to facility with another, especially when faced with an inflexible and limiting LMS.

The online environment created by Blackboard is also seen as passé by researchers keen on the possibilities opened up by mobile technologies, Second Life and Web 2.0. Explaining differences in how teachers respond to the limitations and opportunities presented by older style course management systems is to take the path less trodden, but it is also to address the concerns of a large group if not a majority of teachers.

Shih, Feng, & Tsai’s (2008) content analysis of studies of course management systems found a very low number of articles addressing teacher’s cognition as they navigate the unfamiliar landscapes of online teaching. In a contribution to redressing this, I want to focus on that aspect of cognition - sensemaking (Karl E Weick, 1995) which posits frames and framing as an essential aspect of sensemaking cognition, to draw out the kind of thinking on which teachers base their approach to online teaching.

This study is part of a larger study that uses the lens of the sensemaking research of Karl Weick to understand how teachers in higher education generally make sense of online teaching environments. Here I address sub questions of the study, ‘What makes some teachers more receptive to and better at online teaching than others? What sort of sensemaking is going on here?’

My research suggests that there are at least four very different more or less prototypical ways of thinking about and using online courseware, and that one in particular may offer a way forward.
Framing Pedagogy, Diminishing Technology

to more accurate depiction of the conditions of uptake. It may help to isolate factors that influence instructors’ adoption and use of Internet-based course management systems in ways that produce better quality teaching.

I begin by showing that problems of low uptake and command of courseware systems by teachers in higher education are commonly identified as either problems of insufficient technical knowledge, or as problems of the nature of the technology. I go on to consider an alternative understanding of the relationship between teaching and technology by describing and analysing four characteristic styles of teaching shown by my investigation. I provide two case studies of uncommonly understood but to my mind, archetypal approaches to teaching with technology as an illustration of the argument that effective online teaching owes more to the extent to which a strong and deeply understood personal approach to pedagogy and principles of teaching has been developed beforehand than it does to an innovative and technologically masterful grasp of the software. Finally I consider the role of cognitive frames as an illumination of what might be occurring in the case of teachers who take this approach.

LITERATURE ON TEACHING AND LEARNING – DIFFERENCE, CHANGE AND TRANSITION

Literature on teaching online tends to emphasise the differences between teaching online and teaching face to face over the similarities between them. This idea of differences is conceptualised as a gap or discrepancy in expectation between teaching face to face and teaching online that requires a remodelling of approach to overcome it. Hannon (2008) encapsulates this as,

"...the connecting theme of innovation in higher education contexts seems to be significant change, and its potential to transform practice. As an example, the appropriation by learners of social software technologies of interaction and collaboration is identified as a “disruptive” type of innovation... (p 389)"

Hannon here exemplifies the themes of change and disruption deemed to be characteristic of teaching in online environments.

The idea of the breakdown of conscious and unconscious anticipations and assumptions that allow mental activity to naturally flow when a subject is confronted with disruption or new or unpredictable events and circumstances, is central to Karl Weick’s reading of “sensemaking”, (1995, pp. 4 -6) . Under conditions of confrontation with a conceptual gap, or life ‘not as we know it’, sensemaking may collapse, as Weick illustrates with his story of “fire jumpers” (1993). Alternatively, central assumptions may be radically remodelled but only at the cost of conscious effort, as he illustrates in his story of the emergence of “battered child syndrome” or child abuse as a workable category of event (Weick 1995 p 1-3).

The theme in the online instructional design literature of disruption of thought caused by a perceived disjunction between the two forms of teaching is then overlayed with notions of progress; the idea that it is in fact desirable to change towards greater use of online modes for variously cited reasons (such as institutional economy, industry requirements, or pedagogical desirability) and the idea that this is a forward movement or natural direction of travel. The result is a construction of the relationship between face-to-face teaching and online teaching as a transition across a gap on several dimensions. An incomplete but indicative list includes:

- Changes to technological skill

Essentially this is the change from mastering the ‘low’ technology of the classroom to mastering the ‘high’ technology of online environments.
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Such skill acquisition is often discussed as a division between “early adopters” and “laggards”, echoing the influential ideas of Everett M Rogers, (2003) whose book is now in its fifth edition since 1962 and who then in 1962, divided technology adopters into five groups: ‘innovators’, ‘early adopters’, ‘early majority’, ‘late majority’, and ‘laggards’. Other writers who exemplify a similar orientation, placing technological mastery at the centre and whose work is infused with Roger’s ideas include for instance Wilson and Stacey (2004), Klein (2005), and Kelly (2007).

• Changes to teaching ‘competencies’

This is a requirement for a change in practice and thinking by individual teachers oriented towards special models and new forms of instructional design to accommodate the inherent difference in an online environment.

The subject of extensive research, this literature examines the gaps in understanding and barriers to participation by teachers, and is concerned with adding the frameworks, criteria and standards for good teaching online, eg Anderson (2008) who suggests “…the pervasive effect of the online medium creates a unique environment for teaching and learning…” (p 344 my emphasis); and Sieber (2005) who argues “…neophyte online course developers typically have major misconceptions about the pedagogy that produces effective online learning” (p 329 my emphasis).

Competency based approaches to bridging a gap in staff development for online delivery are suggested by, for example, Goodyear, Salmon, Spector, Steeples & Tickner (2001) and are also reproduced in university policy documents, eg, RMIT University DLS Professional Development (2002) and the University of South Australia’s “Preparing a course for online delivery” (2008).

Bates, (2007) effectively sums up the central idea of an online environment as categorically different from a face-to-face environment for instructional design purposes.

However, for flexible learning, designs for teaching are required which are entirely different from the classroom model. E-Learning not only requires decisions about the place and time of delivery of programs but also the type of teaching and learning that should be adopted. Instructors above all need to understand fully the different options available to them and to keep abreast of the changing needs of employers. Thus e-learning requires a rethinking of the curriculum and how best it can be taught. (p 55)

• Changes to techniques of professional development and scholarship of teaching and learning

Some writers feel that professional development itself should be changed to a technological mode of delivery, including methods of sharing instructional design. For instance Laurellard (2008) advocates “the use of an online learning activity management system as a way of capturing and sharing the pedagogic forms teachers design” (p139) to assist teachers in developing and disseminating their own teaching knowledge. The ‘Peer Review of Online Teaching and Learning Project’ (Wood, 2008), is also currently implementing online professional development, self described as “…a comprehensive, integrated Web-enabled peer review system that guides academic staff in the development or redevelopment of their own courses through reflective processes, and uses these same criteria to have their work evaluated” (para 2).

The final category in this list of change, although not exhaustive of the literature, is that of

• Changes in organisational focus

Here the emphasis is on the change from organisational professional development practices that concentrate on the individual teacher to professional development that reflects the wider
organisational approach to ICT in teaching and learning. Examples include Kirkwood and Price (2006) who argue that for a comprehensive cultural change to take place, all members of the organisation who play a part in the delivery of online solutions, not just teaching staff, must be involved in professional development activities relating to teaching and learning with ICT in order that they understand the implications of their policies and practices. In other words, the change needs to be organisation-wide. Conole (2007) also argues for a comprehensive organisational understanding of a complex range of inter-connected pedagogical, technical and organisational factors which e-learning interventions bring into any setting. She suggests that failure to comprehend the extent and complexity of change required by the introduction of online learning may result in spectacular collapses such as that of UK eUniversity.

All these examples illustrate the idea that the numerous differences between the two forms are the paramount obstacle to successful adoption that then requires an effortful transition from one state to another.

What they have in common is a representation of a gap of the kind as described by Weick, Sutcliffe and Obstfeld when they say,

*Explicit efforts at sensemaking tend to occur when the current state of the world is perceived to be different from the expected state of the world, or when there is no obvious way to engage the world. In such circumstances there is a shift from the experience of immersion in projects to a sense that the flow of action has become unintelligible in some way.* (2005)

What the examples also have in common is a sense of foreboding that if something is not done some sort of collapse or serious deficit will result from that gap and that therefore various kinds of active and effortful sensemaking must be mobilised in an attempt to bridge it.

**TRANSITION TO WHAT? PROBLEMS WITH CURRENT EXPLANATIONS**

When it comes to understanding ‘slow adopters’ grappling with ‘low’ technologies in considering how individual teachers make sense of differences between technological and non-technological environments, the transition theories of most interest are those that either attend to the adopters or to the technology. Sometimes the issue is identified as a problem of the technology itself embedding the ‘wrong’ pedagogy. Sometimes it is identified as a problem of insufficient attention to developing a web based or online pedagogy.

In oversimplifying causal terms these could be understood as two opposing syllogisms – ‘If technology is low level in its ‘affordances’, then adopting will not be optimised’, or ‘If adopters are slow at developing a suitable pedagogy then technology will not be optimised’.

An analysis of Postle and Sturman (2003) illustrates the problems inherent in the view that technology embeds the ‘wrong’ pedagogy. In their survey of the “major issues and dilemmas of online teaching”, they note the “tendency for some to allow the technology (in this case the software) to direct the nature of teaching and learning” (p 21). They quote Skilbeck to show how the way knowledge is imagined in the design of the courseware influences the user’s picture of teaching.

Knowledge is being broken down constantly into manageable, assimilable groups of elements, which are being joined with other elements in creating whole new forms, bodies, structures of knowledge. This is not a philosophical or theoretical movement; it is a result of course design strategies and procedures and the resources of technology. I doubt whether sufficient attention is being given to systematic, coherent curriculum designs grounded in clear views about the contribution of university study to either general education or lifelong learning. (Skilbeck (2001), p. 61 in Postle & Sturman p 19)
Skilbeck with Postle & Sturman interpret such courseware design constraints as having an overwhelming influence on use. In other words they make the problem of using online methods a technology design problem.

Adams and Morgan (2007) provide another illustration of technological structuration. They divide online learning technologies into “first” and “second” generation on the basis of encoded practices they see in the software itself. “First generation” software they claim is teacher centred and fosters “compliant, rule-based learning” whereas second generation software is designed to “(a) put learners in control of their learning and allow them to (b) create self-organizing learning paths…” (p 161).

They say

_...the driving force behind the use of “first generation” e-learning for soft-skills development has been the use of web technology to deliver existing content in new ways and/or to replicate traditional classroom experiences online (e.g., e-readings, e-articles, e-books, webzines, e-classrooms). The focus has been predominantly on the “e” for electronic (e.g., infrastructure, hardware, software, e-products, etc.), not the “I” for learning. Limited attention has been given to the challenge of reinventing learning content or pedagogy to tap into the inherent self-organizing capacities of the Web, hence, to actually improve the quality of learning and its direct application (e.g., to job-based performance improvement). From an early stage, the soft-skills online industry appears to have locked itself into a technology mindset that is now driving e-learning development and the market as a whole. (p 167 – 168)_

To take this view is to agree with the proposition that the technology itself reflects the understanding of pedagogy of the designers – a not unreasonable proposition.

It does however turn over the responsibility for “learner centred teaching” (or, for that matter, any other pedagogical principle, by extension) to the capacities built into the software. As well it suggests that the Web itself is innately possessed of a more flexible pedagogy than that of proprietary software, a kind of invisible hand of self organisation that extends to enhancing the self organisational capacities of the students using it, and that this is preferable to deliberative instructional design and pedagogical principles.

Ask and Haugen (2008) are an instance of the second proposition, that of insufficient attention by teachers to developing a web based or online pedagogy. They quote Kirkwood & Price (2006) “...the use of (Information and Communication Technologies) necessitates more than simply replicating or supplementing existing teaching practices: everything governing these practices must be reconsidered and reflected upon” (p 1-2). In this respect they are at one with the other authors noted above who emphasise the change needed in individual teacher’s pedagogical orientation to accommodate online delivery.

The argument implies that the framing of teaching practice prior to moving to an online teaching environment is an impediment to developing effective online teaching methods. Ask and Haugen do not say why they think this. One possibility is that they attribute almost insurmountable novelty to an online teaching environment that is so unlike face-to-face teaching or which offers so many unfamiliar opportunities for delivery that the old pedagogical certainties no longer hold. They comment,

_To avoid just replicating and supplementing existing teaching practices, staff and administration need to adjust their visions and methods to include the new options. This may however be like shooting at a moving target, since the technology and its applications are changing rapidly. (p 1-2)_.

They suggest that the major problem in delivering online learning is the problem of developing a technology specific pedagogy. The “technology
specific pedagogy” that they go on to discuss however, appears to consist of applying general pedagogy – largely constructivist - to online settings.

This begs the question of whether academic teachers in Ask and Haugen’s study were especially improving their online pedagogy or instead learning more about generally effective pedagogical technique which they could then adapt to an online delivery mode. Comments made by participants hint at the latter. One participant seemed to find constructivism as a whole, a revelation. “I augmented my usual “instructivist” lectures with “constructivist” homework for the first time” (p 6).

A second participant, having learned instructional design specifically for use with courseware commented that “Academically, I can self-direct, plan, set personal learning goals and actively engage in group activities” (p 6). Both constructivism and self direction are teaching techniques which are helpful just as much in face-to-face teaching as they are online, suggesting that while the technological skill of the teachers may well have advanced, along with pedagogical technique, the result could not necessarily be called a “technology specific pedagogy”, but rather a generally improved understanding of pedagogy applicable to a number of teaching modes.

Both arguments outlined above position the pedagogy of technology either as something specific to be separately learned or as something embedded in the software. Both thus credit the technology itself with a degree of agency inasmuch as in both cases technology creates ‘the problem’ that must be surmounted.

This view of technology, as a ‘force’ or as deterministic in some respect or other, has a continuing history in technology studies as a source of debate - the ‘technology wars’. Beginning with Pinch and Bijker’s (1984) call for a constructivist approach to technology studies discussion took off in earnest with the debate between Woolgar and Pinch over ‘relativist constructivism’ (Pinch, 1993; Woolgar, 1991, 1993) and was perpetuated by later similar divides, as exemplified by a debate between Winner and Woolgar over the political consequences (and by implication the technological determinism) of building a bridge that purportedly excluded buses. (Winner, 1999; Woolgar & Cooper, 1999). It re-emerged more recently with new arguments for forms of determinism (in the guise of the persistence of Moore’s law) (Ceruzzi, 2005) and defences of SST (Social Shaping of Technology) such as that by Clausen and Yoshinaka (2004) who suggest that the conditions of actor engagement are shaped by how problems are defined and resolved and this shapes how technology is then analysed and treated. Recently this debate has come to be recognised in discussion of teaching with online courseware (Park, Lee, & Cheong, 2007).

However, under some conditions the particular epistemic beliefs of teachers and the pedagogical principles these beliefs generate, have the capacity to leapfrog any tendency to treat technology as determinist. Neither does useful and creative teaching online necessarily depend on a root and branch remaking of teachers pedagogical beliefs and practices as implied by the “gap” construction of the relationship between online and face to face environments.

FRAMES AS AN EXPLANATION

A possible explanation of differing success in teaching online may lie in the observation that people use old practices to deal with new situations. Kuhn (1970); Goffman (1974); Imershein (1977); Lakoff (1987); Schon & Rein (1994); Orlikowski & Gash (1994); Weick (1995, 2001, 2003, 2005, 2006) and Davidson & Pai (2004) have all argued that change of any sort often begins with the mapping of old habits onto new circumstances.

This can be captured in the concept of ‘framing’; the “reasons that will enable (people) to resume the interrupted activity and stay in action”
Framing Pedagogy, Diminishing Technology

Weick Sutcliffe and Obstfeld, 2005, p. 107). The idea of framing conceptualises people’s approach to novel tasks as bringing with it, assumptions derived from past beliefs and experience and expectations about future behaviour and events crafted by these assumptions.

Frames are derivatives of ‘old habits’. According to Weick, a frame is a kind of roughly internally coherent but abbreviated operating model for action, constructed from past experience as well as from beliefs and values, which not only allows inferences to be drawn about what might occur but which also allows for the filling in of missing information by the same inferences of coherence. Weick calls it an “internally consistent set of simplifying heuristics” (1995 p 118 quoting Martin and Meyerson, 1988 p 93). They allow people to locate, perceive, identify and label occurrences in their lives and world (Weick 1995). Frames are also inherently social in construction although individually meaningful.

Weick understands the normal flow of mental processing of events and conditions around us as putting cues into pre-existing frames. He explains the process of meaningfully connecting conceptual social categories in the form of frames with events thus:

Frames tend to be past moments of socialisation and cues tend to be present moments of experience. If a person can construct a relation between these two moments, meaning is created. This means that the content of sensemaking can be found in the frames and categories that summarise past experience, in the cues and labels that snare specifics of present experience and in the ways these two settings of experience are connected. (1995, p. 111)

It is only when this process breaks down through too much novelty in one’s circumstances or too little pre-existing explanatory capacity in one’s current frames, that the effort of conscious reconstruction or sensemaking must take place.

Orlikowski and Gash who are informed by Weick’s theorising about sensemaking, provide a similar explanation of past cognition influencing present perception about technology.

To interact with technology, people have to make sense of it; and in this sense-making process, they develop particular assumptions, expectations, and knowledge of the technology, which then serve to shape subsequent actions toward it. While these interpretations become taken-for-granted and are rarely brought to the surface and reflected on, they nevertheless remain significant in influencing how actors in organizations think about and act toward technology. (1994, p. 175)

However there is little empirical research that shows how teachers understand and experience the process of offering courses online or which seeks to understand the cognitive models teachers’ hold of online teaching.

Very spare results were revealed by a search confined to literature produced on higher education teachers’ cognitive experience of online teaching that makes use of framing as an analytic tool.

Widening the search for literature to extend to use of Technological Frames of Reference (TFR) in Information Science generally, was also not productive. Davidson and Pai in their search for such literature note “we were surprised to find relatively few published reports of research that actually conducted a TFR analysis or further developed the theoretical framework” (2004, p. 474).

A ‘crossover’ article which uses both description of teachers experiences and normative approaches recommending strategies is the study by De Laat, Lally, Lipponen & Simons (2007) of two teachers with differing online teaching styles which also reviews five different authors’ views of online teacher’s appropriate roles and competencies.

In a content analysis of journal articles from five educational journals published between 2001
and 2005, Shih, Feng & Tsai found that only 444 of 1027 articles were related to the field of cognition in e-learning (2008, p. 958). This demonstrates the relatively low overall number of articles that empirically study varieties of understanding of course management systems.

The categories of literature in which they found the fewest articles are of particular interest as these are the closest to the subject of this paper. They identified that topics to do with how people frame issues of e-learning: “…‘information processing-decision making’” (4 articles), “cognitive psychology characteristics-mental model” (7 articles), and “cognitive psychology characteristics schemata” (10 articles) were the least published research topics…” (p 960). Because they address ‘cognition in e-learning’ generally, it is not clear from their paper whether these articles addressed students e-learning rather than teachers e-learning, but if confined to students e-learning, this makes research on teachers understanding even rarer.

SETTING, METHODOLOGY AND METHOD

Drawing on work in progress within a larger project which takes as its subject, elucidating the general sensemaking processes of teachers using ‘Blackboard’ course management system, this study focuses on how a group of teachers frame their online teaching. These particular teachers use Blackboard as an element in mixed medium delivery of courses which are primarily given in face-to-face mode but which include an online element as mandated by university administration. The requirement introduced 18 months prior to the study, to use online methods is known as ‘MOP’ or ‘Minimum Online Presence’ and has been taken up mostly as its name suggests – by putting the minimum of course documents online. MOP is interpreted by teachers as meaning they must use Blackboard, although some other tools are also available within the Distributed Learning System (or DLS).

Within any Blackboard course ‘shell’, class sizes were of 20 to 600 students. Courses were delivered face to face and online by the course coordinator. Classes above around 30 participants were shared with face to face tutors who themselves made negligible online contributions to the courses in this study. A dedicated Blackboard ‘shell’ was used to deliver to every student in a course. I have found no instance of anyone who has used the capability of Blackboard to create individual online classes. The courses were social science courses across a number of disciplines, (social policy, legal and justice studies, youth work and social work) which used a discursive mode of assessment (discussion, essays, presentations and similar) but only a few of which used online participation, collaboration or discussion as part of their practice. Coordinators’ use of online and electronic media was in no case highly sophisticated, but there was sufficient variation and mastery to class some staff as proficient.

There is reason I think to distinguish between “mixed method” delivery implying side by side modes of delivery with little sense of integration of face to face teaching with the capabilities and ‘affordances’ of the online environment, and ‘blended method’ with its connotation of a pedagogical overview and coherence of planning across the two mediums. In most cases the delivery by staff in this study was ‘mixed’. The two delivery media were held conceptually apart, and Blackboard was seen as moderately convenient for the display of materials generated with face-to-face teaching in mind.

The research question for the greater study was to discover and discuss the sensemaking processes used by teachers using the ‘Blackboard’ course management system, but a key aspect was to identify and explore some of the cognitive frames brought to online teaching as a contribution to understanding sensemaking.
This study was ethnographic in keeping with the social constructivist methodology behind Weickian sensemaking that informs the larger study, that is, “…sensemaking most clearly becomes a process that creates objects for sensing or the structures of structuration” (Weick 1995 p 36). The inbuilt epistemology of a theory like sensemaking entails that one’s own sensemaking is also part of the process of understanding others. This is not to lapse into a welter of introspection and render all things relative, but to take a position that the subjective experience of those studied cannot be entered into purely as a spectator.

The study involved 15 teachers within an academic school of social and environmental science of about 50 teaching staff. This number allows an exploration of the extent to which any of these cases are what Bent Flyvbjerg (2004) calls “paradigmatic cases.” Paradigmatic cases are ‘types’ or exemplars that highlight a wider social condition. In a reflexive explanation of paradigmatic cases, Flyvbjerg completes the circle of his argument by using as an exemplar, Kuhn’s paradigms.

Kuhn has shown that scientific paradigms cannot be expressed as rules or theories. There exists no predictive theory for how predictive theory comes about. A scientific activity is acknowledged or rejected as good science by how close it is to one or more exemplars, that is, practical prototypes of good scientific work. A paradigmatic case of how scientists do science is precisely such a prototype. It operates as a reference point and may function as a focus for the founding of schools of thought. (2004, p. 427)

Data collection was broadly participant observation in keeping with an ethnographic approach and included interviews, collection of relevant documentation, participation in meetings about online delivery and making use of any arising opportunity to further understand its operation in this setting. The interview technique itself was to sit with teachers in front of their computers and talk to them for between one and two hours about what they did while they showed me around their online Blackboard courses. I asked them to choose a course that was significant to them, one they were currently using or one that included something novel, as this not only meant they were less threatened about any perceived inadequacies in online skills, but it also meant I could see how confident and adept they were in logging on and moving around their sites. Some stuck with one course site and some showed me a number. While they were showing me around and actively entering information they were also answering progressively more general questions moving from specific use of sections of Blackboard in front of us, to broad considerations of teaching and technology including their own general teaching goals and philosophy of online and face to face teaching. Towards the end of the interview I would try to probe the extent to which informants understood their online activities as teaching, or brought a philosophy of teaching to them. While for some this produced a ready answer consistent with their earlier discussion, for others this was impossible, as it clearly included the assumption that they had one. It was possible at times to watch a dawning comprehension during the interview of the possibilities opened up by this idea. This was only one of a number of questions directed at elucidating frames and their particularity.

With regard to the analytic method itself, Cornelissen, Oswick, Thoger & Phillips (2008) have divided the use of metaphors in organisational literature, analogous to frames as explanatory devices, into two kinds predominant in different organisational literatures. The first they call ‘projection’ which is based on researchers deducing second order constructs to explain and elucidate behaviour about organisation. The second they call ‘elicitation’, which they describe as more inductive. The latter depends on researchers to “identify the symbolic and interpretive uses of metaphors in people’s sensemaking and communication with one another” (Cornelissen et al., 2008, p. 10).
Framing Pedagogy, Diminishing Technology

Table 1. Technological mastery level and pedagogical frame

<table>
<thead>
<tr>
<th>Frame.</th>
<th>Reactive / Proactive dimension</th>
<th>Technological disinterest</th>
<th>Technological mastery</th>
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<tbody>
<tr>
<td>Information transfer. (top down) Administrative and compliance tool</td>
<td>Quadrant 1</td>
<td>Technologically, staff accept the order and design of the instructional software as a template. To structure online offerings staff use external organisational orders. (eg, Week of semester, administrative need to produce certain documents such as course guides for student distribution etc), and decide what items to add by reference to current administrative and ‘housekeeping’ informational needs (organisational and student). Technology is not necessary and not important.</td>
<td>Quadrant 2</td>
</tr>
<tr>
<td>Education. Collaborative learning and teaching tool.</td>
<td>Quadrant 3</td>
<td>Technologically staff make minimal changes to software default layout and design, but utilise the various strengths of the software for teaching so that it complements face to face mode. Face to face mode is also adjusted to incorporate the now necessary online component. Structurally, external administrative and technological order of all sorts is ignored in favour of structuring around pedagogical organisation. (eg, “topics” not “weeks”). Technology is necessary but not important.</td>
<td>Quadrant 4</td>
</tr>
</tbody>
</table>

The question they raise is to what extent are the frames and metaphors that are located by research the product of the researched and to what extent are they an analytical artefact of the researcher? Both are valid, since empirical research entails picking up something from the researched as accurately as possible but no act of research remains itself unframed by acts of analysis or by prior assumptions, (what Holton (1973) calls ‘themata’). Analytical acts of research such as picking out underlying assumptions or regularities in respondents’ information are both inevitable and desirable. Flyvbjerg also sees no way to externally validate a choice of paradigmatic case, but for him, this does not constitute a great problem.

Ethnomethodological studies of scientific practice have demonstrated that all variety of such practice relies on taken for- granted procedures that feel largely intuitive. However, those intuitive decisions are accountable, in the sense of being sensible to other practitioners or often explicable if not immediately sensible. That would frequently seem to be the case with the selection of paradigmatic cases. (p 428)

For this particular analysis my method was to pick up clues and cues from interviewees as to their framing and to elaborate them into a simple typology – a combination of the two approaches suggested by Cornelissen, but one which begins with the respondents. It was this process of division into a simple matrix consisting of an axis for technological skill which ran from disinterest to ‘mastery’ (defined in terms relative to the rest of the group, not to any wider standard) and an axis of ‘pedagogical frames’ from ‘information transfer’ to ‘education’ that revealed two teachers in particular whose counterintuitive approach seemed to require explanation.

Cases occupying Quadrants 2 and 3 are unexpected in that it is easy to assume that as people get better with online technology they will find it easier and more interesting to experiment with it.
and to transfer learning to online environments. Conversely, someone who uses an online environment well could be expected to be technologically conversant.

The Quadrant 2 teacher, (T7Q2) who was most archetypal was regarded by students and other staff as a competent, experienced and interesting teacher. She was technologically competent with Blackboard, but frustrated by its shortcomings and lack of flexibility.

T7Q2: “Oh I don’t use a lot of it. All I use is for documents and sometimes for links and you’ll see I’ve got quite a few. I do need to download some stuff...”

T7Q2: “My usual problem though is often I’m doing this sort of stuff at home and remote access is really slow so its shithouse. There is a real disincentive. But as an online course guide system I reckon it’s really basic.”

She was interested in experimenting with other software that would work around some of the problems she found with Blackboard even though they were not part of the organisationally sanctioned Standard Operating Environment (SOE). She was keen to demonstrate some of the more sophisticated alternatives she had discovered, and later emailed me a link to a beta version of a web based course materials builder (Utilium, http://utilium.com).

She had a sense of the demand from students for materials online and the demand created by the size of lectures, “so you can’t just run things off for students, because the scale now is too big so you actually need this”. Thus although she saw the technology of Blackboard itself as problematic, her attitude to technology itself was positive, both with regard to the need for it and what she felt capable of doing with it herself.

Her focus tended to be very much on the classroom and lecture experience regardless of the fact that she had the skills to create and manage a reasonably technologically advanced learning environment.

JT “What about things like using the E-reserve, and things like that?” (University Library E reserve which enables photocopies of restricted copyright books and other materials to be accessible for the DLS and Blackboard.)

T7Q2: “No, No don’t use them at all. Don’t know about them, don’t use them.”

JT: “Ok, so do you have any full text documents other than your own in Blackboard?”

T7Q2: “No.”

JT: “Right, ok. And I’m just thinking, do you use any other kind of supplementary lecture support stuff like images or anything like that. Do you put the images up?” (Meaning on to Blackboard)

T7Q2: “Yep, yep what goes up is the entire PowerPoint presentation. The lectures are in power point, so the whole lot go up.”

These comments strongly suggest that she saw the lecture in PowerPoint format as her central teaching medium, and that the DLS was an ancillary way of distributing it.

This impression is confirmed by her own designation of Blackboard as supplementary.

T7Q2: “But could it survive without the DLS? Absolutely. You know if a student does not use the DLS they don’t miss anything, because they may well have noted the reference and often the internet enables people to find things so if I mention a particular writer, a particular government department, an aspect of their work, generally a student can find that and if they couldn’t find it they could certainly come back to me and ask for it so the DLS in and of itself is an independent technology.”
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JT: “Did you deliberately structure it that way? Did you have in mind that some students might not have internet access or something like that? So that you make the non technological parts of the teaching self supporting? Do you actually have that as an issue?”

T7Q2: “No no. For me this is not a chicken and egg, for me the DLS is very secondary to the teaching process, all the DLS is, is a means of making the material available much more widely and as I said in previous times I would have printed notes. So summarised the lecture material, printed notes and distributed those at the lecture. But they would be available for students who could get them via email, or in even earlier times students could get those notes from my office.”

Generally, she framed online methods almost totally in terms of analogy to face to face teaching

JT: “Yes, well I guess that sort of leads into how do you see this DLS presentation as teaching?”

T7Q2: “Oh right. Is it teaching? Yeah, I guess it is teaching, what I’ve done is I have given them a...and this very process of preparation focuses my attention to direct them to particular points in the subject that I am dealing with. So this enables both me and them to concentrate the mind on ok, these are the....and usually what I do with my work is I will have a concept that we are dealing with so this particular lecture that we are looking at, the concept is discursive practices, how do they fit in policy making, how can I substantiate the claim that discursive practices and discourse are policy making?”

JT: “Mmm mmm. ”

T7Q2: “...So in order to do that I’ve got to provide a number of policy making examples and evidence of that claim so that I need to provide links to text material I need to provide links to policy statements and where relevant, images.”

Although this teacher enjoys experimenting with other online tools for providing students with information, it is the line “Oh right. Is it teaching? Yeah, I guess it is teaching..” that so clearly shows she does not consider the educational capabilities of the medium.

The teacher who paradigmatically represents Quadrant 3 however approached online teaching quite differently.

She has in the past worked hard on teaching and teaching method generally, developing expertise in several different forms. She has spent a good deal of time building up her knowledge and practice of Problem Based Learning,. As a result of this she had experimented with a number of non-standard forms of face to face delivery, and was at ease with standing back and allowing students creative freedom and independence within designated boundaries. She had also spent some time designing training for short courses on mediation, blending online and face to face delivery, so had online experience albeit at a low technological level. In addition, through her Masters thesis, which was on problem based learning and mediation, she had an opportunity to carefully think through her own pedagogical approach.

JT: “Just looking at that, you haven’t changed any of the artwork or buttons or banners or anything like that? You are just using it as is.”

T10Q3: “I’m very much ‘as is’. ‘Cos I’m not that great at computers. Even though I have used them for many years in terms of online learning, I really got into it because I was focussed on my main area of research being mediation. And I was really focussed on how could the mediation industry learn more about theory. And we tend in that industry to train through short course training, so that’s three to five days, and basically I thought through my Master’s thesis that if we wanted to
learn more about theory, mediators would need to do it online. Because they tend to do mediation training as a post degree (course), so they have done a degree and then they do short course training on top. So they are already social workers or lawyers or sometimes psychologists.

JT: “...so it seems to me you are coming at it from the perspective of thinking what you can do with it socially rather than technically?”

T10Q3: “Yes, that would be true actually.”

Technologically she was no more experienced than T7Q2, and arguably less, since she had little interest in technology beyond that which she had to use. Unlike T7Q2, she was not an early adopter or a seeker of new technological solutions. In fact what was remarkable about the interview was that for almost two hours, she talked about her teaching in relation to the technology, but virtually did not mention the technology as an entity separate from teaching at all. Unlike any other interviewee to date, she did not mention any limitations of Blackboard. Her approach was not that she found technology that would do what she wanted, as T7Q2 did, but that she adapted that technology she had to hand to produce the teaching outcome she wanted.

JT: (referring to her “online fishbowl” role play exercises.) “So this is through the discussion forum?”

T10Q3: “Yes, you can do these through the discussion forum. Threads can create...and you can also do it through email.”

Movement between media (email and discussion forums) that would produce the effect she wanted with least consciousness of the technology on the part of either the teacher or the students was the source of a good deal of her flexibility to rework things she did not like about earlier iterations of the course.

Her approach to course design within Blackboard shows the same pragmatism about technology and commitment to good pedagogy.

T10Q3: “This (Family Law course online) is very basic stuff. I think that’s really interesting. With the requirement to put things up online I probably put that “Family Law” up because of that, rather than any pedagogical reason. This one however, I put up as a real pedagogy. That’s “Understanding Conflict and Mediation”, which is a third year core course for Legal and Dispute Studies. And it tends to be about 30 in the class. And one of the things is that it's very much about blended learning, so we learn about mediation at an advanced level, in class, theory as well as practice, role plays are constant, and then we have online learning as well, and the two work together. So the idea is that you blend face-to-face and online. And I have been working on online mediation role-plays for many years and I have written about it. And the aim is that instead of just having a face-to-face role-play, which is really valuable, and we still do, I want to emphasise that. We still have those skill developments in class. What the idea was that when you have a face-to-face role-play, you can’t really access the literature, you can’t stop and read, not for any length of time at least, and therefore you don’t necessarily - your interventions your choices in mediation role play are not necessarily as informed by theory as you would like. So you can get them to do pre-reading, but often when they have a thought - ‘should I do this or should I do that’, they don’t have the opportunity in the face to face role play to consult the literature at any length, so the idea is that in tandem with your face to face work, there is also - further in the course a bit - an online role play, and at that time you (i.e. students) can make a choice about interventions but they can be informed by theory because the pace is self paced, and you are able to consult the literature and then make a choice.”
This teacher did not understand online teaching as taking place within a technology so much as taking place within an environment. Her understanding of teaching appeared to be that any environment provided opportunities and affordances for teaching. In this case what was useful to her was the capacity of Blackboard to slow down students’ interactions sufficiently that they had time to consider, read up and reflect before they committed to a course of action. This was simply not possible in face-to-face settings. In addition, the option for interaction was always open online in a way that a classroom is not, thus students could come to a decision at a time that suited them. However it was not because it was an online environment that she used it, it was because it enabled her to fulfil her teaching need.

Her strongly pedagogical approach also showed up in her choice of categories for organising information within Blackboard. She did not organise by electronic genre – for instance ‘links’ which is a form suggested by some content areas of Blackboard; neither did she organise by teaching ‘weeks’ an essentially bureaucratic form of organisation. Instead she organised information by ‘themes’ that pertained to the content taught. Such thematic organisation fits the pedagogical end.

IMPLICATIONS

In both of these cases we see a strong tendency to ‘frame’ the problem of teaching by drawing on prior understanding. For the quadrant 2 teacher (T7Q2), the prior frame was face-to-face teaching and the lecture in particular, although she avowed she preferred workshop style teaching face to face. Nevertheless the ‘lecture’ frame was sufficiently embedded to create a strong unconscious ‘episteme’. She understood knowledge and knowledge transfer as primarily a problem of having access to content; mostly content provided by the lecture supplemented with some other materials. The concept of courseware or online media as an instructional form was outside the frame sufficiently for her to have not considered it as ‘teaching’.

For the Quadrant 3 teacher on the other hand, the experience of spending several years both developing and experimenting with new styles of face to face teaching and then examining this through her research had produced a strongly generalist pedagogical frame that was her first point of reference for solving new ‘media’ problems. They were not new media problems at all for her, they were pedagogical problems.

In both cases the teachers were mapping old habits onto new circumstance. They were framing the problem of teaching online in terms of their uppermost concerns, derived from their beliefs and commitments to particular types of teaching. The difference between the two seems to be that the framing the quadrant 2 teacher used produced a large gap between understanding how to teach in the classroom and understanding what might go on online, whereas the quadrant 3 teacher found little difficulty in using the online environment to best advantage.

For the quadrant 2 teacher, teaching online could really only be imagined as an extension of face-to-face teaching. Any attempt to pull the solutions of that frame into the new environment produced fairly weak results. Indeed one interpretation of her search for more amenable software may have been that she was looking for the tools to support her existing frame. To surmount this gap would require extensive effort on the part of the teacher, because it means breaking and remaking a frame. It requires precisely the conscious commitment to explicit sensemaking that the literature on professional development envisages for better online teaching.

This idea of frame maintenance over different teaching settings, and the cognitive cost of breaking unworkable frames has great explanatory power to make sense of teachers’ ‘resistance’; the unwillingness to take on what was seen as extra work, by most of the teachers I spoke to. It is indeed
extra work in learning and cognition, because it entails not just understanding the technical possibilities but also reworking ideas that have not only been satisfactory for years, but which also produce coherence in teaching style given the holistic inferential coherence of the parts that make up any given frame.

The framing the Quadrant 3 teacher used was wider than the mode of production for any given teaching occasion. It was both flexible and able to be carried into a new situation intact. She did not need to cross a gap because very little gap existed, in that for her, a great variety of environments were sites that might be useful for teaching. She did however bring to teaching a degree of curiosity and an exploratory attitude, so that she was able to determine what capabilities online tools allowed. A frame such as this is more borderless than that above. It is also more internally self referential rather than dependent on its form of production as is evidenced by her comment about not being very good with computers and her easy switching between discussion groups and email for the same purposes.

There are several conclusions that can be drawn from these cases.

Firstly and most obviously, it may not be necessary to be technologically skilled or even very interested in technology to produce good online teaching. What is necessary is strong commitment to good pedagogical practice and a clear idea of teaching strategy combined with a sense that many settings can be adapted as sites of learning. When universities contain many teachers who are slow adopters grappling with ‘low’ technologies, it is useful to know the minimally sufficient conditions which allow for good teaching online. In this sense this study also represents what Flyvbjerg (2004) terms a “maximum variation case” (p 426) or a “least likely case” (p 427), meaning that if successful online teaching can stand up under these conditions it can stand up anywhere.

Secondly, also necessary is a willingness by teachers to explore the capacities and ‘affordances’ of many tools and situations for their learning potential with a clear idea in mind of what it is to be used for. Without this exploratory attitude and clarity of pedagogical intention, it is easy to be subverted by ‘structures’; the intentions of the software designers, directionality built into the software, or if the teaching setting is not software, the conventional behaviour required in a particular physical setting. Relinquishing agency to technological design is a vestige of the ‘determinism wars’ and makes it easy to understand how some teachers feel directed by the software. Fostering the capacity to explore an LMS for its specific solutions to one’s teaching problems or fostering the ability to make unexpected use of a feature designed for something else is a difficult art for professional educators and software designers but one which would produce much more creative use of online education applications.

Thirdly a useful approach may be for teachers and professional development managers to explore explicitly what frames people bring to their use of online education tools. Frames that must be broken in order to adapt to a new environment are hard work for their owners both to maintain in the face of mounting evidence that they don’t work and to remake once they have collapsed. Work is still necessary to further understand the conditions of online teaching under which existing frames break and sensemaking must occur.

Lastly, all this suggests that incremental change is easier for teachers to bear than sudden mandated use of online educational tools. Since sensemaking is social and frames are built up through interpersonal and organisational meanings as well as through personal understanding, experiences of how others achieve successful approaches through engaging with communities of practice and one to one sharing of ideas may be as useful or more useful than formal professional development sessions for the rebuilding of collapsed sensemaking that has failed to negotiate the frame gap between face to face and online teaching.
CONCLUSION

The focus of this chapter has been the exploration of frames and sensemaking as a means of understanding the experiences of teachers who are slow adopters of technology in situations where the technology itself is not cutting edge. The literature treats the relationship between face-to-face teaching and online education as a gap which if left unattended will have serious negative consequences and therefore advocates that teachers should achieve a transition between them.

There are two common approaches to the problem of creating “systematic, coherent curriculum designs grounded in clear views about the contribution of university study to either general education or lifelong learning” in an online setting (Skilbeck 2001 in Postle & Sturman p 19). Sometimes this is identified as a problem of insufficient attention to developing a web based or online pedagogy. eg, Ask and Haugen (2008). Sometimes this is identified as a problem of the technology itself embedding the ‘wrong’ pedagogy eg, Adams and Morgan (2007). Both arguments position Learning Management System technology as something to be surmounted by adding something not already there, either by better pedagogy designed for online teaching or by better technology.

However sensemaking theory is also about the management of cognitive gaps. Under conditions of confrontation with a conceptual gap, sensemaking may collapse. This occurs when pre-existing frames are used to make sense of new situations and prove to be unable to accommodate the stretch.

The case of two teachers who use opposite frames and levels of technological mastery is used to show that there are a set of minimal conditions under which sense can be maintained and still produce excellent online teaching even in people not very technologically skilled or interested by using thinking patterns that are already there. This is the prior acquisition of a pedagogically oriented frame that is already flexible and adaptable enough to accommodate and indeed seek out specifically useful conditions of new settings for learning. Where an existing frame can be successfully employed in a new setting there is little experience of a gap in understanding or of the conscious effort of reframing.

This may be useful for professional development specialists in that it suggests that a concentration on identifying and developing this form of frame will prevent the cognitive load for teachers arising from breaking and rebuilding new frames in order to deal with online settings. It also suggests that incremental change is likely to be most successful in supporting frame maintenance and adaptation.

REFERENCES


Framing Pedagogy, Diminishing Technology


**KEY TERMS AND DEFINITIONS**

**Sensemaking:** A term reinvented by Karl Weick, a social psychologist whose interest is in organisations and risk. Sensemaking refers to the refashioning of meaning that occurs when a particular understanding of the world fails to account for new events or experiences.

**Frames / Framing:** A sociological and social psychological concept that suggests that people rely on previous interpretations of events patterned into schema or stereotypes to organise information or events.
**Pedagogy:** The science of teaching – literally teaching young children but used by association for all investigation of teaching knowledge. (Andragogy is probably the more correct term for the science of tertiary teaching.)

**Technological Determinism:** The idea that technology is a social structure or force, the effects of which cannot be avoided or mitigated. Most arguments about this have been about the nature and degree of social influence over, or social construction of technology.

**Courseware:** Software programs used to deliver structured online courses at tertiary level. Examples include Blackboard, Web CT, Moodle.

**Computer Supported Co-operative Work (CSCW):** The study of collaborative activities and co-ordination of tasks and interactions which are mediated by computer support. Usually but not exclusively occurring amongst people who are connected by membership of an organisation.

**Learning Management System (LMS):** Organisationally based usually proprietary software often connected to the web (ie as well as an intranet) and designed to manage and distribute courses.

**Social Construction of Technology (SCOT):** An explanation for the success or failure of technologies in terms of the social context that gives rise to and shapes them. An antidote to technological determinism, but one among a number of theoretical approaches that addresses this.
Chapter 17
Online Studio Design Pedagogy:
Community, Personality,
Graphic Design, Usability

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ABSTRACT
ART765 Design for the WWW serves as the capstone course in the online post-baccalaureate certificate Interactive Media Design at Towson University. The course and program provide students with the opportunity to advance their web and interactive media design knowledge. The opportunity to design and produce a four course graduate certificate prompted the careful consideration and creation of an online course design system intended to enhance student learning and usability. ART765 Design for the WWW became the design prototype for the IAMD certificate. The pedagogical and design strategies used to create ART765 Design for the WWW include: creating a sense of community and personality, considering the needs of the online learner; graphic design, information architecture, web usability, appropriate multimedia methods, Web 2.0 technology and MUVE’s, and the Quality Matters® peer review. These strategies serve to unify the online teaching and learning environment for all four of the Interactive Media Design courses.

INTRODUCTION
ART765 Design for the WWW serves as the capstone course in the online post-baccalaureate certificate Interactive Media Design at Towson University. The course and program provide professionals, artists, and educators the opportunity to advance their web and interactive media design knowledge by offering coursework via the Internet. Students must complete four graduate-level courses to earn a certificate: Elements of WWW Design, Graduate Typography, Interactive Media Concepts and Theory, and Design for the WWW. The certificate emphasizes visual communication and graphic design theories and practices within the applied context of website and interactive media authoring.

The opportunity to design and produce a four course graduate certificate prompted the careful
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consideration and creation of an online course design system made up of essential design strategies each intended to enhance student ease of use and improve student learning. ART765 Design for the WWW became the design prototype for the IAMD certificate, and ultimately the course served as the template for subsequently designed IAMD online courses. The pedagogical and design strategies used to create ART765 Design for the WWW include: creating a sense of community and personality, course content that considers the needs of the online learner, graphic design, information architecture, web usability, appropriate multimedia methods, Web 2.0 technology and MUVE’s, and the Quality Matters® peer review. These strategies serve to unify the online teaching and learning environment for all four of the Interactive Media Design courses.

ART765 DESIGN FOR THE WWW CASE STUDY

Overview of the course. Through a series of WWW exercises and projects ART765 Design for the WWW students analyze and apply current aesthetics and methods of World Wide Web design and authoring in order to create comprehensive and effective WWW sites. Students utilize digital imaging methods for image generation, and WWW authoring techniques. Students utilize current industry WWW authoring software including: Adobe Dreamweaver®, and Adobe Photoshop® to engage in the design and production of websites that are published via the Internet. Students also participate in researching various aspects of design for WWW and it’s impact on industry, culture, education, and the visual dissemination of electronic information. Additionally students utilize Web 2.0 and MUVE technology as a means of raising their awareness to how these new web technologies expand and alter the expectations of today’s web users.

ART765 Design for the WWW is delivered online through the Blackboard® environment, permitting students from remote locations to complete the course without attending classes at the main campus. Students are expected to have basic to mid-level computer skills. Access to a suitable computer with Internet service is required, and a high-speed Internet connection is recommended.

Creating a Sense of Community in an Online Course

In a face2face studio teaching and learning environment the physical meeting time and place of the class creates a sense of community by default. Face2face group and one-on-one critiques of design projects require much discussion and the in-class interaction further fosters the development of the classroom sense of community. Creating a sense of community in an online course is integral to the student experience and their ultimate success in the course. The Sense of Virtual Community (SOVC) is a recognized significant feature of virtual communities and is defined by Blanchard (2007) as, “members’ feelings of membership, identity, belonging, and attachment to a group that interacts primarily through electronic communication.” (Blanchard, 2007) The challenge lies in recreating elements of the face2face community for the online learners. Quite often in an online course, as in face2face teaching and learning environments, the strength and dynamic of the group enhances the students’ learning experience. Likewise a poor group dynamic hinders the pedagogical success of the course–leaving students confused and disillusioned.

Palloff and Pratt (2007) noted, the following indicators “provide evidence that community has formed in an online class:

- Active interaction involving both course content and personal communication
- Collaborative learning evidenced by
comments directed primarily student to student rather than student to instructor.

- Socially constructed meaning evidenced by agreement or questioning, with the intent to achieve agreement on issues of meaning.
- Sharing of resources among students
- Expressions of support and encouragement exchanged between students, as well as willingness to critically evaluate the work of others” (Palloff & Pratt, 2007, p. 31).

A strategy designed and implemented by Sullivan to foster the development of an online community for ART765 Design for the WWW includes the extensive use of the online discussion board in Blackboard for class discussions. With the exception of the discussion Course FAQs, all discussions are assessed as writing assignments requiring the use of proper grammar and punctuation. Rewarding participation in the discussions promotes student involvement. Without points awarded for the discussions students do not voluntarily participate. Discussion guidelines are outlined in the course syllabus, and reiterated periodically by the professor, if required, to remind students of the preferred discussion format.

The first discussion, *Introduce yourself to the professor and classmates*, is designed to jump-start the online community dialogue. At the beginning of the semester students eagerly write about their web design background, favorite foods to eat, favorite non-computer activity, and the scariest thing that ever happened to them. Students also upload a photograph of themselves to this preliminary discussion to aid in visualizing each other as they read their classmates’ posts throughout the semester. This discussion fosters robust group chats where students reveal many personal preferences and opinions. Other discussion forums include: *Course FAQs, Preliminary group critiques of projects, and related topical group discussions*.

In the Course FAQs discussion forum students are encouraged to share information with each other and answer each other’s questions if appropriate. Group critique forums permit students to respond to each other’s work prior to the professor responding to each student’s individual project. Students read all comments made by the professor and rework projects for final submission.

**Revealing Personality to Help Students Connect with Professor and Content**

In the online and face2face teaching and learning environments the use of story telling and personal anecdotes adds meaning to course content. The professor’s viewpoint and sense of humor in combination with their own personality traits draws a student into the course content. The student becomes a willing participant in the journey through the course content allowing the professor to guide them through difficult and complex concepts. A level of trust developed between professor and student increases the openness of the student to new ideas and practices.

From the perspective of basic communication, Munro (1998), a researcher in distance education, explained, “all communication is facilitated by electrical charges that cross empty spaces. Human beings seem to be built of and for relationships, all conducted across fields of empty space” (Munro, 1998, p. 57). Certainly the empty space within a face2face educational setting is similar to the empty space between the professor and student in an e-learning environment.

Sullivan bridges the empty space to establish relationships utilizing specific multimedia and graphic elements to create a sense of personality in the ART765 online environment. A video taped introduction is available to students at the start of the semester to provide a sense of the professor’s physical mannerisms and speech tonalities (see Figure 1). The students’ visual memories will conger up a “live video” image
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Figure 1. Video welcome from the professor

of their professor speaking when they later listen to the professor’s slide lectures, software demonstrations and project critiques. A personality rich environment is selected as the backdrop for the video introduction to fortify the students’ understanding of the professor as they see her seated in her office. The introduction is short and fairly informal encouraging students to contact the professor with any questions they may have about the course.

ART765 content is delivered in weekly outlines that include introductory comments from the professor (see Figure 2). These comments are presented in a consistently positioned and formatted box with a small friendly caricature drawing of the professor to remind students that the hints are coming from an actual person who wants them to succeed in the course. The hints from the professor are designed to contextualize the large amount of written content and make it more manageable for the student.

Nielsen (2000), web usability researcher stated, “each hypertext page should be written according to the ‘inverted pyramid’ principle that is commonly taught in journalism schools. Start with a short conclusion so that users can get the gist of the page even if they don’t read all of it; then gradually add detail. The guiding principle should be that the reader can stop at any time and still have read the most important pieces of information.” (Nielsen, 2000, p. 112)

The “helpful hints” comments from Sullivan often reveal a sense of humor and contain personal anecdotes related to that week’s content. Writing for the web is different than writing for print. Nielsen (2000) stated, “Be succinct. Write no more than 50 percent of the text you would have used to cover the same material in a print publication… Although web text should be short, it should not

Figure 2. Week one course content outline - hints from the professor
be without personality. Usability studies show that users appreciate some amount of humor and attitude in web pages. What is respected is a clear voice, perspective, and personality in the exposition” (Nielsen, 2000, p. 101).

Additional guidance is provided to students through the inclusion of numerous web pages intended to orient the student to the e-learning experience and the professor’s expectations.

ART765 course web pages designed to aid students include:

- **Yikes! Don’t Panic—what to do when everything goes wrong**. A set of step-by-step instructions on how to troubleshoot and solve with possible course related hardware and software issues. Also includes a list of resources and phone numbers for students to call for assistance with Blackboard, university e-mail accounts, etc.

- **Tips and tricks—how to succeed in this course**. A straightforward statement of advice from the professor of what an online student needs to do to insure success in the course: schedule a class meeting time for yourself, and keep it; good attendance = a good grade, have a backup plan for when your computer goes down, backup your work, complete all work on time, read and understand all course content, etc.

- **Information about quizzes—including a sample quiz**. This page provides an overview of the purpose of the ten quizzes in the course to motivate students to complete all course reading assignments. Quizzes in *Design for the WWW* represent a total 20% of the student’s final grade and provide the opportunity for students to earn up to a total 8% extra credit in the course. Comprised of true or false, fill in the blank, multiple choice and multiple answer questions the twelve question quizzes are essentially open book, however they are timed at 35 minutes not permitting enough time to actually read all assignments while taking the quiz.

In an effort to make the professor more available to the student the professor provides two weekly *Virtual Office Hours*. During the pre-announced times the professor is available either by phone (office), in-person (office) or online via IM (instant message), or at a weekly in-world meeting time in Second Life. During both of the *Virtual Office Hours*, students know the location and availability of the professor thus creating a sense of personal connection (see Figure 3). The virtual office hours held in Second Life take place at the Waterside Café in the New Media Consortium campus. Sullivan introduces the virtual café as a location for socializing in a relaxed atmosphere. Harasim, Hiltz, Teles and Turoff (1996) stated, “Social communication is an essential component of educational activity. Just as [face2face] school or campus provides places for students to congregate socially, an online educational environment should provide a space, such as a virtual café, for informal discourse. The forging of social bonds has important socioaffective and cognitive benefits for the learning activities. The virtual café should be primarily a student space and not be directly tied to the curriculum” (Harasim, Hiltz, Teles & Turoff, 1996, p. 137). Often after the structured event ends the students continue their social interaction without the professor.

**Considering the Needs of the Online Learner**

The differences between the needs of the undergraduate and graduate audience for online learning are noteworthy. When offering a similar undergraduate version of the course, *ART365 Design for the WWW*, Sullivan observed the undergraduate Studio Art students at Towson University, who are primarily engaged in face2face learning, required time to transition between the...
face2face and online learning environments. This transition has been critical to their success with the course and needed to be factored into the course design. Self-discipline is a critical factor in online student success. Without traditional twice-weekly face2face classroom sessions for 14 weeks students are left to their own devices to make time for online course activities. Improvements in the online undergraduate course included the addition of optional face2face meetings for Q&A sessions and feedback on projects, and frequent e-mail reminders from the professor that helped to keep students on track with assignments.

This issue with undergraduates inexperienced with online learning is supported in research conducted by John Allan and Naomi Lawless. Allan and Lawless (2004) stated, “The less experienced student expect[s] to log on about once a day, [while] the more experienced students anticipating between once and more than once per day; the higher figure being a more realistic expectation” (Allan & Lawless, 2004, p. 123).

It is also useful to consider the impact of only offering an online section of a required undergraduate major’s course. Not all succeed in the online learning environment and campus-based undergraduates rebel against being required to take an online course. It is important to note that the undergraduate population of the Art Program at Towson University is a campus community only just recently being offered more online course opportunities.

In contrast the needs and experiences of online graduate students can be quite different than undergraduates. Many graduate students work fulltime and have more interest in the independence offered with the online experience. Already familiar with self-learning technology, multi-tasking and time management, graduate students come to the online course happy to be working at their computers at home or in their offices. In the course ART765 Design for the WWW some graduate students did require flexibility of deadlines due to professional commitments. Considering that synchronous activities may present a hardship for fulltime professionals—alternative activities were offered in such cases. All lectures demonstrations and critiques for ART765 Design for the WWW took place asynchronously providing the greatest flexibility for students.

When designing an online course the audience of that course should be fully considered. Vice president and creative director of Nickelodeon, David Vogler (2001) directed his Nick.com designers with the following “five design principles:
1. respect your audience – offer intelligent menu systems that work for your audience
2. use templates – all webpages should follow a strict set of design guidelines. “this ensures consistent site packaging and enhances user clarity… the UI should be ‘invisible’ and unobtrusive. The [user] interface is there to help you access content, not overshadow it.”
3. surprise, movement and play – keep the site lean and functional, but maintain a sense of play and discovery. This will add visual dimension and personality to the course content keeping the student engaged and curious.
4. consistent navigation – keep your navigation system “unclever”, a bland visual element consistently placed in the same position for ease of location and use.
5. graphics with attitude – observe and utilize graphic elements relevant to your audience. Invest a moderate amount of time in looking at magazines, and websites you know are dedicated to the same audience you serve in your online course” (Heller & Volger, 2001, pp. 151-152).

In the course ART765 the overall design of the course content considers the audience of working professionals enrolled in the course for career advancement. The content is structured into weekly course content outlines that are zipped folders of web pages uploaded into the Blackboard environment. Each weekly outline appears as a link. When the linked is followed Blackboard un-packages that week’s outline and its supporting web pages into a new browser window (see Figure 4). This method of delivery of content is consistent throughout the course and permits ease in controlling the format and design the course content.

Sullivan utilizes persistent navigation on the left side of the course content outline web pages (see Figure 5). This entire left portion of the web page remains consistent from week to week. Its repeating appearance on every page helps the students orient themselves to web page and easily locate the course content they are seeking.

Throughout the course content several templates are utilized to create consistency in the overall design. This uniformity aids students in reading and understanding the content. The templates are similar in their layout and vary only in their page names (see Figure 6).

Page Names. Sullivan identifies all pages using consistently placed page names. This consistent element placement makes the reading and understanding of content much faster for students. Page names act like road signs for the visitor to the web site. Krug(2006) stated, “four things to know about page names:
Every page needs a name - highlighting the page name is the navigation is not enough, use the page space and include the page name.

- The name needs to be in the right place - Put the name in a position where it frames the content that is unique to the page (somewhere at the top of the content)
- The name needs to be prominent - Use size, position, color and type choice to reinforce the visual hierarchy
- The name needs to match the navigation vocabulary - Use the same word(s) Consistency is critical to foster understanding” (Krug, 2006, p. 62).

Figure 5. Weekly course outline with persistent navigation on left – illustration Scott Spector

**Graphic Design, Information Architecture, and Usability**

**Graphic Design.** The application of basic graphic design, information architecture and web usability principles will make an online course easier for the student to understand and navigate. Better readability and more efficient navigation will improve the students’ learning experience.

In the course ART765 Design for the WWW consistent layout design and element placement with systematic formatting of type aid the student in visually finding their way through content. Such a design system applied to the creation of an online course improves the appearance and visual organization of the course resulting in a less stressful experience for the student attempting to locate and comprehend information from
the web pages. Norman (2002) described in his essay Emotion and Design: Attractive things Work Better, “Tools that are meant to support serious, concentrated effort, where the task is well specified and the approach relatively well understood are best served by designs that emphasize function and minimize irrelevancies… The design should not get in the way: it must be carefully tailored for the task” (Norman, 2002).

The design system for ART765 Design for the WWW served as the brand identity prototype for all four of the Interactive Media Design certificate courses. A design system establishes a devised set of formatting or design decisions that strengthen the cohesive visual presentation of information. Whether creating a large or small-scale project, design systems will aid you in your design process.

Design decisions such as grid layout and application, color, type treatment, navigational design, and image quality or type should be identified. It is useful to record various aspects of the design system criteria as it unfolds, and refer to the document often while creating course content. When uniform design work is required from a team of designers a written description of the design systems is published, often referred to as a style guide. Designers often must follow style guide specifications when working for a corporate client requiring a consistent visual presence or brand identity.

Sullivan engaged a graduate design student to create the collaged illustration graphics to be placed in the left navigation columns of the weekly outline web pages (see Figure 7). These
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Figure 7. Weekly collaged illustration bottom left in course content outline - illustration Scott Spector

clever illustrations anchor the weekly outline web pages providing a visual break from all of the text and tease them with a visual riddle of sorts. The illustrations maintain a similar look and feel throughout the course creating another consistent visual element to structure the web pages.

Sullivan also uses simply illustrated icons sold as the font set Big Cheese purchased from Émigré. com (see Figure 8). These iconic images utilized in a minimal fashion and positioned consistently throughout the course outlines created relevance to the topic and an air of levity for the audience.

Sullivan developed a color system to apply in a uniform manner throughout the content to create familiarity with the location of key elements. Effective color choice improves student understanding, and use of the Web-safe color palette when selecting colors insures consistent color reproduction on various platforms in various browsers. Use of screen fonts to set type displayed on computer monitors enhances clarity of letterforms and improve readability of type.

Most common serif screen font choices include Georgia, Times New Roman, and Times. The most common sans serif screen font choices include: Verdana, Helvetica, and Arial.

Information Architecture. Information architecture is responsible for the synthesis of information and design that for falls in a shared area between content, users and the context. Rosenfeld and Morville (2003) stated each of these parts (see Figure 9), “can be described as follows:

- Users are defined by audience and its: tasks, needs, browsing habits, and experience.
- Content is made up of document and data types. object, volume (quantity) and existing structure.
- Context includes the client’s goals, funding, politics, culture, technology, resources,
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Figure 8. Illustrations from Émigré font set Big Cheese

Figure 9. Quality Matters 2007 seal of recognition

and outside constraints” (Rosenfeld & Morville, 2003).

Most often, web designers new to the field forget to fully consider the areas of users and context. A natural mistake and the tendency is let the content dictate the information organization. A heightened awareness of how users and context impact the course design will result in more successful learning. Sure “Content is King” when it comes to the web, but if the audience cannot find what it needs, and the project is created with no respect to the technology available to the student users, the final result is an online course that frustrates and turns off its students.

In the design of ART765 Design for the WWW, Sullivan stepped into the shoes of her students — a wide audience of varied technical skills familiar with 14-week courses delivered in a traditional face-to-face studio setting. With this audience in mind Sullivan structured the online course content into 14 weekly course content outlines. Each outline presents course activities in the same manner from top to bottom: hints, objectives, topics, reading assignments, tutorials, project, exercise, quiz, and virtual office. The information architecture considers the students’ learning goals within the context of the course activities.

Usability. To improve the usability of course content Sullivan presents written text using visual hierarchy, strong contrast, chunking of pages, and follows basic guidelines of usability. Sullivan has adopted a method of writing for scanability—avoiding long continuous passages of text and instead breaking content into shorter paragraphs with frequent subheadings and a generous use of bulleted lists. Topics are broken into separate web pages leading to written content or video/audio lectures and demonstrations.

Nielsen indicated (2000), “Research has shown that reading from computer screens is about 25%
slower than reading from paper. As a result people don’t want to read a lot of text from computer screens. Therefore you should write 50 percent less text—not just 25 percent less—because it’s not only a matter of reading speed but also a matter of feeling good” (Nielsen, 2000, pp. 101-103).

In a usability study Nielsen (2000) stated, “… 79 percent of test users always scanned a new page they came across; only very few users would read word-by-word” (Nielsen, 2000, p. 104).

Nielsen (2000) advises, “to write for scanability:

- Structure articles with two or even three levels of headlines. Nested headings also facilitate access for visually impaired users with screen readers.
- Use meaningful rather than “cute” headings.
- Bulleted lists and similar design elements should be used to break the flow of uniform text blocks.
- Use highlighting and emphasis to make important words catch the user’s eye” (Nielsen, 2000, p. 114).

Selecting appropriate multimedia methods to disseminate course content

In a face2face studio design class learning requirements are met primarily through: demonstration of process (step-by-step), execution of design work, viewing and discussing actual design work (group and one-on-one critique), and slide lecture. In contrast reading and writing become the primary activities of learning in an online environment. For the course ART765 Design for the WWW Sullivan utilizes different multimedia methods of teaching the studio design student in an online environment. Using Adobe Captivate® Sullivan creates online video and audio software demonstrations to highlight important technical aspects of project execution. Slide lecture presentations provide audio of the professor explaining related conceptual and aesthetic principles as well as analyzing contemporary web design. Online critiques take place in discussion forums using written responses and audio/video pod-casting, and the course will holds two online critiques in a Mediasite® enabled classroom for live participation or asynchronous playback. Presentation of information through various multimedia methods engages the student in the course content by tempering the emphasis on written course material. Lidwell, Holden, and Butler (2003) stated, This mixing of presentation modes is a useful course content delivery design method that improves order to insure that students may easily access video lectures, software demonstrations and Mediasite® presentations. Take care to avoid the overuse of multimedia elements, and consider the audience’s technology interest and thirst. Just image how infuriating multimedia can be for the visitor who just wants to get to the information without having to listen to a droning soundtrack or navigate around a downloading flash movie. On the flip side, strategically placed audio, video and flash sequences can engage and excite a techno-thirsty web audience.

Not all online learners have the same needs and the format of presentation should consider various methods of learning beyond ADA compliance. In a face2face studio design class learning requirements are met primarily through: demonstration of process (step-by-step), execution of design work, viewing and discussing actual design work (group and one-on-one critique), and slide lecture. In contrast reading and writing become the primary activities of learning in an online environment.

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learning through the minimization of the proactive interference effects (Lidwell, W., Holden, K., & Butler, J. 2003).

To expose online students to the vast amount of credible and authoritative resources available for graduate study and self-training, Sullivan utilized electronic journals, e-reserves, and Internet articles as required reading assignments for *ART765 Design for the WWW*. These resources complemented the multimedia lectures and demonstrations. Students completed online quizzes in Blackboard to assess their reading accomplishment and understanding of key concepts.

**Utilizing Web 2.0 Technology and MUVE’s for Maximum Student Immersion**

Web2.0 technologies utilized in the course immersed students in the medium of web design—helping students to find their way to the future of web design. Web2.0 technologies utilized in *ART765 Design for the WWW* included: wiki building, YouTube®, and Second Life®.

In all Interactive Media Design online courses Sullivan utilizes Blackboard discussion boards for collaborative learning and building community within the eLearning environment. The adoption of the wiki format for building collaborative documents came easily to the IAMD students while simultaneously exposing them to the potential of collaborative learning and working in the wiki environment.

*ART765 Design for the WWW* students participated in two wiki activities. First the students utilized Wikipedia.org® etiquette and protocol for posting an authoritatively referenced comment in a topic of their choosing on Wikipedia.com. Students were required to document the posting in Wikipedia® for submission to the professor. For the second part of the project the students collaboratively built a Wiki document using the Epsilen.com® Group Wiki tool. Later in the course the wiki platform was utilized to create *HowTo* and *Tips&Tricks* documents requiring students to share their newly acquired knowledge of Adobe Dreamweaver software and the Second Life interface.

Students and faculty may create Epsilen.com accounts for free as long as they register using an .edu e-mail address. With an Epsilen.com account the faculty member can create a group and invite students to join the group. Within the group, wikis can be created. There are many free wiki services available including PBwiki.com® and Wikidot.com®. Wiki sites can be accessed using most current Internet browsers.

The wiki course activities presented a reasonable challenge for *ART765* students who where all technically proficient and had some previous exposure to collaborative learning activities in IAMD courses. Several students took the Wikipedia posting quite seriously and posted to controversial topic quickly experiencing the immediate removal then subsequent replacement of their posts. The collaborative aspect of building the group wiki in Epsilen.com exposed misaligned student expectation. Sullivan anticipated this and built in a grading structure, which assessed the individual wiki contribution at a higher level than the assessment made of the resulting group product.

*ART765 Design for the WWW* students created a video tutorial for one of their projects. The purpose of the assignment was to expose students to the potential of YouTube as a method of dissemination of multimedia communication. The project objectives directed students to create a video tutorial related to course activities using freeware and shareware specified by the professor.

This project presented a reasonable challenge for *ART765* students who where all quite technically proficient and had some previous exposure to computer video editing. Frustrations where abated by the high level of interest and enthusiasm the
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students had for the project. Many commented on their excitement to be creating video for distribution via the Internet.

MUVEs (Multiple User Virtual Environments) such as Second Life provide ART765 students with an opportunity to analyze the impact of 3-D simulated environments on future trends in interactive media design. ART765 Second Life activities include: office hours, field trips, analysis of business and education destinations, and the creation of Second Life devices for selling student designed objects.

Sullivan’s initial reason to add Second Life as a forum for communication stemmed from the desire to conger up a greater sense of identity and community with the online students. Walther (1996) stated, “Forming relationships in an online learning environment takes more time than in a face-to-face environment, even though the level of information exchanged may be equivalent, many students found it frustrating to build relations and work asynchronously” (Walther, 1996) Granted the SL MUVE is synchronous, but even more important to online students is how the platform puts individuals’ faces and figures in motion with the added dimension of voice. Palloff and Pratt (2007) state, “For [an] electronic personality to exist, certain elements must manifest [including]…

- The ability to create a mental picture of the partner in the communication process
- The ability to create a sense of presence online through the personalization of communications” (Pratt, 1996, pp. 119-120)

As the class worked and met in-world the power of the MUVE medium to connect the class in a SOVC became apparent. ART765 students responded favorably to the MUVE’s new and different opportunities for Internet communication and learning.

Second Life requires a fairly robust computer with a good graphics card and a broadband connection. Interactive Media Design students are all required to have such a computer and a broadband connection is recommended for viewing online video lectures, demonstrations and critiques. The Second Life software is free to download (www.secondlife.com), and ART765 students are required have a microphone for audio communication.

Second Life presented all ART765 students with a challenge. Students required on average six hours to: download the software, create their avatar, and acclimate to the SL virtual environment. Sullivan presented the SL environment early in the semester. Initial student activities took a casual tone. Students were required to attend 3 out of 6 posted “in-world” office hour meetings. These casual events permitted students to ease into the format, and if their connection failed the pressure was off. Several weeks later basic exercises required building and exchanging of objects and data in-world. Student Second Life skills and confidence increased considerably as the semester progressed. Following their analysis of Second Life ART765 students expressed amaze-ment and excitement about the potential uses of Second Life in education and business.

ART765 - QUALITY MATTERS®

PEER REVIEWED

Following the first run of ART765 Design for the WWW Sullivan applied to have the course peer reviewed by Quality Matters®. The Quality Matters program is a faculty-centered peer course review Quality Assurance process. Review criteria are linked to external standards; criteria and process are supported through instructional design principles; and the process is vetted by faculty experts. The goals of the program are to increase student retention, learning and satisfaction in online courses by implementing better course design. Quality Matters is sponsored by MarylandOnline and has been adopted by hundreds of higher
education institutions across thirty-five states and Canada. (www.qualitymatters.org)

Quality Matters has generated widespread interest and received national recognition for its peer-based approach to quality assurance and continuous improvement in online education. The process utilizes the Quality Matters Rubric: a set of forty specific elements, distributed across eight broad standards, by which to evaluate the design of online and hybrid courses. The web-based, fully interactive rubric is complete with annotations that explain the application of the standards and relationship between them. The eight broad standards include: Course Overview and Introduction, Learning Objectives, Assessment and Measurement, Resources and Materials, Learner Engagement, Course Technology, Learner Support, and Accessibility.

The process of review ART765 took place over approximately three months. Following the initial review, the peer reviewers made suggestions for improving the course tied to essential Quality Matters standards — specifically clarifying measurable objectives and realigning the course grading system. Following amendments made to the course by Sullivan, and a subsequent review, the Quality Matters review team recognized ART765 as meeting the quality standards of the Quality Matters rubric. The review resulted in a compiled Final Team Review based on the individual reviews. In order to meet Quality Matters review expectations, a course must meet each of the 14 essential standards (standards valued at 3-points). In addition, the course must receive a minimum of 68 (out of 80) points. ART765 Design for the WWW can now be marketed and advertised as being recognized by Quality Matters (see Figure 10).

CONCLUSION

Translating face2face studio art pedagogical methods into the online learning environment presents an exciting challenge. The success of ART765 Design for the WWW demonstrates that effective teaching and learning of electronic media and web design can be achieved online through the strategic use of online discussions, and the inclusion of such multimedia elements as: online video and audio software demonstrations, slide Lecture presentations (with voice-over), and feedback on projects via video podcasts. In today’s Web2.0 environment of MySpace® and FaceBook®, the Sense of Virtual Community (SOVC) is a significant component of the online learning experience worth fostering and considering in online course design. Today’s students are hungry for the adoption of Web2.0 technologies and MUVE’s in online learning. If adopted incrementally these pedagogical methods and new technologies will improve the students’ learning experience, provide needed skills for students to enter into the future of web design, and at the same time reveal the evolving potential of online learning to the academic community. Online professors, instructional technologists and instructional designers have not yet come to fully understand nor realize how these new technologies will alter students’ learning experiences and faculty teaching experiences. It is just a matter of time. Time to permit experimentation, invention and discovery. With some of the techniques utilized in ART765 Design for the WWW Professor Sullivan begins to engage online learners with the collaborative tools available in the market and workplace of today. The ever-expanding resources of the Internet can and should be experienced fully by today’s online students within the context of their usability and visual needs — both significant components of the online student’s pedagogical experience. An online course can and should become the nucleus of an online community — an inviting place to learn and exchange ideas.
REFERENCES


KEY TERMS AND DEFINITIONS

**Brand Identity:** a symbolic embodiment of all the images, visual qualities, and ideas connected to a company, product or service.

**SOVC, Sense of Virtual Community:** Blanchard (2007) states the sense of virtual community is defined as, “members’ feelings of membership, identity, belonging, and attachment to a group that interacts primarily through electronic communication.”

**Face2face, FACE2FACE:** traditional face to face teaching in a seminar, studio or lecture format.

**Web Usability:** Nielsen (2003) states that, “Usability is a quality attribute that assesses how easy user interfaces are to use.” The word “usability” also refers to methods for improving ease-of-use during the design process. Usability is defined by five quality components 1) learnability- how easy is it for users to accomplish basic tasks the first time they encounter the design? 2) efficiency- once users have
learned the design, how quickly can they perform tasks? 3) memorability- when users return to the design after a period of not using it, how easily can they reestablish proficiency? 4) errors- how many errors do users make, how severe are these errors, and how easily can they recover from the errors? 5) satisfaction- how pleasant is it to use the design?”

**Information Architecture:** Rosenfeld states that, “Information Architecture (often abbreviated I.A.) is the practice of structuring information (knowledge or data) for a purpose. The term is most commonly applied to Web development, but also applies to disciplines outside of a strict Web context, such as programming and technical writing.” (p. 13)

**Persistent Navigation:** web site navigation that remains persistent in location, and, for the most part, consistently displays the same links.

**UI, User Interface:** the aggregate of means by which individuals (users) interact with a system
Chapter 18
Using Ontology for Personalized E-Learning in K–12 Education

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ABSTRACT

This chapter introduces the development of a K-12 education ontology for e-learning environments. It presents design and implementation processes, followed by several recommendations for future directions for ontology development. E-learning environments incorporate the notion of semantic Web-based ontologies into their future directions. Semantic Web uses ontologies to show the interconnectedness in a Web environment. Within the concept of semantic mapping, domain ontology is at the core of intelligent e-learning systems. In order to achieve an ontology for K-12 education, the authors propose a domain-specific ontology PoleONTO (Personalized Ontological Learning Environment) with the emphasis on its development and incorporation into an e-learning environment.

INTRODUCTION

E-learning environments incorporate the notion of semantic Web into their future directions. Semantic Web uses ontologies to show the interconnectedness in a Web environment. Ontologies are being developed in order to decrease the annotated amount of markup and increase the reliability of using computational (intelligent) agents; consequently, a number of ontologies in a variety of domains are being constructed.

Within the concept of semantic mapping, domain ontology is at the core of intelligent e-learning
Using Ontology for Personalized E-Learning in K-12 Education

systems. Domain ontologies, explicit formal specifications of the terms in the domain and relations among them (Gruber 1993), cover a common ground vocabulary for researchers and educators who need to share information in a domain. In domain ontology, basic concepts and relations among them are defined and translated into machine-interpretable forms.

In addition to domain-specific ontologies, broad general-purpose ontologies are also being developed. For example, the United Nations Development Program and Dun and Bradstreet collaboratively developed the UNSPSC ontology, which provided a terminology for products and services (i.e., http://www.unspsc.org). Similarly, enterprise organizations are modeled through ontologies to design e-commerce systems. The CIM-OSA enterprise models (i.e., http://cimosa.cnt.pl/Docs/Primer/primer0.htm), for example, offer representations such as business processes and procedural rule sets. Another example is the TOVE ontology project, which aims at developing a set of integrated ontologies for the modelling of both commercial and public enterprises (i.e., http://www.eil.utoronto.ca/enterprise-modelling/tove/index.html).

There are several ontologies being developed in the field of education, as well. EduOnto, for example, is based on the metadata schemes for The Gateway to Educational Materials (http://www.thegateway.org/) and its controlled vocabulary. The class types include reusable classes (Person, Organization, and Contact), resource object classes (instructional, informational, research), and vocabulary classes (subject categories and terms) (Qin & Hernandez, 2006). Another ontology is Personalized Education Ontology (PEOnto). PEOnTo claims to provide learners relevant learning objects based on their individual needs. In PEOnTo, five interrelated educational ontologies (curriculum ontology, subject domain ontology, pedagogy ontology, people ontology, and personalized education agents) are being employed (Fok, 2006). In a recent study, Turksoy (2007) developed a tool to share and reuse of learning objects created during activity development process. The author claims that by reusing and sharing the learning objects, instructors use their time efficiently when producing new learning objects. Nevertheless, either no ontology currently exists specific to the K-12 education domain or they are based on using layers of learning processes (for example, problem solving, critical thinking, decision making, etc.) and concepts (for example, number, optics, mole, etc.) simultaneously. Therefore, the purpose of this study is to create a K-12 education ontology by extracting learning processes and concepts to be applied in e-learning platforms.

WHY DO WE NEED TO DEVELOP AN ONTOLOGY FOR K-12 EDUCATION?

There are several reasons to develop an ontology for K-12 education. First, sharing common understanding of the structure of information among people or software agents is a common goal (Musen, 1992; Gruber, 1993). By developing an ontology, the e-learning platform will be a junction for other e-learning components in the network. Secondly, such domain ontology will enable reuse of domain knowledge. For example, each student will be able to access interrelated domains as well as a single domain through semantic relations. Therefore, navigation among the concepts will not be limited to a single domain area. Thirdly, separating the domain knowledge from the operational knowledge is another common use of ontologies (McGuinness and Wright, 1998). We can describe an expectation (or standard) in the learning space and implement a learning space independent from the expectations through learning processes and concepts. Finally, while developing a domain ontology, terms and their specifications are analyzed, which is extremely valuable when both attempting to reuse existing ontologies and extending them (McGuinness, et. al., 2000).
METHODOLOGY

Sheth, Ramakrishnan, and Thomas (2005) organize semantics in three forms: implicit, formal and powerful (soft). Implicit semantics refers to the kind that is implicit from the patterns in data and that is not represented explicitly in any strict machine processable syntax. Formal semantics, on the other hand, promotes the use of natural language as a means for machines to communicate with other machines by using machine-processable models and expressions. Powerful (soft) semantics applies statistical analysis of data in order to explore the relationships that are not explicitly stated.

In this study, an implicit semantic model was used to develop educational ontology for several reasons. First, the Turkish language is an example of an agglutinative language, where words are a combination of several morphemes and suffixes. Hence, a single Turkish word can give rise to a very large number of variants in searches of Turkish text databases (Ekmekçioglu, Lynch, & Willett, 1996). There are serious research projects undertaken to model Turkish corpus (i.e., Ekmekçioglu, Lynch, & Willett, 1996; Oflazer, 1994; Türk, Hakkani-Tür, Oflazer, 2003), however, this research area is outside the scope of this paper. Secondly, natural language methods for Turkish is still at its infancy. Therefore, it was very likely that certain restrictions would be encountered when dealing with huge chunks of texts. The use of implicit modelling facilitated the identification of relations inherent to the corpus itself. Consequently, concepts and their relationship between learning processes became the focus of the POLE methodology, not the language corpus itself. This system, therefore, will make multiple as well as various curricula operate on the same platform.

Building object-oriented applications with reusable learning objects based on semantic Webbing techniques require a sequence of steps to build such an application. Sheth, Ramakrishnan, and Thomas (2005) group these sequences in to two categories: Bootstrapping and utilization phases.

In the next section, these phases will be described and explained in detail.

Bootstrapping and Utilization

Bootstrapping is a technique that enables the designers to pull out their corpus from domain-specific corpora. In an educational ontology context, the corpora include graded subject matters and related skills. Bootstrapping is usually applied by automatically generated intelligent robots in machine learning environments, where formal and/or powerful semantic models are applied. When applying implicit semantics, Sheth, Ramakrishnan, and Thomas (2005) urge designers to use clustering techniques for entity disambiguation.

During the bootstrapping phase, first, the co-occurrences of field-dependent concepts and skills (i.e., action verbs) were gathered in the same cluster. Secondly, two different taxonomies were developed based on these concepts and skills listed in the clusters (See, Table 1). These taxonomies displayed the classifications of concepts or skills as they appeared in the educational curriculum. Consequently, these clusters disambiguate the repeated skills and concepts within each domain; for example, does the word “temperature” in a document refer to geographical temperature (i.e., geography), body temperature (i.e., biology), or a measurement of temperature (i.e., an interdisciplinary problem solving activity).

The utilization phase with implicit semantics puts an emphasis on questioning and answering in order to find connections and patterns in the data. Once the chunks of school curriculum were bootstrapped, semi-structured data were obtained and analyzed to extract patterns. During this process, answers were sought in order to understand the relationships between the concepts and skills existing in the taxonomies. This process was mainly used to generate the relationships between entities in the selected context.
POLE EDUCATIONAL ONTOLOGY

POLE emerged as a result of a combination of various learning processes and concepts in defining an expectation or a standard. Learning processes were defined as a set of skills, which were embedded in the curriculum and requested by instructors. In the POLE context, skill is defined as the interaction and any processes between persons and concepts. For example, the concept of table is envisioned in one’s mind; yet, they can restate it, they can transform the table into some other thing (i.e., a playhouse by turning it upside down), which is creative thinking. The table can be manipulated by its location, which requires problem solving. These skills are initially tacit; however, this relationship can be explicitly canalized into various expectations or standards through a learning design.

Concepts are the solid knowledge articulated across the curriculum. Mass, nouns, optics are several examples. Learning processes are generally represented in the form of verbs. Some verbs, however, can also be considered as a concept rather than a skill. Reading, measuring, and listening are examples of such concepts. These concepts do require further skills to master as well as a mastery of inter-related sub-components due to their multi-dimensional nature. Hence, the main characteristics of concepts in an educational setting would be their relationship and hierarchical interactions. For example, in order for a student to understand the concept of scaled maps, s/he needs to have mastered ratios and fractions. In order to pinpoint the reason why a student fails in answering a map question, we also need to check the related concepts. Thus, any suggested ontology should be comprehensive enough to show the concepts’ inter-dependency as well as the required learning processes between concepts (see, Figure 1).

Table 2 displays a sample of the POLE ontological model for a sample course in mathematics.
In the POLE context, the terms will mean the relations in the domain. The learning processes will show the interdependency within each concept and learning process through the relations. Here, five different types of relations were identified. These are:

- ∈: Component of a unit
- Y: Is a representation of (Inherited)
- A: Applicable characteristic in the domain
- K: Is defined as
- C: Is convertible to
- P: Is proportional to

These relationships are dynamic in that they can be increased or limited in use depending on the content area. A similar pattern was utilized for the skill taxonomy (See, Table 3).

This ontology will constitute the base for developing and packaging the learning objects in the personalized learning system. This e-learning system will enable the users to pack their own personalized and efficient packages, taking individual differences (and deficiencies) into account. The packaging model and the interaction of learning processes and concepts are presented in Figure 2.

This model draws on learning processes and concepts from two different repositories. The requested expectation (or standard), either manually or intelligently, can be packaged according to the POLE ontology (PoleONTO). The intelligent decision will be reasoned by using students’ responses from generated tests, which will also be embedded in the learning space. These tests will not be used for summative assessment, but for diagnostic purposes. In these tests, a weight will be calculated for each expectation (namely the weight for each learning process-concept relationship). This weight will be adjusted as students put more input into the repositories. In other words, the system will seek patterns in learners’ responses. The learners, then, will be advised which learning objects (LOs) they need to study.
Using Ontology for Personalized E-Learning in K-12 Education

Table 2. Relationships across concepts

<table>
<thead>
<tr>
<th>Entity</th>
<th>Relation</th>
<th>Entity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point</td>
<td>∈</td>
<td>Line</td>
</tr>
<tr>
<td>Line</td>
<td>∈</td>
<td>Plane</td>
</tr>
<tr>
<td>Shape</td>
<td>∈</td>
<td>Plane</td>
</tr>
<tr>
<td>Open Shape</td>
<td>∈</td>
<td>Shape</td>
</tr>
<tr>
<td>Closed Shape</td>
<td>∈</td>
<td>Shape</td>
</tr>
<tr>
<td>Rectangel</td>
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<tr>
<td>Square</td>
<td>Y</td>
<td>Rectangle</td>
</tr>
<tr>
<td>Plane</td>
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<tr>
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<tr>
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<td>Y</td>
<td>Closed Object</td>
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<tr>
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<tr>
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<tr>
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<td>Closed Shape</td>
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<tr>
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<td>Volume</td>
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<td>Year</td>
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<td>YTL</td>
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Table 3. Relationships across skills

<table>
<thead>
<tr>
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</thead>
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<tr>
<td>Classify</td>
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<td>Find</td>
</tr>
<tr>
<td></td>
<td>∈</td>
<td>Choose</td>
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<tr>
<td></td>
<td>∈</td>
<td>Sort</td>
</tr>
<tr>
<td></td>
<td>∈</td>
<td>reclassify</td>
</tr>
<tr>
<td>Classify</td>
<td>Y</td>
<td>Organizing Skills (i.e., acquire and integrate knowledge)</td>
</tr>
<tr>
<td>Responding</td>
<td>∈</td>
<td>Retell</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Summarize</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interprete</td>
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<tr>
<td></td>
<td></td>
<td>Define</td>
</tr>
<tr>
<td>Responding</td>
<td>Y</td>
<td>Engagement Skills (i.e., extend and refine knowledge)</td>
</tr>
</tbody>
</table>

in a learning container (LC). The relationships between the LCs will also be adjusted via intelligent bots (namely, which learning processes or concepts they need to focus). These bots will be responsible for suggesting personalized learning packages throughout the entire e-learning system. The following figure (Figure 3) displays the modeling framework.

The success of any e-learning environment depends highly on instructors’ and learners’ interactions between the system and themselves.

Figure 2. Learning space- interaction between learning processes and concepts
Using Ontology for Personalized E-Learning in K-12 Education

Figure 3. Decision making process in POLE. D- decision at the ontology level. T- type of assets (presentation, evaluation, practice, summary, introduction)

Therefore, POLE lets instructors manually design their learning packages by navigating though PoleONTO. Simply by selecting which specific LOs they want and in which order they should be displayed, instructors can develop their own learning packages. The following is a sample screenshot from the POLE environment (See Figure 4).

Figure 4. A screenshot from POLE user interface

CONCLUSION

According to several researchers (e.g., Altman & Bada, et. al., 1999) most of the domain ontologies are limited in use to the groups who created them and for their initially defined purposes. This statement can be true for various domains. The acceptance of ontologies, however, will depend highly on the shared experiences across domains.
Therefore, POLE is yet another contribution to provide another dimension to ontology development and integration. Since POLE is based on concept and skill ontologies leading to expectations, it is aimed to be applicable to different curricula in various institutions, such as K-12, Higher Education and Corporate Training. Eventually, the system will also give output for curriculum and instructional designers, since the weight for each expectation will be calculated for constituting parts of the whole curriculum.

Some limitations of this study should also be noted. First, ontologies are designed to show the relatedness of entities within a domain. However, this relationship is determined by the language itself. There is a need to discuss and obtain top-level ontologies, especially for social sciences. Secondly, in this project, object-oriented structure was preferred rather than XML based specifications. There is a further need to discuss the advantages and disadvantages of using two different structures when utilizing re-usable object repositories. Finally, the user interaction, both for the learner and the instructor, requires special attention so as to understand how other cognitive issues, such as disorientation, search patterns, and user navigation, affect the sustainability of these systems.

REFERENCES


**KEY TERMS AND DEFINITIONS**

**Implicit Semantics:** The kind that is implicit from the patterns in data and that is not represented explicitly in any strict machine processable syntax.

**Formal Semantics:** The use of natural language as a means for machines to communicate with other machines by using machine-processable models and expressions.

**Powerful (Soft) Semantics:** The use of statistical analysis of data in order to explore the relationships that are not explicitly stated.

**Concept:** The solid knowledge articulated across the curriculum.

**Skill:** The interaction and any processes between persons and concepts.

**Learning Object:** A chunk of elements that can be independently drawn into a momentary assembly in order to create an instructional expectation. These chunks can be reused, re-created and maintained, re-organized and stuck together.
Chapter 19
A Framework for Developing and Implementing u-Learning Models

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ABSTRACT
The advent of u-learning environments requires the development of appropriate u-learning models to inform the use of such environments. As there is no single u-learning model to suit all environments and learning situations, there is a need to develop a methodology for developing models appropriate to various environments and situations. This chapter outlines such a methodology as a useful framework on which to base the derivation of particular models for specific situations. The study then illustrates the use of this methodology to derive a particular model: a task-based u-learning model, incorporating well-bounded learning content. Following this, the study proposes a system architecture to embody this derived u-learning model, and, then describes the implementation of this architecture through the development and deployment of the Walkabout u-Learning Environment.

INTRODUCTION
The advent of networked mobile devices has made the deployment of online learning environments to such devices technically feasible. E-learning environments can be utilised by multiple devices: desktops, laptops, tablets, PDAs, Pocket PCs and mobile/cell phones. Extending traditional desktop e-learning environments to mobile learning (m-learning) environments has created ubiquitous learning (u-learning) environments. An appropriate u-learning model needs to precede the development and deployment of any u-learning environment. The system architecture for the u-learning environment should be derived from this u-learning model. The deployed u-learning environment, then, needs to be informed by a sound u-learning model, and to operate within the technological constraints of the available desktop and mobile delivery devices.

Figure 1 illustrates the main components of this study. The study first proposes a methodology for developing u-learning models. This methodology
A Framework for Developing and Implementing u-Learning Models

Figure 1. The u-learning system development cycle

This iterative approach illustrates an application of design science methodologies. The design science approach is described by Hevner, March, Park & Ram, (2004) as fundamentally a problem solving paradigm which has its basis in engineering practices. This methodology posits that knowledge is generated through action and is accumulated for the purpose of producing new and innovative artefacts, rather than for producing theories (Owen, 1997). The aim of this paradigm is to improve the use of Information Technology within organisations by producing innovative ideas, practices and technical capabilities that can be used for improving the design and development of useful artefacts. The creation of these artefacts relies on existing root theories which can be then be applied, evaluated, modified and adapted through the implementation of the artefact (March & Smith, 1995, Walls, Widmeyer, & El Sawy, 1992, Markus, Majchrzak & Gasser, 2002).

Design science, therefore, encompasses two expansive activities: building and evaluation, where building is the process of constructing an artefact for a specific purpose and evaluation is the process of determining how well the artefact performs in the situation for which it was designed (March & Smith, 1994). The authors followed this iterative sequence, where subsequent iterations of the development cycle provided data to enable further refinement and validation.


METHODOLOGY FOR DEVELOPING U-LEARNING MODELS

The first step in the u-learning system development cycle (see Figure 1) is to propose a methodology for developing u-learning models. There has been much research in the field of general learning models and, recently, the development of online learning models has gained some popularity (Haythornthwaite, Bruce, Andrews, Kazmer, Montague, Preston 2007, Bonk and Zhang 2006,
A Framework for Developing and Implementing u-Learning Models

MacDonald, Stodel, Farres, Breithaupt & Gabriel, 2001). The breadth and diverse nature of this research shows that there is no single learning, or online learning, model which suits all learners or all learning requirements. The same is true for the development of u-learning models. An appropriate u-learning model needs to be developed for a particular learning environment. However, in devising a u-learning model for a particular situation, the authors believe it would be useful to have a general framework of factors which could form a starting point. These factors, would inform the development of a particular u-learning model and its related environment. The authors therefore propose the following factors, based on prior experience with online learning environments:

- general learning models,
- the learning domain,
- the characteristics and needs of the learners,
- strategies for information, skills and attitudes transfer, and
- the capabilities of the deployed technologies.

This study uses these five factors as the basis for devising a process to develop u-learning models, while noting that other, or more, such factors could be considered. Each of these factors is considered in turn, and then examined with respect to the particular learning situation addressed in this study.

1. General Learning Models

The development of any u-learning model would be informed by the general common characteristics of human learning. Successful learning occurs universally. Formal and informal learning takes place in a wide variety of settings and cultures. Humans seem to be adept at teaching, and learning from, each other. Many learning theories and models have been proposed: models based on human biology, psychology, sociology and educational theory. Aspects of these models should inform the development of u-learning models. In particular, any preferred general learning model would flow naturally through and inform any derived u-learning model. Among the many and varied relevant learning models, the following are typical examples.

- Instructivism (Andrews and Goodson 1980, Finn, Chester and Ravitch 1996), which is characterised by an agreed body of knowledge delivered from the teacher to the students. The focus is on the content rather than any self-discovery and reflection on the part of the learner.
- Constructivism (McKenna and Laycock 2004, Yager 2000, Brennan, McFadden & Law 2001), which encourages learning through experience and reflection. Knowledge is actively constructed by the learner, not passively received, through authentic tasks in a meaningful context.
- Behaviourism (Mackenzie 1977, Hart and Kritsonis 2006), which has had a long partnership with Instructivism, and is concerned with the idea of behaviour-response, where the reinforcement of a response is responsible for the learning.
- Cognitivism (Thompson, Simonsen & Hargrave, 1996), which concentrates on the conceptualisation of students’ learning processes. It focuses on the exploration of the way information is received, organised, retained and used by the brain.
- Connectivism (Siemens 2005), which is driven by the idea that decisions are based on rapidly altering foundations, with new information continually being acquired. Learning and knowledge rest on a diversity of opinions, with the ability to see connections between fields, ideas, and concepts.
A Framework for Developing and Implementing u-Learning Models

Regardless of which model, or combination of models, is to be used, formal teaching and learning environments have some common characteristics.

- Material to be taught is assembled. There may be a physical gathering and developing of resources and often there is an arranging and sequencing of the material according to some perceived logical order, to facilitate learning.
- The material is presented to learners in some fashion: verbal explanation, visual demonstrations, use of media or instigation of discussion, for example. Associated with this presentation are some related learning activities, typically student activities, designed to reinforce the presented material: the completion of exercises, for example.
- With face to face teaching and learning, there is often an iterative interaction between students and teacher. The teacher assesses how successfully students are learning and adjusts the teaching/learning process accordingly. This constant adjustment to take into account the current state of learning of the students, can be important for a good learning environment. This process has a temporal dimension. Ideally, the time delay between successive steps of the iteration should be minimal.
- The teacher can assume a role of manager and motivator of the learning process: directing students’ activities, assessing their performance and encouraging them.

The role played by human interaction is worth underlining. Teacher and learner engage in a form of human relationship. Formal education from pre-school to post-graduate level often features considerable human to human social interaction. Not only does the social interaction enable the transfer of information, but often also provides some of the motivation for participation in the learning.

2. The Learning Domain

A learning domain consists of the content to be learned, and may include acquired information, knowledge, skills, beliefs or attitudes. Learning theorists have stated that teaching skills and techniques is of little use outside of a particular knowledge domain in which they can be grounded. Defined fields of study often have unique methods of describing knowledge regarding that field and effective domain learning is usually prescribed by the epistemology and context of that domain (McPeck, 1990; Bransford, Brown & Cocking, 1999). Additionally, any proposed u-learning domain needs to be assessed for its suitability to a u-learning environment. Given the significance of human interaction in some learning domains, learning domains requiring high levels of human interaction may be unsuited to u-learning environments (learning to perform classical ballet, for example). Learning domains that require the mastery of information are more suited to u-learning environments. Hybrid interaction models, which incorporate both face to face and online components, can address the needs of learning domains which require higher levels of human interaction.

Some learning domains can take advantage of the open accessibility of the web. With such domains, students are encouraged to go exploring. Other learning domains may be more bounded. Bounded learning domains are those for which a well defined content transfer is required: for example for the transfer of specific information or for particular skills acquisition.

The degree of “boundedness” of a learning domain will influence the system architecture. A tightly bounded domain will tend to require an architecture containing learning objects which exactly specify the learning domain. A less bounded domain will tend to have an architecture that facilitates exploration of local and external resources relevant to the domain.
3. Characteristics and Needs of the Learners

The development of a u-learning model will need to take careful note of the characteristics and needs of the learners. Obvious characteristics of learners would include their age, stage of personal development, cultural factors, previous exposure to the specific domain and their personal motivation. Needs of the particular learners might include flexibility of time and place for learning to facilitate the integration of the demands of learning into a balanced life style and the need for suitable communication with, and feedback from, the teacher.

4. Strategies for Domain Transfer

Transfer strategies refer to the means to be used to communicate the domain to the learners. For example, in an online environment, a student might read text, follow an audio or video presentation, watch a simulation and then undertake some exercises of various types, or engage in online discussions, or take some self-testing quizzes. The strategies included in the u-learning model will be suggested by the general learning model adopted, the learning domain and the characteristics and needs of the learners. However, the capabilities of the deployed technologies will set the bounds of technical possibilities for the strategies.

5. Capabilities of the Deployed Technologies

U-learning models need to consider the technical possibilities and constraints within which any proposed system architecture and u-learning environment will be developed and deployed. Some of these technical constraints are transitory, others are more permanent.

The cost of mobile Internet connection is an example of a transitory constraint. Typical low cost, high bandwidth, Internet access methods include connection via wire or radio to a local area network with broadband Internet access. While these connection costs are relatively low, they are only suitable for students in an on-campus or home situation where there is a local area network or broadband Internet access. For mobile devices to contribute significantly to u-learning, they need to be connected to mobile networks, such as broadband wireless networks. Currently, services offered by these networks are relatively expensive, and so deter widespread student use. However, broadband wireless network charges continue to fall and so this cost limitation should be considered transitory.

The power and memory capabilities of mobile device processors are another transitory constraint. Phones, PDAs and Pocket PCs, for example, only support cut down versions of web browsers with fewer features than full desktop browsers. Again, this constraint is being progressively addressed with each new mobile device model.

A more permanent constraint comes from the physical nature of mobile devices, typically equipped with necessarily small screens. There is a limit to screen sizes that can still display useful quantities of information. The typical seven or eight line phone screen is designed for brief information only, such as SMS text messages, and user input through menu systems. PDA and Pocket PC screens are just large enough for web browsers to display useful quantities of information. These screen sizes are determined by the limitations of the human eye in reading from a hand held device. The introduction and widespread acceptance of wearable screen devices (worn like reading glasses), or projected screens, may be a way around the problem of small screens on mobile devices.

In any u-learning environment there will be some compromise between the educationally desirable and the technically feasible. However, the boundaries of technological feasibility move rapidly: last year’s technological impossibility is this year’s technological commonplace.
A Framework for Developing and Implementing u-Learning Models

DEVELOP A U-LEARNING MODEL FOR A GIVEN SITUATION

The next step in the u-learning system development cycle (see Figure 1) process is to develop a u-learning model for the given situation, using the methodology outlined above. Therefore, each of the five factors described above is now considered in the context of a particular learning requirement.

1. The General Learning Model Adopted

No single general learning model was considered appropriate as the basis for the development of this u-learning environment. Rather, a blended model was adopted using aspects of Constructivism, Instructivism and Cognitivism.

Constructivist theory is well suited to the building of e-learning environments as these environments are able to support the building of knowledge through interaction and activity that involves the mental and possibly physical construction of concepts (McKenna and Laycock 2004). As stated by Ally (Ally 2004), learners learn best when they can contextualize what they are learning for immediate application and personal meaning. Therefore the environment was structured to allow the learners to construct their own knowledge via the investigation and development of problem solutions through the completion of exercises and assessment tasks.

Whilst a purely Instructivist model does not encourage the lifelong learning and informed action capabilities that are expected from today’s University graduates (Candy 2000), the learning domain in this case lends itself to a certain degree of Instructivism. The learning content being delivered is of a technical aspect and quite specific in nature, requiring direct instruction for items such as the syntax required for programming languages.

Cognitive learning theory posits that information needs to be transferred from sensory input to working memory where it is processed and then moved to long-term storage, with the ultimate aim being to change an existing cognitive structure to incorporate the new information. Ally (Ally 2004) describes several steps to increase the potential for the success of this process, including informing learners of the expected learning outcomes of the lesson, “chunking” information to prevent overload during processing and sequencing content from simple to complex. The bounded learning domain and student needs were suited to “chunking” and sequencing from simple to complex, and so these aspects of Cognitivism were employed.

2. The Particular Learning Domain

The learning domain in this instance consisted of two main parts:

• the knowledge of how web based applications are written and
• the skills needed to write such web based applications.

Web based applications include both static web pages and web pages incorporating computer programming. A bounded learning domain was used and, consequently, all the information and skills acquisition materials needed by the students were to be contained within the u-learning environment. Students could, of course, move outside the bounds of the environment, but this would not be required for successful completion of the learning.

3. Characteristics and Needs of the Particular Learners

In this instance, the learners were undergraduate students from a large Australian University, most of whom were studying information technology.
related areas. Students were based on Australian, Malaysian and South African campuses of the university.

In recent years, a number of factors have impacted on the way undergraduate students interact with university based learning. The on-campus, full-time mode has been eroded by factors such as student need to undertake paid employment and the use of electronic media to deploy learning materials. Krause, Hartley, James and McInnis (2005) noted that fifty five percent of full-time, commencing Australian university students were engaged in some form of paid employment, up from thirty seven percent in 1999 (McInnis, James & Hartley, 2000). Further, a study of University of Adelaide first year students found that more than seventy percent had the expectation of being able to combine work and study (Turnbull, Nettelbeck, Ward, LeCouteur, Sarris, Strelan, Crisp, Palmer, & Schneider, 2006). Turnbull et al. also noted that around ten percent of full-time students in paid work frequently did not attend class due to work commitments, with an even higher regular non-attendance reported for part-time students.

Many of these students fall into the “Generation Y” classification, sometimes referred to as “Generation Next” or “Digital Natives”, consisting of those born roughly between 1980 and 1994. Kennedy, Krause, Gray, Judd, Bennett, Maton, Dalgarno & Bishop, (2006) note that these students can be characterised by:

- a preference for receiving information quickly,
- an adeptness at processing information rapidly,
- a preference for multi-tasking and non-linear access to information,
- a low tolerance of lectures,
- a preference for active rather than passive learning
- a heavy reliance on communications technologies to access information and to carry out social and professional interactions.

Statistics also show that mature age students comprise a significant and increasing percentage of university enrollments (DEST 2005, UTS Web Site) and, while research has indicated that mature age students generally make good students, who are very motivated and achieve high academic performance, the retention rate for these students is much lower than for younger students (Scott, Burns & Cooney 1996). Yorke (1997) found that mature age students were more likely than school leavers, to be forced to withdraw from their studies due to demands on their time for work and family commitments.

Consequently, students are, increasingly, looking for more flexibility in time and place of study. They have deserted the traditional lecture in considerable numbers and are looking for alternative life models incorporating a balance of study, paid employment and family and social life.

Many professions assume life long learning by their members. While some of this learning may be undertaken by returning to a formal educational environment, much of it will need to be undertaken informally, typically through self-directed study using printed or electronic media. Life long learning requires a high level of self-motivation. Consequently, while these university students are still engaged in formal learning, they can benefit from exposure to some informal learning which also requires higher levels of self-motivation for successful completion.

4. Strategies Adopted for Domain Transfer

The overall strategy adopted for this domain transfer was task based learning. Students were presented with a series of relatively small tasks (nine or ten over the course of a 13 week semester) to be solved individually. Task based learning was used as it mirrors, in part, the type of learning these students will encounter in their professional lives. For example, a client will ask for the development of a web based application. The student will need
to assess that knowledge and skills are needed to perform the task. Any deficient knowledge and skills will have to be mastered before solving the task. In this learning environment, the students are presented with graded tasks, together with learning materials which present the knowledge and develop skills necessary for the solving of the tasks.

The learning materials incorporate text and images, with accompanying short audio explanations of one or two minute’s duration. The materials were modularised into quite small pieces, to enable students the flexibility to study for shorter or longer periods.

Before attempting a task, students were presented with a series of sub-tasks (with solutions), to lead them towards attempting the larger task. Multiple choice quizzes were available for students to check their mastery of content. An online note taking system enabled students to integrate their personal notes into the online content.

A hybrid interaction model was used, and incorporated a face to face component, for those students who want some human interaction. On-campus helpdesk sessions were scheduled each week of semester, as well as online sessions using full duplex text, audio and video.

5. Capabilities of the Currently Deployed Technologies

The currently available technologies are the standard desktop computers running a standard browser with the usual audio and video capabilities. Duplex desktop video conferencing software was used for online helpdesk sessions. Since almost all students had standard mobile/cell phones, SMS messaging was used for just in time reminders. Although few students had access to networked pocket PCs, or other web enabled mobile devices, the environment was deployed to these devices.

DEVELOP A SYSTEM ARCHITECTURE TO EMBODY THE DERIVED U-LEARNING MODEL

The next step in the u-learning system development cycle (see Figure 1) is to use the derived u-learning model, developed for this particular situation, to develop an appropriate system architecture.

Some General Architectural Requirements

A general consideration for any u-learning system architecture is that content developers cannot maintain parallel web sites for various desktop and mobile delivery systems. All site content needs to be in a common store, accessed by the applications that will generate the browser output. This common store could be implemented through, for example, a standard database or XML files. The applications rendering the browser output need to interrogate the requesting browser and tailor the output according to the requesting browser’s capabilities and the requesting device’s technical limitations and screen dimensions. The u-learning environment may also filter content on educational criteria. For example, a learning activity may be technically feasible on a mobile device, but not educationally useful, and so the system would filter out this activity from those presented to users on mobile devices. Environments may also allow users to select the parts of the environment to be delivered to particular devices. For example, a student may decide to have textual, but not audio, materials delivered to a networked pocket PC.

The System Architecture Defined

It is theoretically possible to design a system architecture suited exactly to the circumstances of a particular learning requirement: i.e. a preferred general learning model, a defined learning domain, the characteristics and needs of particular learners, preferred domain transfer strategies and the
capabilities of deployed technologies. However, if any variations in these factors mean re-designing the architecture, then more flexibility is required. Consequently, while system architectures may be designed with a particular set of factors in mind, they also need be flexible enough to serve similar sets of factors. The system architecture in this instance has been designed with flexibility in mind, as well as addressing a particular set of factors. The system architecture is shown diagrammatically in Figure 2.

The architecture has a common store containing the bounded learning domain, learning tasks, content exposition, and learning activities. Administrative and communications functionality is also included. The learning domain is encapsulated in text, images and other media. Applications generate HTML output, and provide access to other media types such as streamed audio files. The content exposition, communication and administrative functionalities are expressed through purpose developed applications.

The main components of the system architecture are as listed below.

- **Learning tasks**: the tasks and sub-tasks students undertake, in this case developing web applications.
- **Bounded learning domain**: the media objects which contain the content of the learning modules, including text, graphics, audio/video and other media.
- **Content exposition**: the method used to transfer the content, for example, through students reading materials or listening to streamed audio explanations in conjunction with the content media.
- **Learning activities**: taking personal online notes, completing sub-tasks and quizzes, for example.
- **Communications functions**: the methods used for communication between students and teachers, and students and other students. In this case text/audio/video real time systems, and on-campus helpdesk sessions.
- **Administrative functions**: the applications needed to perform various administrative tasks associated with the learning, for example, submitting task solutions for assessment, managing student groups.
The architecture filters objects from the common store according to a set of filtering criteria. Such criteria might include: whether particular content is technically feasible on a particular mobile or desktop device, or whether the content is educationally useful for the learner in a mobile or desktop context. An application of a technical criterion might determine, for example, that downloading large content PDF files to a mobile device is not feasible, while further determining that streaming audio lectures is quite feasible. An application of an educational criterion might further determine that the streaming of audio lectures to a mobile device is also quite useful educationally. As indicated by the arrows in Figure 1, content in the common store could be deemed technically feasible and educationally suitable for the desktop environment, the networked PDA/pocket PC environment, the mobile/cell phone environment, or a combination of these. Having filtered objects for their environments, the architecture renders each object according to its environments’ requirements, taking into account each environment’s browser capabilities and device technical limitations.

**IMPLEMENT AND DEPLOY A U-LEARNING SYSTEM THAT EMBODIES THE DERIVED U-LEARNING MODEL AND SYSTEM ARCHITECTURE**

The final step discussed here, in the u-learning system development model (See Figure 1), is to implement and deploy a u-learning system that embodies the particular u-learning model and the derived system architecture. The Walkabout u-Learning Environment has been developed accordingly.

**Description of the Walkabout u-Learning Environment**

The learning domain in the common store is encapsulated in XML files (which are rendered to HTML by purpose written applications), images and media files (for streaming). Communications and administrative functions are encapsulated in various purpose built and off-the-shelf applications. The filtering is implemented through alternative menu systems. The rendering applications are implemented in Microsoft’s ASP.NET using the C# programming language. These technologies support the writing of applications that detect the capabilities of calling devices and their browsers. Consequently, the applications can determine the capabilities of the web browsers requesting the web pages, and then generate appropriate output on the fly to suit particular requesting browsers.

Various techniques were used to adjust output once the output browser environment had been detected. Parallel style sheets were used to control the general display, including the resizing of images, for desktop and mobile browsers. Application logic proceeded to different code blocks (or different applications) according to the calling browser’s environment.

Figure 3 shows part of a typical web page output for the desktop environment. Each task has a series of “Need to Know” sections which present the information needed to complete the particular task. Each Need to Know is divided into a number of parts, one of which is shown in Figure 3. This structuring of the content helped students to undertake their learning in manageable content portions and study time slices.

Figure 3 shows text and an image, together with the controls to start a short audio lecture. The student notes editor is shown. This editor enables students to add personal notes on the content material and save and re-loaded them. Personal notes can be placed, together with the content text and graphics into a PDF file for downloading and printing.
Not shown in Figure 3 are accompanying sub-tasks used to give students practice in aspects covered in the content materials, and quick quizzes to help students consolidate concepts. Various other functions are also provided, including login and verification applications, a unit diary, staff contact details, a download facility from which students can download software needed for the unit, a search engine to search both the learning materials and the student’s own notes, and various administrative functions.

Recent formal evaluations of student experiences in using the environment suggested some further refinements. For example, while u-learning environments de-structure the time and place of learning, they also remove one of the structural helps for students to persevere with their learning: namely the regularity of a time and place for learning, as embodied in regular lectures and tutorials. Some students have indicated that total freedom may not be an unbounded blessing, and are looking for time based structures to support their learning. One such support subsequently implemented is the use of emails and SMS to send reminders to students, indicating what they might be expected to have achieved at given times throughout the semester. Students can also send an SMS to retrieve their current marks.

Face to face contact was maintained through on-campus helpdesk sessions and online live video and audio helpdesk sessions. The online facility is implemented through the Marratech system (http://www.marratech.com).

Figure 4 shows the mobile PDA/pocket PC screen equivalent to the desktop screen shown in Figure 3. Both views are generated from the same common store materials.

The Walkabout system also has an administrative site for staff, enabling them to manage student groups, submitted quizzes and tasks, as well as
Hybrid Interaction Models

As noted previously, hybrid interaction models can be utilised. These models include an element of face to face contact as well as the online component. A number of hybrid models can be employed with u-learning environments, including the following.

- The u-learning environment is used as an adjunct to traditional on-campus lectures and tutorials. For example, regular lectures may cover the theoretical elements of a subject, and the environment is used for practical skills building activities.
- Parts of a subject use lectures and tutorials, and other parts use the u-learning environment. Perhaps, for example, the subject begins with several weeks of lectures to open out the subject, followed by some weeks of students studying through the environment, and finishing off with some concluding lectures.
- A model can be used with the environment as the sole learning medium, but with regular on-campus and online helpdesk sessions, for students who want face to face assistance. This model has been used in this study.
- A totally off-campus model can be used with the environment as the sole learning medium. In this case, the face to face interaction is implemented solely through an online communications system.

It is worth noting that different students will use different hybrid models in the same offering of a subject. For example one student may use the u-learning environment in a totally off-campus mode, while another may use the on campus and online helpdesk sessions extensively.

CONCLUSION

The deployment of u-learning environments can provide flexibility in both time and place for learning, and so provide a suitable platform for life long learning. However, such u-learning environments need to be developed from system architectures, which, in turn, have been designed with sound u-learning models as their bases. The u-learning models, in turn, should have been formulated from a set of relevant factors, such as the five instanced in this study.
While the deployment of u-learning environments into mainstream learning is still very much a work in progress, the deployment process needs to leave behind the hit and miss, technology driven models of earlier years, in favour of a more considered approach, squarely based on the learning requirements of each learning situation.

REFERENCES


Brennan, R., McFadden, M., & Law, E. (2001). All that glitters is not gold: Online delivery of education and training. Adelaide: NCVER


A Framework for Developing and Implementing u-Learning Models


Chapter 20
A Practical Guide to Evaluate Quality of Online Courses

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ABSTRACT

This chapter introduces a graphic approach to define quality in online courses. The Decomposition Model (Borich & Jemelka, 1982) is used to illustrate course structure and the salient characteristics of an effective online course. The constraints that influence the success of online courses are discussed. Salient transactions (activities) that occur in online courses are described. And the means-end continuum in the process of online learning is illustrated graphically. The chapter is expected to provide readers with a whole picture of a quality online course through an architectural framework.

INTRODUCTION

During the last decade, the number of online courses has increased rapidly, and online learning has become trendy for all levels of education. Online courses prepare learners to transition successfully through high school, improving high school graduation rates (Southern Regional Education Board [SREB], 2007). In addition to their significance for K-12 education, online courses create diverse learning experiences for learners in higher education and improve their chances of academic success (Phipps, Merisotis, & Harvey, 2000). Well-designed online courses can ensure that students get quality learning and teaching. Thanks to the emergence of online courses, people have a more equal opportunity to gain education, compared to the process involved in gaining education from traditional brick-and-mortar schools (SREB, 2007). In the report of Virtual Schools and 21st Century Skills, published by North American Council for Online Learning [NACOL] (2007a), the 21st skills are defined as follows: global awareness, self-directed learning, information and communications technology (ICT) literacy, problem-solving skills, time management and personal responsibility. There is a growing understanding that online courses can meet academic requirements and provide learn-
ers with the 21st century skills for future career (NACOL, 2007a).

Course management systems are often a popular alternative for instructors to create online courses. Typically, a school or institute purchases a course management system (such as Blackboard) and then invites instructors to attend an overview class. The trainers explain how the software works and how to navigate or access the various features. It is relatively easy for anyone who is familiar with email and word processing to import text into the boxes provided by the course management shell. Course management systems provide a way to avoid building a course site from scratch, but they do not provide a complete foundation for building a high quality online course (Brett, 1999). Instructors need to learn what constitutes a quality online course in order to create an effective online course (Hao & McGee, 2003).

The roles of learner and instructor are being revolutionized in online courses. In online learning environments, online learners and instructors have little physical contact; most interactions take place through text-based communication in synchronous and/or asynchronous ways. Online learners are expected to have the motivation to learn and be self-directed (Palloff & Pratt, 2003; SREB, 2007). People who take online courses need to adjust their expectations and attitudes for learning. Possessing adequate communication skills through text, being able to manage their time wisely, and being willing and able to take responsibility for their own learning, are required to succeed in online learning. Instructors also must adapt their classroom teaching styles to become successful online teachers. Online instructors play the role of activity facilitators and discussion moderators; they provide guidance and direction but they do not instill knowledge into learners. There obviously needs to be a transition for instructors from teacher-centered traditional classroom teaching to student-centered online instruction. Not all instructors are able to make this transition. Although online instruction shares many features of face-to-face teaching, if instructors are to teach well online, they will require a unique set of skills (Salmon, 2000; NEA, 2006) and a new mindset (Barker, 2002).

The Decomposition Model (also called Program Modeling), is a heuristic technique originally developed for program evaluation in the social and behavioral sciences by Borich and Jemelka (1982). The Model was derived from general systems theory, values and decision oriented evaluation, and computer software program design. It can identify and prioritize the needs of students, take into account social and political constraints (environmental factors), and demonstrate how the parts in a mechanism (i.e., a program or a course) are related to each other and contribute to the functioning of the whole mechanism. Thanks to its systematic approach, the Decomposition Model can provide a useful way to analyze online course structures.

This chapter uses the Decomposition Model to illustrate course structure and the salient characteristics of an effective online course. According to a report (Allen & Seaman, 2006) published by the Sloan Consortium, a recognized institution for improving online education, an online course is one where at least 80 percent of the course content is delivered online. The chapter adopts the Sloan-Consortium definition of an online course: where most of or all of the course content is delivered online and there are rare or no face-to-face meetings. The chapter considers the quality standards or benchmarks in the reports published by American Federation of Teachers [AFT] (2000), Institute for Higher Education Policy [IHEP] (Phipps, et al., 2000), North American Council for Online Learning [NACOL] (2007a, 2007b), National Education Association [NEA] (2006) and Southern Regional Education Board [SREB] (2007, 2006a, 2006b), reorganizes and fits them into the Decomposition Model. The purpose of this modeling is to ensure that the outcome of a course is met, by providing a graphical structure to both evaluate and oversee the structure of an online course.
BACKGROUND

To date, there have been quite a few research studies, organizations and institutions examining the quality issues of online courses. In 2000, the IHEP published *Quality on the Line: Benchmarks for Success in Internet-Based Distance Education* (Phipps, et al., 2000). This report was commissioned by the NEA, the U.S. largest professional association of higher education faculty, and Blackboard Inc., a widely used platform provider for online education. The report concludes with 24 benchmarks for success in Internet-based distance education. The benchmarks refer to the categories of institutional support, course development, teaching/learning, course structure, student support, faculty support, and assessment/evaluation. Studies on effectiveness of online courses continue to be published based around those criteria. For example, Collins (2004) created e-Learning frameworks for *No Child Left Behind* and indicated factors related to the quality of online courses. They are factors for evaluating curriculum and assessment materials in online courses, for creating online instruction, and for the implementation of online courses.

Recently, in 2006, the NEA published *Guide to Teaching Online Courses*. The guide reviews online education, indicates opportunities and challenges for students and educators, explains the development of an effective online education system, and makes a few suggestions on preparing and supporting online teachers. The guide was produced as an effort to ensure secondary students with online teachers who are of the highest quality: well equipped, trained and supported in the process of online teaching. The SREB published *Standards for Quality Online Courses* (2006a) as a comprehensive set of criteria in 2006. These standards include criteria to evaluate course content, instructional design, student assessment, technology, evaluation and management. In the same year, the SREB published *Standards for Quality Online Teaching* (2006b). These standards include criteria to evaluate teachers’ academic preparation, content knowledge, skills and temperament for instructional technology, online teaching and learning methodology, management, knowledge, skills and delivery.

Based on the SREB *Standards for Quality Online Courses* (2006a), the NEA *Guide to Teaching Online Courses* (2006), and the NACOL *Virtual schools and 21st century skills* (2007), in 2007 the NACOL, an institution for increasing educational opportunities and enhancing learning by providing collegial expertise and leadership in K-12 online teaching and learning, created a report, *National Standards of Quality for Online Courses* (2007b). The report indicates the dimensions for the evaluation of standards are content, instructional design, student assessment, technology, course evaluation and management, and 21st century skills (one dimension newly added). In the same year, the NACOL conducted a comprehensive review of online teaching standards and created *National Standards for Quality Online Teaching* (2007c). The dimensions of these evaluation standards include teachers’ meeting the professional teaching standards, teachers’ technology skills, instructional design skills, online leadership, modeling of online behavior, having experience with online learning, providing student support, and the ability to collaborate with colleagues.

The past evaluation studies and reports of online learning mostly utilized literature reviews, surveys, interviews, or the Delphi techniques to collect perspectives from the stakeholders. The contribution of the studies and reports to the field is significant. This chapter is based on the findings of these studies and reports, in an attempt to construct a whole picture of a quality online course. In the following paragraphs, the chapter considers the quality standards or benchmarks mainly in the reports of AFT, IHEP, NACOL, NEA, and SREB, reorganizes and fits them into the Decomposition Model.
OVERVIEW OF THE DECOMPOSITION MODEL

The Decomposition Model creates a picture of an online course through a series of diagrams, each accompanied by a section highlighting key points. The result is a conceptual representation of the course that moves from the most general level down to the level of specificity needed for implementation. The Model should be recognized as different from such activities as flow charting. It does not result in an outline of the steps to be followed in implementing a course. Instead, it illustrates course components relative to desired outcomes. All diagrams include four basic components: inputs, constraints, outcomes, and activities (transactions) as shown in Figure 1, Basic components of a modeling diagram.

As illustrated in Figure 1, a box is used to represent any course activity. Activities, also called transactions, are planned events for which there is a measurable outcome (i.e., number of postings in an online discussion). The box means nothing in and of itself, but is brought to life or “activated” by inputs (which always enter from the left), constraints (which always press down from the top), and outputs (which always exit the box from the right). Inputs stimulate the transaction into action and are used to produce the outcome. Inputs are the elements required for the functioning and creation of the course, such as potential learner descriptors, information sources and necessary facilities. These elements (or factors) are measured in an on/off, present/absent (binary) manner. Constraints are characteristics of the stakeholders (including learners, course instructors, technicians, and administrators) and the contextual factors of the course which can modify the implementation of a transaction or an outcome (i.e., learning style) and can be measured in degrees, i.e., on a continuum (e.g., 1-10). Outcomes are what the stakeholders are expected to exhibit at the completion of all transactions. Outcomes are the desired results from the activity - for instance, improving learner performance, developing a particular skill, etc. First outcomes, which are closer to the course result, should be used to indicate course quality or effectiveness. Second or third outcomes are to indicate the overall course direction.

The input, constraint, and outcome designations reveal how transactions within a course are tied together. The transactions need to proceed in a reasonable way in order to derive a realistic means-end continuum. The four components (transactions, constraints, inputs, and outcomes) can be described at any level of generality depending on the level at which the course is being conceptualized. Transactions can be implemented and outcomes are operationalized at the most specific levels. When a box (transaction) is broken down into its component parts, the broad course components are translated into increasingly detailed parts. The successive process, a process originally for program decomposition (Borich & Jemelka, 1982), is illustrated in Figure 2.
DECOMPOSITION OF EFFECTIVE ONLINE COURSES

As yet, there may be no model which can fully capture the complexities of online courses. As Thomas Reeves (1997) indicated, a simplified model still can help us understand the complex structure of online learning. This chapter uses the Decomposition Model to illustrate course structure and the salient characteristics of an effective online course. In the following paragraphs, the basic components of the Decomposition Model (inputs, constraints, outcomes, and transactions) applied in the context of online learning environment are described. The inputs of an effective online course are indicated. The constraints that influence the success of online courses are discussed. And the transactions occurring in online course are described. Regarding transactions, first of all, the first level diagram of an online course is demonstrated. Then, the primary transactions of an online course are indicated. Afterwards, other sub-transactions weaving the primary transaction are demonstrated respectively. The purpose of this course modeling is to ensure that the outcome of a course is met, by providing a graphical structure to both evaluate and oversee the structure of an online course.

Figure 2. The successive process (Borich & Jemelka, 1982)
INPUTS

In the transactions of an online course, the inputs or requirements of an online course, are measured in an on/off, present/absent (binary), according to the Decomposition Model. If an online course is to operate, the inputs for the course operation are learners, instructors, and all technology tools.

CONSTRAINTS

In an online course, constraints are the characteristics of the stakeholders (including learners, course instructors, technicians, and administrators) and the contextual factors of the course (i.e., funding). Constraints are measured in degrees (i.e., on a continuum), and they can modify the implementation of a transaction or an outcome. In addition to motivation and realistic learning objectives, the constraints of online courses include learner readiness for online learning, instructor preparedness for online teaching, institutional support, technical support, and pedagogical support.

1. Learner Readiness for Online Learning

To have a successful online learning experience, learners must possess adequate technical and communication skills, be able to manage their time wisely, and be willing and able to meet the academic demands of courses that rely on self-directed learning (Palloff & Pratt, 2003; SREB, 2007). There have been a few studies investigating learner readiness for online learning: Smith (2005) used a sample of 314 Australian university students and factor-analyzed the Readiness for Online Learning Questionnaire (McVay, 2001). Two factors were confirmed in the study. One was self-directed learning. The other was comfort with e-learning. Pillay, Irving, & Tones (2007) validated their diagnostic instrument to assess post-secondary education students’ readiness for online learning which had four factors: technical skills, computer self-efficacy, learner preferences, and attitudes towards computers. It is strongly recommended that learners are assessed to measure if they are ready for online learning.

Some of the readiness issues modified from the report of AFT (2000) and the study of Pillay, Irving, & Tones (2007) are derived from four topics, technical issues, computer self-efficacy, learning preferences, and attitudes towards computers.

1). For technical issues learners must:
   ◦ Possess the proper equipment and know how to make it work.
   ◦ Have the skills to perform in a writing-based, online learning environment.
   ◦ Have motivation and realistic learning objectives for the course.

2). For computer self-efficacy learners should:
   ◦ Know how to send and receive e-mail messages.
   ◦ Feel confident in using computers to connect to the Internet.
   ◦ Be able to use various search engines to research materials.

3). For learning preferences, learners are able to:
   ◦ Read the material from a computer screen but not listening to a lecture.
   ◦ Find out information using a computer but not from an instructor.
   ◦ Communicate with the instructor online.
   ◦ Communicate with other learners online.

4). For attitudes towards computers:
   ◦ Use computers for research learners are able to:
   ◦ Communicate with others using e-mails to support learning.
   ◦ Spend time on the Internet.
   ◦ Work on tasks on a computer that they can do by following directions.
It is necessary to make sure learners are provided with sufficient learning resources and materials to increase their success before the online course begins. If learners lack technical skills, a face-to-face orientation is necessary. In the orientation, the instructor should go through each step, provide hands-on sessions and make sure learners can work independently in the online learning environment. Logging in and logging out of the course management system (or course web site), posting or replying messages in the discussion board, meeting their class in the online café, etc. are all required steps learners should be able to perform independently.

2. Instructor Preparedness for Online Teaching

Drop-out rates in online courses are high, online course satisfaction is so unpredictable, and online learners are often reported in great distress (Essex & Cagiltay, 2001). These disturbing phenomena made people recognize that online teaching may not be suitable for all instructors and online instructors must be prepared before launching an online course. Even when the course design is sound, the course content is excellent, and there is sufficient support for teachers from the institution, a well prepared online instructor is a key factor for course success. The instructor is a facilitator for learners to learn constructively, and is a moderator for learners to interact effectively. Instructors must adapt their own teaching styles to become successful online instructors but, unfortunately, not all instructors are able to make this transition (SREB, 2006b). Several institutions have published guides for instructors to help make the transition to online teaching. For example, the Higher Education Program and Policy Council of the AFT published Distance Education: Guidelines for Good Practice (AFT, 2000). The NEA published Guide to Online High School Courses (NEA, 2002-2006), and Guide to Teaching Online Courses (NEA, 2006). The SREB published Standards for Quality Online Teaching (2006b). The NACOL published National Standards for Quality Online Teaching (2007c). With the above guides as a basis, and Spector and de la Teja’s (2001) analyses as a reference, the chapter modifies and lists essential qualities a qualified online instructor should embody and exhibit:

1). Academic preparation:
   ◦ As in traditional teaching, instructors must have the appropriate academic credentials.
   ◦ Instructors should have experience teaching the same content in traditional classrooms.

2). Content knowledge, skills, and temperament for instructional technology:
   ◦ Instructors demonstrate the ability to use computers and Internet: word-processing, presentation software, Internet browsers, e-mail applications, course management system, basic skills of material production (i.e., scanning documents and exporting the files) and Internet etiquette.
   ◦ Instructors must continue to update academic knowledge and technology skills.

3). Online teaching and learning methodology, management, knowledge, skills and delivery:
   ◦ Instructors will plan, design and incorporate strategies to encourage all types of interaction (one-to-one, one-to-many, many-to-one, many-to-many, synchronous, and asynchronous) in the online learning environment.
   ◦ Instructors will moderate learning in a way that encourages learner success through regular feedback and timely response.
   ◦ Instructors will set up realistic learning objectives.
Instructors will construct a learner-centered learning community.
Instructors will facilitate individual and collaborative activities.
Instructors will model online behavior and Internet etiquette.
Instructors will have experienced online learning as a learner.

3. Institutional Supports

Institutional support ensures that online courses will have a high quality learning environment, and administrative support helps operationalize policies which encourage high quality design and development of online teaching and learning. The issues for consideration listed below include technological infrastructure issues, a technology plan, and professional incentives for instructors (AFT, 2000; Phipps, et al., 2000).

1). Professional incentives for instructors should provide:
   ○ Innovative practices to encourage development of online courses.
   ○ Institutional rewards for the effective teaching of distance learning courses.
   ○ Economic compensation for meeting the extensive time commitment of online teaching.

2). A technology plan should address and include:
   ○ A document available to ensure quality standards.
   ○ Electronic security measures to ensure the integrity and validity of information.
   ○ Information to learners on how to communicate with the online instructor and the technical staff, including information on the process for these communications.

3). Technological infrastructure should include:
   ○ A centralized system to address issues and support the creation and maintenance of the distance education infrastructure.
   ○ A timely, responsive system to address learner complaints and instructor needs.
   ○ Written information available to learners regarding the required equipment and computer skills in an online course.
   ○ Sufficient, available library resources.

4. Technical Support

One of the issues that cause online learners the most distress is how to solve technical problems. If an online course is equipped with sufficient technical support, there is a greater probability that learners will feel satisfied with learning. Technical support, modified from the report of the AFT (AFT, 2000), includes the following:

1). For learners:
   ○ Provide hands-on training and information to aid them in securing material through electronic databases, interlibrary loans, government archives, news services, etc.
   ○ Provide easily accessible technical assistance throughout the duration of the online course. A telephone contact number for technical support, with as many hours of availability as possible.
2). For instructors:
   - Provide adequate training and technical support in the process of course operation, in terms of hardware, software, and troubleshooting,
   - Provide learners and instructors with written resources to deal with issues arising from everyday use of online systems and materials.

5. Pedagogical Support

Relatively speaking, online teaching is a new field for most educators. Most educators finished their teaching certificates and professional training before online learning emerged and became popular in education. They never experienced this new type of learning, so it is a big challenge for them to design and teach such a course. Therefore, pedagogical support is essential before the course is open, during the course, and after the course is complete. In general, pedagogical support provides:

- Assistance to transition from teacher-centered classroom teaching to student-centered online instruction.
- Peer mentoring resources.
- Continuous training related to online teaching and moderation of online discussions.

OUTCOMES

Most research studies on evaluation of online education can be categorized into three types: 1). student outcomes, such as grades and test scores, 2). student attitudes about learning through distance education, and 3). overall student satisfaction toward distance learning (Phipps & Merisotis, 1999). The online learning environment is complex, and achieving effective teaching is a challenge. Reeves (1997) suggested a model of the effective dimensions of interactive learning on the Internet. The outcomes of the model are knowledge and skills, robust mental models, and higher-order outcomes. This chapter considers the outcomes in the model and expands them. The acquisition of knowledge and skills on aspects of online learning represented by grades, leads to the development of a mental model to interpret information, which leads to higher order thinking and problem-solving. The acquisition of knowledge and skills and mental models are

Figure 3. First-level diagram of an online course
known as 1st order outcomes. The higher-order thinking related to 21st century skills is the 2nd order outcome. Still further along the means-end continuum is the ability to transfer this learning to new and different contexts, in other words, to contribute to life-long learning.

Course management tools are a popular way to design online courses. As Benigno and Trentin (2000) indicate, online courses have a few common characteristics with face-to-face courses, but there are different elements to evaluate when referring to the quality of an online course (Phipps, et al., 2000). The use of modeling explains the elements by illustration. The first level diagram of an online course is shown in Figure 3, First Level Diagram of an Online Course.

TRANSACTIONS

Primary Transactions of an Effective Online Course

If an online course is wholesome, based on the past studies and research reports, there are four primary transactions to must take place successfully: course content, instructional design, teaching, and course evaluation. One needs to notice that there is no clear cut division between the transactions; they are interrelated and intertwined with each other.

Although online courses have different characteristics from face-to-face course designs, there are still a few bottom-line issues they have in common. In an online learning environment, because of the physical absence of the instructor and other learners, support and creating a learning community are essential (Paloff & Pratt, 1999; Preece, 2000; Rovai, 2002). The priority of course design for online courses is to construct a learner-centered learning environment, form a learning community in which the instructor can provide learner support and help develop social presence (Aragon, 2003; Gunawardena & Zittle, 1997; Gunawardena, 1995) and demonstrate the accountability of learner assessment (NACOL, 2007). Regarding course development, the use of technology in online courses, including the presentation of course materials and the communications tools for course participants to use should be developed with pedagogy as support.

In the primary transactions, course evaluation is easily ignored but is important. Most of

Figure 4. Second-level diagram of an online course
the online learning research studies like to study instructor and course satisfaction, since the two types of satisfaction are direct and observable outcomes. To retain low attrition and drop-out rates, the two types of satisfaction must not be ignored, and it is considered in the chapter. The second level diagram of an effective online course is illustrated in Figure 4. Second Level Diagram of an Online Course.

1. Transactions within Course Content

Course content “serves as the foundation for quality because it addresses the interest and the needs of learners” (Chao, Saj, & Tessier, 2006, p. 34). Based on research reports, a few indicators for evaluating the quality of content are as follows (AFT, 2000; SREB, 2006a; NACOL, 2007b). The transactions within course content of third level diagram of an online course are illustrated in Figure 5.

1). Course content:

- Provide learners with a clear statement about the course. The statement includes course overview, syllabus (with course goals and objectives), course requirements, the weekly time commitment and specific computer skills required by the course, and a presentation of the practical difficulties of working at a distance and what is needed to manage those challenges successfully.
- Summarize learning outcomes for each course module in a clearly written, straightforward statement.

2). Course standards:

- Are aligned with official standards.
- Have sufficient rigor, depth, and breadth to reach official standards.
- Are accurate, current, and free of bias.

3). Integrating other knowledge or skills:

- Information literacy and communication skills are incorporated as an integral part of the curriculum.
- Issues associated with the use of copyrighted materials are addressed and monitored.
- Academic integrity and netiquette (Internet etiquette) expectations regarding lesson activities, discussions, e-mail communications and plagiarism are stated clearly and monitored.
- Privacy policies are stated clearly and monitored.
2. Transactions within Instructional Design

The quality of online courses lies at the heart of instructional design, which includes designing a learner-centered online course structure, selecting appropriate technologies, and embedding student assessments into the process of online learning. The transactions within instructional design of third level diagram of an online course are illustrated in Figure 6. The details are as follows.

2.1. Course structure: There have been numerous researchers emphasizing the importance of online learning environments (Cohen & Ellis, 2003; McLoughlin & Oliver, 2002; Vrasidas, 2000). However, the potential of online learning is not in its use of state-of-the-art technologies, but rather in creating a course structure in which learners are allowed more possibilities for various types of interaction among all the learners and the instructor, and being learner-centered. Owing to the importance of course structure, the chapter places it as the first issue to consider in the transactions within instructional design.

1). Maximizing interaction:
- Incorporate both synchronous communication (i.e., online chat rooms or instant messaging) and asynchronous communication (i.e., e-mails, discussion boards) in the course.
- If possible, provide learners with opportunities of face-to-face meetings with the instructor and other learners in the duration of the course.
- Provide opportunities for appropriate instructor-student interaction, including timely and frequent feedback about student progress.
- Provide opportunities for appropriate instructor-student and student-student interaction to foster mastery and application of the material and a plan for monitoring that interaction.
- Provide opportunities for appropriate student interaction with the content to foster mastery and application of the material.

2). Considering individual differences:
- Course design reflects a clear understanding of student needs, and incorporates varied ways to learn and multiple levels of mastery of the curriculum.
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- Provide learners with multiple learning paths to master the content, based on student needs.
- Engage learners in learning activities that address a variety of learning styles and preferences.
- Adapt learning activities to accommodate learners’ needs.

3). Organizing course content:
- Organize a course into units and lessons.
- The course unit overview describes the objectives, activities and resources that frame the unit. It includes a description of the activities and assignments that are central to the unit.
- Each lesson includes a lesson overview, content and activities, assignments, and assessments to provide multiple learning opportunities for students to master the content.
- Readability levels, written language assignments and mathematical requirements are appropriate for the course content and the students.
- Provide learners with access to resources that enrich the course content.
- Provide assessment and assignment answers and explanations.

4). Advancing learning levels to be more diverse and higher-order:
- Design the course to teach concepts and skills that learners will retain over time.
- Include instructional activities that engage learners in active learning.
- Provide learners with opportunities to engage in higher-order thinking, critical-reasoning activities and thinking in increasingly complex ways.

2.2. Use of Technologies: Use of modern communication technologies does not guarantee learning effectiveness. Whether the course is delivered through a course management system, the instructional designer and the instructor need to ensure course design (including content planning, class projects, visual aids, course materials and teacher-to-student and student-to-student interaction) maximize the potential of the available technologies (AFT, 2000). A few issues indicated as below need attention.

1). Accessibility:
- The course website is easy to navigate.
- Hardware, Web browser and software requirements are specified.
- Prerequisite skills in the use of technology are identified.

2). Usability:
- The architecture permits the instructor to add content, activities and assessments to extend learning opportunities.
- The course makes maximum use of the capabilities of the online medium and makes resources available by alternative means; e.g., video, CDs and podcasts.
- The course utilizes appropriate content-specific tools and software.

3). Universality:
- The course meets universal design standards ensuring access for all learners.
- Interoperability allows sharing content among different learning management systems.
- Interoperability ensures sharing of questions, assessments and results with others.
- Course materials meet SCORM standards regarding sharability.

2.3 Learner assessment: Learner assessment is part of instructional design. Embedding learning assessment in the process of instruction, the instructor ensures that learners meet instructional
1. Assessment as a part of the course:
   - Make grading policy and practices easy to understand.
   - Have learner evaluation activities consistent with course goals and objectives.

2. Regular feedback:
   - Assessment strategies and tools make the learner continuously aware of his/her progress in class and mastery of the course content more than letter grades.
   - Conduct ongoing and frequent assessments to verify each learner’s readiness for the next lesson.

3. Facilitate instructors to assess learners:
   - Assessment materials provide the instructor with the flexibility to assess learners in a variety of ways.
   - Provide the instructor with grading rubrics and models of partially to fully completed assignments.

4. Multiple assessment strategies
   - The course structure includes adequate and appropriate methods and procedures to assess students’ mastery of content.

3. Transactions within Online Teaching:
   Technology cannot make poorly designed instruction become good. An effective online course, like any traditional course, still depends on effective teaching and learning skills and design. Effective teaching transforms the results of learner analysis and instructional design into components of teaching and learning. Research studies have shown that
the activities of effective teaching are important quality indicators of online courses. For example, Cashion and Palmieri (2002) specify the critical features of effective online learning, some of which are flexible learning, responsive teaching, and quality of course design. This section focuses on the aspects of teaching. The transactions within teaching of third level diagram of an online course are illustrated in Figure 7. A few important issues, based on the framework of Hao and McGee (2003), are indicated as follows.

3.1. In order to help learners transfer knowledge and skills:
- The instructor separates the online course into self-contained units/modules that can be used to assess learner mastery before moving forward in the course.
- The instructor makes units/modules varying lengths determined by the complexity of learning outcomes.
- Each module requires learners to engage themselves in analysis, synthesis, and evaluation as part of their course assignments.

3.2. In order to provide learners with task ownership and learner-centered environment:
- Learners identify an area of inquiry in their field in which technology is used to train specific populations.

3.3. Promoting interaction and interactivity in the learning environment:
- Learners work in teams, participate in structured and unstructured discussions, engage in peer critiques, and join regular synchronous chats.
- The instructor facilitates learner interaction with him/her through a variety of ways.
- The instructor facilitates learner interaction with other learners through a variety of ways.
- The instructor provides feedback to learner assignments and questions in a timely manner.
- The instructor provides feedback to learners in a manner that is constructive and non-threatening.
- The instructor makes sure class voice-mail and/or e-mail systems are provided responsively to encourage learners to work with each other and their instructor.

3.4. In order to enhance social presence:
- Allows learners to share information about themselves as a precursor to learning teams.
- Discussions, chats, learning teams and bi-monthly streaming video messages from instructor enhance social presence.

3.5. In order to provide metacognitive support:
- The instructor designs the online course requiring learners to work in groups utilizing problem-solving activities in order to reflect thinking and develop topic understanding.
- Learning teams provide peer support while review and re-writes of course assignments provide opportunities for reflection.

4. Transactions within Online Course Evaluation
The drop-out rates are usually higher for online courses (Cohen & Ellis, 2002). If learners are satisfied with their online course, they tend to continue to take subsequent online courses from the same education provider (McGorry, 2003). Therefore, course satisfaction is essential to consider in course evaluation (Bolliger & Martindale, 2004; Boverie, Nagel, McGee, & Garcia, 1998). The transactions within course evaluation of third level diagram of an online course are illustrated in Figure 8. The following section indicates a few issues to keep in mind when examining course evaluation.
4.1. Conduct formative evaluation:
- Update courses periodically to ensure timeliness.
- Evaluate intended learning outcomes regularly to ensure course clarity, utility, appropriateness, and effectiveness.

4.2. Conduct summative evaluation:
- The evaluation findings and processes are used to improve the teaching/learning process.
- Have specific standards to compare and improve learning outcomes.
- Uses multiple methods to evaluate course effectiveness. For example, drop-out rates, course satisfaction, instructor satisfaction, successful/innovative uses of technology.

4.3. Student satisfaction with the instructor is determined by how the instructor:
- Responds to learners’ questions, grades and returns all assignments in a timely manner.
- Is supportive with regard to learners’ learning throughout the course
- Provides constructive feedback to learners’ questions and assignments.
- Effectively facilitates interaction in the discussion forums.
- Provides a learning environment that encourages learners to participate in online discussions.
- Is encouraging.
- Shows personal interest in learners’ graded work.
- Used the features of (some) technology tool well.
- Overall, meets learners’ expectations.

4.4. Course satisfaction:
- Learners think what they learned will be useful to them in the future.
- The workload for the course is manageable.
- The course progresses at a reasonable pace.
- Learners are satisfied with the quality of interaction with classmates.
- Learners are satisfied with the rubrics by which they are being graded.
- Overall, the online course effectively presents the subject matter.
- Overall, the course meets learners’
learning expectations.
- Learners would recommend the online course to others.
- Learners would like to take an online course again in the future.
- Learners have a positive attitude toward online learning at the end of the course.

**CONCLUSION**

The Decomposition Model serves as a blueprint for addressing the issues of online course evaluation using a graphically structured approach. It is used as a heuristic for course quality monitoring and self-evaluation of online teaching. The illustration in the chapter delineates the activities in an online course. This will assist instructors in determining what type of activity is lacking for their expected learning outcomes and help define quality for online courses. As indicated earlier, at the most specific level, activities can be implemented and outcomes operationalized. The significance of this approach may be that a well-structured approach to documenting what instructors think about an online course can materially aid both our thinking and ability to convey the understanding of a quality online course to others. By considering and understanding a course’s conceptual structure, a common understanding of course objectives can be achieved. An understanding of the nature and structure of courses and knowledge of the process of course implementation may all be essential components for making effective online courses. The model provides pivotal guidelines for practitioners in the field of online learning and for administrators who would like to have a whole picture of quality for online courses. With the model, making effective online courses is no longer a mystery.

**REFERENCES**


Cashion, J., & Palmieri, P. (2002). *The secret is the teacher: The learner’s view of online teaching.* Leabrook, SA: NCVER.


A Practical Guide to Evaluate Quality of Online Courses


KEY TERMS AND DEFINITIONS

**Online Course:** A course that is delivered through the Internet.

**Online Course Evaluation:** A determination of the value, quality or significance of an online course
**Course Modeling:** A technique for identifying and demonstrating how the components of a course relate to each other and how these components help course functionalities

**Quality of Online Courses:** A determination of the value of online courses

**Evaluation Criteria:** The standards used to determine value, quality and significance.
Chapter 21
Web Accessibility Essentials for Online Course Developers

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ABSTRACT

According to Section 508 of the Rehabilitation Act of 1973, federal agencies must provide access to electronic and information technology to individuals with disabilities who are federal employees or members of the public. As institutions of higher education (IHE) put more services and resources online, formatting pages so they are accessible to users with disabilities is essential. Although IHEs are attempting to comply with Web Accessibility Standards with their public Web pages, full compliance has been difficult. In addition, the growth of online courses has only complicated the issue. Although learning management systems (LMS) may claim to be Web accessible, accessibility of individual content items at the course level, is set by the course developer. This chapter will discuss essential information necessary for online course developers to develop Web accessible content.

INTRODUCTION

When designing online courses, there are so many components to prepare that the needs of students with disabilities can be overlooked. Not that this is intentional, but preparing for students who are not seen by the instructor allows him/her to make assumptions that all students will be able to access the information. Paciello (2000) notes that

The fact that the Web is inherently inaccessible is not the result of some malicious or premeditated intent. The Web followed a very typical development process based on standard engineering processes that, all too often, do not include considerations for people with disabilities. Web page designers and content producers observe similar methods. Subsequently, most advanced technologies are not accessible to people with disabilities. Until now, it was satisfactory to create an assistive or adaptive device (or application). Until now, very few laws or standards mandated accessibility (p. 21).
Students who opt for online learning may face many barriers in accessing their courses, and the barriers do not stop with there. They may have difficulty obtaining schedules, registration materials, grades, library services, the Help desk, and evaluations, to name a few. It is similar to the student in a wheel chair who shows up for class only to find it is located on the second floor, and there are no elevators. As Finkelmeyer (2008) states, “For many young adults, making the step from high school to college can be an unnerving experience. For those with disabilities – either physical or mental – taking that jump to an institution of higher education can be downright scary” (¶1-2). Whether the classes are face-to-face or online, it is imperative that educators find tools to make them as accessible to everyone as possible.

This chapter will discuss essential information necessary for online course developers to develop Web accessible content. The chapter will be divided into three sections. First, there will be a discussion of Web accessibility using the tenets of Universal Design for Learning and the disabilities affected by Web accessibility. Next, issues related to Web accessibility and online courses will be discussed. Finally, tools for evaluating course sites for accessibility and ways to make online course components accessible will be given. This will include a discussion of Web accessibility standards and guidelines as well as the accessibility of learning management systems and using multimedia in online courses. It is hoped that the reader will take away a better understanding of what it means to be prepared for all students who enroll in a class and a few suggestions for accommodations that can make this possible.

BACKGROUND

Universal Design for Learning

Koppelman and Goodhart (2005) define the term “disability” as “a restriction of functional ability and activity caused by an impairment (such as hearing loss or reduced mobility)” (p. 283). This could also include visual, motor, and cognitive impairments. For students with disabilities, making a course accessible means simply, as Paciello (2000) states, “information, regardless of form, structure or presentation that can be easily accessed by any person, regardless of ability” (p. 373). This does not mean that a course will be absolutely accessible by everyone but that legally and ethically, we must try to make it as accessible to as many people as possible. The tenets of Universal Design for Learning are appropriate and useful to this end. Rose and Meyer (2000) note that “Universal Design for Learning (UDL) is a research-based set of principles that together form a practical framework for using technology to maximize learning opportunities for every student” (p. vi). Universal Design for Learning has its roots in Universal Design, an architectural term that promotes developing materials and buildings to accommodate diverse populations from the outset rather than retrofitting them at a later time. The inclusion of elevators in all modern buildings rather than adding ramps later is an example of universal design. The elevators may have initially been intended for use by people with mobility concerns, but they have become universal in that everyone uses them. This is the premise for UDL as well – that materials or functions may be designed for those with disabilities but may, in fact, be used by anyone with preferences for those options. The Partnership Grant at the Ohio State University (2004) defines UDL by stating that

Universal design is an approach to designing course instruction, materials, and content to benefit people of all learning styles without adaptation or retrofitting. Universal design provides equal access to learning, not simply equal access to information, Universal design allows the student to control the method of accessing information while the teacher monitors the learning process and initiates any beneficial methods (¶1).
Universal Design for Learning is achieved by means of flexible curricular materials and activities. It provides alternatives for students with differing abilities, and alternatives built into the design and operating systems of materials – not added later. This allows courses to be ready for all students from the first day of classes. Even students who do not have a disability will have options for learning if they so choose without having to wait for the instructor to procure additional adaptive materials or devices. As Horton (2000) states, “Reaching the goal of global training requires solid knowledge of the differences among learners throughout the world – and careful design for these differences” (p. 439).

In its Website, The Center for Universal Design at North Carolina State (2008) lists seven principals of Universal Design that can be readily adapted for online application of UDL:

1. Principle One: Equitable Use: The design is useful and marketable to people with diverse abilities.
2. Principle Two: Flexibility in Use. The design accommodates a wide range of individual preferences and abilities.
3. Principle Three: simple and intuitive. Use of the design is easy to understand, regardless of the user’s experience, knowledge, language skills, or current concentration level.
4. Principle Four: Perceptible Information. The design communicates necessary information effectively to the user, regardless of ambient conditions or the user’s sensory abilities.
5. Principle Five: Tolerance for Error. The design minimizes hazards and the adverse consequences of accidental or unintended actions.
6. Principle Six: Low Physical Effort. The design can be used efficiently and comfortably and with a minimum of fatigue. (Eliminating repeated need to volley between links.)
7. Principle Seven: Size and Space for Approach and Use. Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user’s body size, posture, or mobility. (Any adaptive technology will enhance the learner’s ability to navigate the site.), p.1.

Incorporating these principles helps to address the needs of all, incorporates the same fundamental ideas into learning, and supports improved access to information and learning. It should be noted that access to information may seem intuitive, but access to learning is equally important. Paving the way for students to use, reflect upon, and adapt the accessed information increases their ability to learn. The point of online education should be the students’ learning, and this is accomplished by addressing their needs and providing options that will help them reach their potential. It is not about tricking students or making navigation of the Website so difficult that the message is lost. Coombs (2002,) states that “failure to integrate the necessary design principles is causing new and needless barriers to educational success” (¶ 1) for those with disabilities.

To make classes accessible, then, instructors need an awareness of the basic laws and guidelines that govern online learning. They need tools such as UDL to level the playing field for all, and they need to be prepared at the beginning of class. Table 1 addresses the four types of disabilities that may be encountered and suggestions for what helps.

### Visual Impairments

While most people think of visual impairments as total blindness or low vision, color blindness can be a problem as well in that Websites often rely heavily on color or color recognition as part of their design. Making certain that this is not the case will remedy the situation.

Screen readers are effective for those with total visual impairments or with low vision. According to Thatcher, et al. (2006),

In its Website, The Center for Universal Design at North Carolina State (2008) lists seven principals of Universal Design that can be readily adapted for online application of UDL:
A screen reader is an output device that provides feedback on users’ interaction with their computer, in the same way that a monitor is an output device that helps users interact with their computer. Screen readers read out anything that happens when you interact with the operating system, other applications, in browsers, and eventually in your Website” (p. 296).

However, as Crow (2008) notes, “Designers of online materials should avoid using background images to convey meaningful information. Screen readers are currently unable to read background images” (¶8). He goes on to say that it is necessary to keep sites uncluttered and to use a sans-serif font and limit the use of italics. Italics and serif fonts can become difficult to read if the viewer has a monitor with low resolution.

Screen magnifiers that enlarge areas of the monitor screen can be very useful for those with partial vision, and the use of alternate text buttons can be especially helpful. An alt-text is defined by Thatcher, et al (2006) as “a generic term describing descriptive text attached to certain objects on a Web page that can be read aloud by a screen reader, so that a person with a visual impairment can know the nature of such objects, too” (p. 582). Inserting alternate text (alt tags) as a matter of procedure each time a Website is developed will keep sites more readily accessible for all from the outset, following the principles of UDL.

### Hearing Impairments

People who have hearing disabilities can be aided by the use of “real-time text captioning for all audio, video, multimedia presentations that are placed on learning Web sites” (Crow, ¶13). Offering a text version of the Website is sometimes substituted for this, but this is in violation of Section 508 that mandates real-time captioning. Recommendations for captioning will be discussed later in the chapter.

### Motor Impairments

For anyone with disabilities, and especially, those with motor impairments, time is a big factor. Allowing extra time to complete assignments and taking advantage of the asynchronous quality...
of online learning helps to address this. While students with motor impairments may use assistive technologies such as, keyboard inserts, voice activated commands, eye-tracking devices, etc., instructors still need to be aware of the possible need for other adaptations and greater time allotment for assignments and other tasks.

Cognitive Impairments

Cognitive impairments cover a broad spectrum but as stated in WebAIM (2008), “In loose terms, a person with a cognitive disability has greater difficulty with one or more types of mental tasks than the average person” (¶1). The severity may be profound or less so and may include difficulties with memory, problem-solving, attention, reading, linguistic, and verbal comprehension, and/or math and visual comprehension (WebAIM). Designing organized, neat, sequential, and easy-to-navigate Websites will be appreciated by those with cognitive impairments, and again, this addresses universal design principles that work for everyone. Time is certainly a factor as mentioned in the section concerning motor impairments.

EVALUATING WEB ACCESSIBILITY IN ONLINE COURSE

Web Accessibility in Online Courses

When users with disabilities can access and use the Web just as effectively as users without disabilities, then a Web page is considered to be accessible (Section 508, n.d.). Creating accessible Web pages requires Web content developers to learn and/or get training on what Web accessibility means and how to make accommodations using Web authoring software, adjusting scripts within Web page programming code, or making use of options within a learning management system to make content accessible. Although Web development software and learning management systems have become more user friendly, and the ability to create Web pages has become less technical, many accessibility standards require more technical knowledge for to make pages accessible. In order to comply with Section 508 of the Rehabilitation Act of 1973, Web page and online course developers must have an understanding of 1) what each standard means, 2) how those standards translate in terms of Web content, and 3) technical knowledge required to make content in Web pages and learning management systems accessible.

One of the issues hindering instructor compliance with standards includes the lack of awareness and understanding of Web accessibility as well as technical knowledge required to develop accessible Web content. Most course instructors are not well versed in the tools and techniques to evaluate whether or not their content is accessible as well as how to develop accessible online content. Web development and productivity software has become more user-friendly with the “What-You-See-Is-What-You-Get” (WYSIWYG) interface. Although this has increased the number of Web content developers, many of these developers lack the technical knowledge required to make their content accessible.

In addition, most online courses are delivered using learning management systems (LMS) such as Blackboard and Angel. Some major learning management systems have released statements regarding their system’s accessibility. These statements may include information about the company’s dedication to accessibility as well as information about accessibility testing of the system (Blackboard, 2008). Although learning management system may be accessible as a system, the content added at the course level is not accessible unless the course developer has provided the required elements to make it accessible. These elements may include alternative text equivalents for images or other multimedia files used for instruction.

One of the first steps an instructor can make toward developing accessible online content is to
evaluate a page for accessibility. The next section will present tools for evaluating Web accessibility, including Web accessibility guidelines, a method to manually review a page for basic accessibility compliance, and accessibility validators.

**Tools for Evaluating Web Accessibility**

As mentioned earlier, Website designers do not set out to make their pages inaccessible. However, because pages are often inaccessible, it has been necessary to define guidelines and laws to remedy the situation. Web accessibility guidelines can be used to assist developers to ensure Web pages and online courses are accessible. Two commonly used sets of guidelines include the Section 508 standards as well as the Web Content Accessibility Guidelines (WCAG) developed through the Web Accessibility Initiative (WAI) of the World Wide Web Consortium (W3C). According to the American Foundation for the Blind, “In general, Section 508 of the Rehabilitation Act (Appendix A) requires federal governmental agencies to develop, procure, maintain and use electronic and information technology that is accessible to and usable by people with disabilities, including both such agencies’ employees and members of the public generally.” While not all institutions must comply with these mandates, it would seem that ethically any Website for learning should follow them. What is the point of providing learning sites if there are those who cannot use them? In addition to the federal mandates, the World Wide Web Consortium for international use developed Web Content Accessibility Guidelines (WCAG) in 1999 (Appendix B). According to Wells and Barron (2006),

*The WCAG define three levels, Priority 1, Priority 2, and Priority 3. Priority 1 contains the basic requirements and must be implemented for a Web site to be considered accessible; Priority 2 should be implemented to remove significant barriers; and Priority 3 may be implemented to improve access to Web documents. The Web Content Accessibility Guidelines (WCAG) includes 14 checkpoints (p. 25).*

These checkpoints correlate well with the federal guidelines but may seem somewhat simpler to follow. They are also in accordance with the tenets of UDL and promote high usability for people with disabilities and those without.

Both sets of guidelines consist of fairly technical terminology. As previously stated, many Web developers, including online course instructors, lack the technical knowledge required to understand accessibility terminology. However, as online course developers learn about Web accessibility and related terminology, they can start evaluating their online content by using the World Wide Web Consortium’s (W3C) “Preliminary Review of Web Sites for Accessibility” (W3C, 2006). This preliminary review was developed as part of the Web Accessibility Initiative. According to W3C (2006), this review allows quick identification of accessibility problems for online content. The review does not require the evaluator to know Web development languages, but he or she should be comfortable working with browsers and their settings. Conducting this review would also help the developer begin to learn some of the technical terminology associated with Web accessibility and how it is related to Web content. Steps for conducting a preliminary review for accessibility are in the next section.

**Conducting a Preliminary Review for Accessibility**

The “Preliminary Review of Web Sites for Accessibility” (W3C) includes six steps:

1. Turn off images, and check whether appropriate alternative text for the images is available.
2. Turn off the sound, and check whether audio content is still available through text equivalents.

3. Use browser controls to vary font-size: verify that the font size changes on the screen accordingly; and that the page is still usable at larger font sizes.

4. Test with different screen resolution, and/or by resizing the application window to less than maximum, to verify that horizontal scrolling is not required (caution: test with different browsers, or examine code for absolute sizing, to ensure that it is a content problem not a browser problem).

5. Change the display color to gray scale (or print out page in gray scale or black and white) and observe whether the color contrast is adequate.

6. Without using the mouse, use the keyboard to navigate through the links and form controls on a page (for example, using the “Tab” key), making sure that you can access all links and form controls, and that the links clearly indicate what they lead to.

This section will outline how to conduct each of these steps to review online content for accessibility.

The first step, “Turn off images, and check whether appropriate alternative text for the images is available” (W3C, 2006) will partially cover Section 508 standard (a) and WCAG guideline #1. These standards require any non-text element such as images, videos, and animations to have text equivalent alternatives, or “alt text.” To test whether your online content has text equivalent alternatives, first open your online course content in a Web browser. In the browser preferences or options, turn off the option to automatically load images. This is usually found in the Advanced Settings section. Refresh or reload the same Web page. If you have specified alternative text for your images, text will show up where there were previously images.

For the next step, “Turn off the sound, and check whether audio content is still available through text equivalents” (W3C, 2006), navigate to an audio or video file located online. Turn off the sound and look to see if there are any options for captioning. These options will either show up automatically or you just won’t hear any sound. Although transcripts are helpful, they do not meet the requirement of real-time synchronization (Section 508, n.d.). In the case of video, a transcript does not allow users to see the text in combination with the events on the video. Captioning will allow those with hearing impairments to read the captions while viewing the video.

Step three of the preliminary review tests the readability of a Web page at larger font sizes. Adjustable font sizes enable users with visual impairments to change the font sizes of the text to meet their needs. Text adjustments can usually be made from the “View” menu in most browsers. For example, in the Firefox Web browser, go to the “View” menu, select “Zoom,” and then “Zoom In.” You will notice all items on the pages will get larger. Some Web browsers will allow you to enlarge text only.

Users should be able to change screen resolutions as well as window sizes without a horizontal scroll bar appearing. According to Slatin & Rush (2003), scrolling can be confusing for people using screen magnifiers and tiring for those with limited hand mobility. Step four of the review process tests for this. With an online course page open in a browser, resize the window to view changes. This can be done by using the mouse to click and drag a corner of a window. Check to see whether or not scroll bars appear when dragging to resize the window. Screen resolution changes can be made within the control panel or system preferences of a computer operating system.

Step five of the review addresses users who have limited visual perception of colors, or color blindness. Colors are often used to emphasize points or grab student attention. However, approximately ten percent of males cannot perceive
the colors red and green (Slatin & Rush, 2003). By changing the display colors of a browser to only show gray scale colors, or simply printing out a page, instructors can see whether or not their online content have barriers to those who are color blind.

The last step of the preliminary review for accessibility tests whether or not a page can be navigated by a user with limited mobility. An accessible Web page should be able to be navigated by using the tab and/or arrow keys of a computer. To test this, a user will need to change settings within the browser. After changing the setting in a browser to allow for the use of cursor keys, users should be able to move within a page to by using the tab or arrow keys. When navigating to a link, click on the Enter key to follow the link.

**Accessibility Validators**

Accessibility validators can assist developers to evaluate whether or not their Web pages comply with either Section 508 or WCAG. One example of an accessibility validator is the HiSoftware Cynthia Says Portal (HiSoftware Inc., 2008). Developers can go to http://www.cynthiasays.com, insert a URL, or Web page address and test the site for accessibility. These validators will allow developers to designate which standards to evaluate the page against. Results let the developer know whether or not the site passes for each standard.

There are several validators available on the Internet; however, depending on the validator, results can be highly technical and thus, intimidating for the non-technical course instructor.

**Making Online Course Materials Accessible**

As previously discussed, many learning management system interfaces are generally Web accessible; however, materials added at the course and instructor level need other elements in order to make them accessible. One area of concern is multimedia. Harley (2007), conducted a study regarding faculty use of digital resources in undergraduate teaching. Out of 831 respondents, 75% stated they used images and visual materials, 62% used digital film or video, and 46% used audio (Harley, 2007). With the increasing use of digital media in instruction, instructors need to provide supplemental alternatives for those with disabilities. When uploading images to a course site, the instructor should provide a text alternative. Most LMS’s will give an “Alt Text” option for instructors to fill in. In Blackboard, the option to add “Alt Text” is offered when inserting images or links. Provide a simple yet clear statement of what the image is. In the event that it serves as a button or link, the statement should state it is a link to a Web page.

For audio or video files, alternatives can be in the form of captions for the deaf and audio descriptions for the blind. For captioning, text can be edited directly onto a video or multimedia presentation or be added as a subtitle using a Web-based tool called dotSub. This tool not only allows subtitles for captioning purposes, but also for language translation (dotSub, 2008). To add subtitles, dotSub gives an interface in which users can play and pause the Web video while inserting the text. The text is inserted so that it shows at the same time the audio plays. For audio files, instructors can record and give students access to digital audio descriptions.

Ideally, however, supplemental captions and audio descriptions would be made available as streams that play along with the source file in real-time. Media Access Generator (MAGpie), a free downloadable utility developed by the National Center for Accessible Media (NCAM), is a used to create captions and audio descriptions as supplemental streams (WGBH, 2008). Two formats of supplemental caption and audio streams are W3C’s Synchronized Multimedia Integration Language (SMIL) and Microsoft’s Synchronized Accessible Media Interchange
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(SAMI). When using SMIL, it is possible for users to turn captions or audio descriptions on or off within a user interface such as Apple Quicktime Player, GRiNs Player, Ambulant Player, or Real Player. SAMI only allows captions to be turned on or off when using Windows Media Player on the Windows operating system only. MAGpie can produce captions and audio descriptions for SMIL files, and captions only for SAMI and Flash files (WGBH, 2008).

FUTURE TRENDS

The World Wide Web will continue to evolve at a rapid pace. According to an Internet usage statistics Website, the total number of Internet users in the North America increased by 129.6% between 2000 and 2008 (Miniwatts Marketing Group, 2008). As the Web grows, so does the online course delivery medium. According to Gallagher (2004), an independent research firm, nearly 300,000 high school students attended online classes during the 2002-2003 academic year. In addition, rising gas prices during the summer of 2008 prompted an increase in online course enrollment in higher education institutions across the United States (Young, 2008). The growth in the Web and online course enrollment as well as the rapid evolution of new technologies will continue to create new challenges for users with disabilities.

It is hoped that new tools for making Web content accessible will also evolve with the technology. Some Web development tools have made accessibility options available, but more support and training on how to use the accessibility options is necessary. This support and training is necessary to increase the awareness of instructors, course developers, and the entire institutional community of accessibility issues of public Web pages and online course sites. According to Coombs (2002), the following are examples of those individuals and groups who should be aware of accessibility issues and tools: the institutions chief academic officer, the chief information officer, the university Webmaster and staff, distance and/or online learning departments, librarians, instructors, and the coordinator and staff of the disabilities office. It is a moral and legal obligation for institutions to increase the awareness of Web accessibility issues and strive to meet the needs of students with disabilities.

CONCLUSION

There is much to learn about making online content accessible. This chapter touches on some essential information to increase online course developer awareness of Web accessibility. The U. S. Census Bureau (2002) counted 282,831 million people who have some type of disability. Over 222 million are over the age of fifteen. With the continued increase in online learning, if steps are not taken to increase instructor awareness and make Websites accessible for all, not only do those with disabilities lose, but so does the general public. Education matters, and learning should be for all.

REFERENCES


http://www.Webaim.org/articles/cognitive/


KEY TERMS AND DEFINITIONS

Disability: “a restriction of functional ability and activity caused by an impairment (such as hearing loss or reduced mobility)” (Koppelman & Goodhart, 2005, p. 283).

Universal Design for Learning (UDL): Universal design is an approach to designing course instruction, materials, and content to benefit people of all learning styles without adaptation or retrofitting. Universal design provides equal access to learning, not simply equal access to information, Universal design allows the student to control the method of accessing information while the teacher monitors the learning process and initiates any beneficial methods (Ohio State University, 2004).

Web Accessibility: when users with disabilities can access and use the Web just as effectively as users without disabilities (Section 508, 2008).

Section 508: Section of the Rehabilitation Act of 1973 mandating federal agencies must provide access to electronic and information technology to individuals with disabilities who are federal employees or members of the public. The section also specifies standards for compliance.


Learning Management System (LMS): Systems used to facilitate the delivery of online courses. Also known as course management systems, examples include Blackboard, Angel, and Moodle.

Alternative Text Equivalent: Text made available for non-text elements such as images, audio, video, or animations.

Captioning: Text that is synchronized with multimedia presentations using audio
APPENDIX A

1194.22 Web-based intranet and internet information and applications.

(a) A text equivalent for every non-text element shall be provided (e.g., via “alt”, “longdesc”, or in element content).
(b) Equivalent alternatives for any multimedia presentation shall be synchronized with the presentation.
(c) Web pages shall be designed so that all information conveyed with color is also available without color, for example from context or markup.
(d) Documents shall be organized so they are readable without requiring an associated style sheet.
(e) Redundant text links shall be provided for each active region of a server-side image map.
(f) Client-side image maps shall be provided instead of server-side image maps except where the regions cannot be defined with an available geometric shape.
(g) Row and column headers shall be identified for data tables.
(h) Markup shall be used to associate data cells and header cells for data tables that have two or more logical levels of row or column headers.
(i) Frames shall be titled with text that facilitates frame identification and navigation.
(j) Pages shall be designed to avoid causing the screen to flicker with a frequency greater than 2 Hz and lower than 55 Hz.
(k) A text-only page, with equivalent information or functionality, shall be provided to make a Web site comply with the provisions of this part, when compliance cannot be accomplished in any other way. The content of the text-only page shall be updated whenever the primary page changes.
(l) When pages utilize scripting languages to display content, or to create interface elements, the information provided by the script shall be identified with functional text that can be read by assistive technology.
(m) When a Web page requires that an applet, plug-in or other application be present on the client system to interpret page content, the page must provide a link to a plug-in or applet that complies with §1194.21(a) through (l).
(n) When electronic forms are designed to be completed on-line, the form shall allow people using assistive technology to access the information, field elements, and functionality required for completion and submission of the form, including all directions and cues.
(o) A method shall be provided that permits users to skip repetitive navigation links.
(p) When a timed response is required, the user shall be alerted and given sufficient time to indicate more time is required.

APPENDIX B

Web Content Accessibility Guidelines

1. Provide equivalent alternatives to auditory and visual content.
2. Don’t rely on color alone.
3. Use markup and style sheets and do so properly.
4. Clarify natural language usage
5. Create tables that transform gracefully.
7. Ensure user control of time-sensitive content changes.
8. Ensure direct accessibility of embedded user interfaces.
10. Use interim solutions.
11. Use W3C technologies and guidelines.
12. Provide context and orientation information.
13. Provide clear navigation mechanisms.
14. Ensure that documents are clear and simple.
Chapter 22
Web Accessibility Policy for Students with Disabilities in U.S. Postsecondary Distance Education

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ABSTRACT

“Web accessibility” is the ability to access information online. In distance education, most instructional material is located online, and anything that prevents a person from accessing these materials becomes a barrier to distance education. Demand for distance education is growing, and the Web is the most common mechanism for its delivery. Not all Websites are accessible, despite the availability of design guidelines. The purpose of this chapter is to inform Web accessibility policy decisions at U.S. postsecondary institutions by increasing the awareness of Web accessibility issues in distance education, examining societal implications, and discussing methods for improvement. This chapter also reviews the current U.S. legal context and provides alternative cost-justification and cost-benefit frameworks for consideration by policymakers.

INTRODUCTION

Distance education combines technology and pedagogy to break down the barriers of time and place, enabling students to enroll in and complete coursework from any location with a computer and an Internet connection. The flexibility provided by distance education is a substantial benefit to students who cannot, or prefer not to, travel to a physical campus. However, one group of students—those with disabilities—is overlooked when it comes to distance education at many postsecondary institutions in the U.S.

“Web accessibility” is the ability to access information on the World Wide Web, or the Internet. In distance education today, most instructional material and related information is located online. Anything that prevents a person from accessing this content becomes a barrier to distance education. It is possible to reduce these barriers, but it is a challenge to gain attention and support for Web accessibility policy because it involves technology...
Web Accessibility Policy for Students with Disabilities in U.S. Postsecondary Distance Education

that can be difficult to comprehend, and students with disabilities represent a relatively small portion of the population.

Why are Web accessibility measures needed in U.S. postsecondary education, and what are the policy consequences in U.S. postsecondary distance education? Web accessibility measures are needed because they reduce barriers to distance education for students with disabilities. Demand for distance education is growing, and the Web is the most common delivery mechanism for distance education. However, not all Websites are accessible, despite the availability of design guidelines. Web accessibility policy provides increased opportunities for learners and is consistent with the social justice principles of equal access and nondiscrimination. Web accessibility policy can be better understood through models of disability, alternative cost-benefit frameworks, and can be cost-justified using metrics such as social return on investment (social ROI) (Wilson & Rosenbaum, 2005). U.S. postsecondary institutions need to be aware of recent legislative changes, such as the reauthorization in 2008 of the Americans with Disabilities Act (ADA), which provides the legal basis for a broader interpretation of disability and sets the stage for increased requests for accommodations by students with disabilities.

Web accessibility policymakers at U.S. postsecondary institutions face a myriad of challenges, including increased demand for distance education, alternative models of disability, unsympathetic socioeconomic paradigms, competing social theoretical perspectives, lack of technological understanding, and a changing legal environment.

This purpose of this chapter is to inform Web accessibility policy decisions at U.S. postsecondary institutions by increasing awareness of Web accessibility issues in distance learning, examining societal implications, and discussing methods to improve Web accessibility. This chapter also reviews the current U.S. legal context and provides alternative cost-justification and cost-benefit frameworks for consideration by policymakers.

BACKGROUND

Growth in Distance Education

As demand for distance education grows, Web accessibility policy becomes more important. Online enrollment as a percentage of total enrollment at U.S. postsecondary institutions more than doubled from 2002-2006. In the fall of 2002, enrollment in online distance education courses represented 9.7% of total enrollment. By the fall of 2006, online enrollment had grown to 19.8% of total enrollment (Allen & Seaman, 2007). Increased computer use by students (especially mobile computing) is now supported by new and smaller equipment designs, reduced equipment cost, and greater broadband and WiFi network availability on college campuses, in libraries, and in public meeting places.

The annual growth of online enrollment far outpaced the annual growth rate of total enrollment in U.S. degree-granting postsecondary institutions in the same period. Between 2003 and 2006, growth in total enrollment in U.S. postsecondary institutions averaged 1.525% per year, while growth in online enrollment averaged 21.85% per year (Allen & Seaman, 2007).

The Internet is the primary means of providing distance education at U.S. postsecondary institutions. Of U.S. postsecondary institutions offering distance education courses in 2000-2001, more than 93% used Websites to deliver those courses (Waits & Lewis, 2003). The trend toward increased use of Web-based instructional content in distance education is likely to continue as the availability of broadband and WiFi access also continues to increase, and the cost of computing continues to decrease. The economies of scale possible in Web-based instructional content distribution, and on-demand access to this content, benefit both students and institutions.

The Sloan-C Report Online Nation: Five Years of Growth in Online Learning (Allen & Seaman, 2007) indicates that institutions list access as the
number one goal of distance learning. Increasing access is viewed as the socially correct thing to do and aligns with the mission of many postsecondary institutions. Following Web accessibility guidelines is a way to help achieve this goal of increased access and remain true to the mission.

Undergraduate Students with Disabilities in U.S. Postsecondary Institutions

Students with disabilities represent 5.5% of all undergraduate enrollments in U.S. postsecondary institutions. In 1995-1996 U.S. undergraduates reported the following disabilities: visual impairment (16.3%), hearing impairment or deaf (16.3%), speech impairment (3%), orthopedic impairment (22.9%), learning disability (29.2%), other (21.2%). Note: some students reported more than one disability so totals do not add to 100% (Horn, Berktold, & Bobbitt, 1999).

Students are not required to report disabilities to their institutions, so the 5.5% number likely under-represents the true number of students with disabilities. If postsecondary institutions continue to offer distance education courses at the same or planned increased rates reported, without improving the extent to which they follow accessibility guidelines, students with disabilities face the possibility of inaccessible distance education courses. This situation limits flexibility for students with disabilities compared to other students. Increased commitment to employ Web accessibility guidelines by U.S. postsecondary institutions will help to decrease barriers to distance education faced by students with disabilities.

Web Accessibility Guidelines

Guidelines and recommendations have been established to help designers of online content understand the need for Web accessibility, and to design and develop accessible materials for users with disabilities.

In 1999, the World Wide Web Consortium (W3C) published the Web Content Accessibility Guidelines (WCAG 1.0) at the recommendation of the Web Accessibility Initiative Committee (WAI). The WCAG guidelines are considered the de facto technical standard for institutions aiming to meet Web accessibility compliance (Chisholm, Vanderheiden, & Jacobs, 1999). Additional recommendations outlined in the second iteration, known as WCAG 2.0, promote awareness of Web accessibility issues and encourage adoption of updated standards and guidelines to increase the accessibility of online content by people with disabilities (Caldwell, Cooper, Reed, & Vanderheiden, 2008). Following WCAG guidelines generates added benefits because online content that is created according to these guidelines is generally more usable by everyone, not just people with disabilities.

Web accessibility has not been adequately addressed in U.S. postsecondary institutions. During the academic year 2000-2001, less than 50% of all institutions that reported using Websites in distance education rated themselves as following accessibility guidelines to a “moderate” or “major” extent, 3% reported not following accessibility guidelines at all, and 33% did not know if they followed any accessibility guidelines. Private four-year institutions fared the worst in terms of following Web accessibility guidelines. Only 11% reported following the guidelines to a major extent, and 42% reported not knowing whether they followed the guidelines at all (Waits & Lewis, 2003).

If postsecondary institutions continue to offer distance education courses without improving the extent to which they follow accessibility guidelines, students with disabilities face a greater likelihood of inaccessible distance education courses. Increased commitment by U.S. postsecondary institutions to the use of Web accessibility guidelines will help reduce barriers to distance education faced by students with disabilities.
Universal Instructional Design

The concept of Universal Design considers, at the initial design stage, how people with varying abilities use a product. The approach is “universal” because people of varying abilities are factored into the process from the beginning, and as a result the end product is usable by many more people.

“Assistive technology” (AT) refers to devices (software or hardware) that help people with disabilities use computers and information technology. Assistive technology cannot guarantee access to online educational materials and systems because, in many cases, the instructional materials themselves are not designed to be accessible.

“Universal Instructional Design” (UID) addresses this problem and can be adopted as a standard for the design and development of new instructional materials that increase accessibility. Redesigning existing material is problematic because it is not often practical or possible. It is often necessary to recreate the same material from scratch using UID principles in order to make the material more accessible. UID does not replace assistive technology, but it helps to ensure that people using assistive technologies can achieve better results with online content.

The principles of UID (Scott, McGuire, & Shaw, 2003) address the design of the instructional material itself as well as the physical environment in which the material is accessed and used, the physical effort required of the learner, and the culture and community of learners. The principles of UID extend beyond technical specifications and take into consideration the process and context of learning. Designing instructional material using UID principles helps to ensure that students with disabilities can perceive the material despite the challenges of a disability. Proactive steps in this direction include creating and presenting material in multiple formats, such as transcripts for audio or video content, and text alternatives. Ensuring good color contrast, color choice, and compatibility with screen reader software also helps increase Web accessibility. UID also provides a learning environment that is open and inclusive, and applies a social constructivist approach by promoting communication and collaboration among all members of the learning community.

WEB ACCESSIBILITY POLICY

Web accessibility policy is not an abstract, unattainable goal, nor should it be an undue burden. Levine and Sun (2002) describe it this way: “In essence, higher education institutions must create Web sites that work with students’ adaptive technology or, in some cases, furnish appropriate auxiliary aids and services to ensure equal opportunity” (p. 11). Although it makes sense that larger institutions with more resources are better able to adopt and implement Web accessibility policies, this does not preclude smaller institutions from researching, planning, and taking steps toward universal design of new online material or increasing institutional awareness and building support for this issue. Postsecondary institutions with accessible Web policies include California Community Colleges, MIT, Regis University, San Jose State University, and University of Wisconsin (Schmetzke, 2001).

Without institutional preparation for Web accessibility, finding and mobilizing the proper resources is more difficult and costly. If steps are taken in reaction to legislation, then duplicated effort is required to create another version of instructional materials that is accessible, which is not an efficient approach. Web accessibility policy is effective for minimizing both risk and cost to an institution, especially if there is some possibility of a future government mandate.

What are the reasons behind the uneven response to setting Web accessibility policy and committing to Web accessibility guidelines? Policymakers face competing social perspectives, economic considerations, increasingly complex technologies, and a lack of specific government mandate. Each of these is discussed in the sections below.
SOCIAL PERSPECTIVES

Models of Disability

There are several models of disability (Seale, 2006), and the application of these models affects how people with disabilities are viewed in society, and the policies that impact them. In order to move beyond the status quo, a new perspective is required, one that focuses on the whole person and seeks to provide the highest quality of life possible for all, equally. The models are described below.

- Medical Model – focuses on the impairment itself and requires the individual to adjust to the disabling condition.
- Charity Model – emphasizes the personal tragedy aspects of disability. It portrays disabled people as sad, helpless, and in need of care and protection.
- Administrative Model – focuses on a specific area, such as education or employment, and is used to determine eligibility for certain benefits or compensation. Legislation defines the disability and focuses on the impairment, not the physical or social environment. The implication is that specialized services must be provided.
- Social Model – focuses on society’s failure to identify ways that the social and physical environment can include disabled people. The implication is that barriers should be removed.
- Service Provision Model – emphasizes individual and collective responsibility over professional help and medical responsibility.

Disability can be considered in a functional context, meaning the disability is viewed as a mismatch between a person and the environment. A functional framework concludes that the person or the environment can be changed, which increases options and solutions, including application of a universal design approach. Web accessibility ties to universal design because Web-based content that is universally designed can be perceived and used by more people. The concept of universal design is consistent with the Social Model of Disability, which helps to frame Web accessibility as an issue of inclusion and social justice and not simply as an individual’s personal problem. The United Nations Convention on the Rights of Persons with Disabilities (CRPD) takes a human rights approach to disability rights. Using the positivist language of the CRPD helps take this model one step further. As Vaughan (2008) notes:

CRPD notions such as respect, dignity, equal worth, the full enjoyment of all rights, equality of opportunity, mandated legislation and governmental activities, the use of special measures as well as other economic and social rights, and duties relating to proactive alteration of the social understanding of disability, lie beyond the currently conceived parameters of United States law. (p. 9)

The CRPD language expands the Social Model of Disability perspective by moving the focus toward the well being of the whole person. The language of the CRPD has the potential to further influence public opinion, Congressional action, and judicial interpretation. The U.S. has yet to ratify the CRPD.

THE COMMUNITARIAN PERSPECTIVE

In the communitarian perspective, members are embraced and supported, and the various abilities of individuals are seen as complementary and valuable. People of varying abilities contribute to the community in their own way to the greater good of all. The communitarian perspective takes measures that help disadvantaged members of a
community improve their lot. Facilitating others also furthers the individual because the ends are shared and held in common.

Special support provided to members of the community is not seen as a redistribution of resources but as an investment that benefits the community. Accessibility infrastructure, including Web accessibility, is an example of special measures that foster inclusion for community members with disabilities and help these members thrive and contribute.

SOCIO-ECONOMIC PERSPECTIVES

Equity and efficiency are competing concepts when determining resource allocation and fair distributive justice. An economic examination of individual preference curves appears to be at odds with social justice and the communitarian perspective because individuals will seek to maximize their own utility at all times.

Theory of Social Justice

John Rawls (1974) developed the Theory of Social Justice to prove how individual preferences can lead to a just social outcome. He examined equity as part of social contract theory. Each person’s starting point, or “original position” in society, is the same, and under such conditions “the most reasonable principles of justice are defined as those that would be unanimously agreed to in an appropriate initial situation that is fair between individuals conceived as free and equal moral persons” (p. 141). This hypothetical, unanimous agreement is called “original agreement” and is, according to Rawls, a socially just outcome.

Rawls’ theory of social justice considers the distribution of “primary goods,” which include liberty, freedom, powers and prerogatives of offices and positions, income, wealth, and the social bases of self-respect. Primary goods are fairly allocated, even if unequally distributed, if the allocation is based on individual choice. Unequal allocation of primary goods is unfair if the distribution results from the privilege or disadvantage of certain individuals caused by arbitrary or undeserved circumstances. All people should have a “fair share of primary goods, and that people’s fate should be determined by their choices and decisions, not by the circumstances which they happen to face” (Chu & Liu, 2001, p. 258).

Maximin Principle of Justice

Rawls viewed all people as equal and moral beings. As such, if people are ignorant of their position in a society, then they are behind a “veil of ignorance,” and have a level of risk that is incalculable. Under these conditions people will unanimously agree to create the best possible scenario for the worst position in society. This agreement is what Rawls calls the “Maximin Principle of Justice” (Chu & Liu, 2001, p. 268). This theory attempts to ensure that the outcome affecting the least-advantaged members of society is as good as possible when resources are distributed.

Rawls believed that once the least-advantaged groups in society are identified, it is fairly easy to decide which policies are advantageous to these groups. It is not as easy to decide which policies maximize the marginal utility of already advantaged groups, and to what degree can this be increased in a just manner; therefore the maximin theory has a practical policy application. Advantaged groups are likely to prefer a utilitarian approach, as this would maximize their utility compared to a maximin, or equal distribution, approach. Equal distribution or treatment is not a socially just option. To this point, Wilson (2004) notes: “There is nothing meritorious per se about similarity of treatment (that is an old mistake): justice demands that different cases be treated differently” (p. 101).

An economic efficiency perspective concludes that accessibility infrastructure alterations, such
as wheelchair ramps or Web accessibility measures, are not economically efficient because usage is low. The purpose of such infrastructure improvements is improved social mobility for a disadvantaged group in society. Without accessibility infrastructure people with disabilities are “essentially in an absorbing state of a Markov process from which they could never get out” (Chu & Liu, 2001, p. 267). Accessibility measures help to change this absorbing state for people with disabilities, which is consistent with Rawls’ concepts of equality and justice.

**Transition in Disadvantaged Context Model**

Carlo Raffo (2006) compared a standard school-to-work transition model to a school-to-work transition modeled in a disadvantaged context. He concluded that young people who are disadvantaged have difficulty accessing resources beyond a restricted, localized source. “These young people are then potentially marginalized from the new economies of the city in terms of the informal practical knowledge, understanding and skills needed to potentially access those economies, i.e., the appropriate social, cultural and human capital” (p. 91).

Raffo examined socioeconomic disadvantage, but his model of transition in a disadvantaged context also applies to people disadvantaged by a disability. He stated:

*If we are to create more equitable forms of support for disadvantaged young people, then transition policy and practice may need to investigate and then invest in those particular educational, training and transition interventions that create opportunities for enhanced social and cultural capital developments. (p. 91)*

This model helps to understand accessibility measures as an investment rather than as a cost. Accessibility measures are interventions for people with disabilities that create new opportunities for development and contribute to society.

**ALTERNATIVE COST-JUSTIFICATION AND COST-BENEFIT FRAMEWORKS**

Financial cost-benefit analysis should not be the only consideration in policy decision making. In fact, when policy impact includes non-financial outcomes, financial tools alone are inadequate. In these cases methods designed to calculate social costs and benefits, and return on investment, are more appropriate. Social impact analysis, combined with financial analysis, gives policymakers greater context and more complete information.

**Internal and External Social Return on Investment**

Wilson and Rosenbaum (2005) discussed the concepts of internal and external social return on investment (ROI). Internal social ROI is a measure of the value-added of an activity (Web accessibility in this case) based on the perceptions of internal stakeholders in an institution. Collecting this type of data is obviously difficult, and the data itself is subjective, but it is important to try because these perceptions and attitudes of stakeholders are what lead to support for policy, or not. Satisfaction surveys can be used to measure internal social ROI. Alternative metrics include tracking inquiries, requests for help or accommodations, number of funded positions with the activity in the job description, and number of members involved in the activity included in development or strategic management teams. Outreach and establishing and improving internal relationships and connections improve internal social ROI.

External social ROI involves measuring external stakeholders’ perceptions of the activity (Web accessibility), its importance, and impact.
according to different constituents. Instruments to help measure external social ROI include surveys and ethnographic interviews.

**Net Social Benefit Framework**

It is not possible to attempt WCAG compliance or to advance a Web accessibility policy without adequate resources. Understanding the importance of Web accessibility, its impact on various constituencies, and true costs and benefits, allows institutions to make better-informed decisions about Web accessibility policy.

The actors that have standing concerning Web accessibility are those that “have a right, justification, or duty to be considered within the scope of the analysis” (Steinemann, Apgar, & Brown, 2005, p. 327). Based on the perspective adopted, standing may be determined from the basis of legal rights, by identifying parties impacted by the issue, and may also be extended to include future generations. The key stakeholders for Web accessibility in distance education (the parties with standing) include students with disabilities (and their families), students without disabilities (and their families), faculty, the institution, government, and society.

Tables 1 and 2 together provide a sample framework for determining the streams of costs and benefits of Web accessibility. Applying this framework yields total net categorical benefits. This framework does not place actual values on costs and benefits, as these are specific to each institution, but categorizes and tracks the streams of costs and benefits to the parties of standing to determine the net social benefit.

**Benefits**

When all this information has been gathered, it enables an institution to evaluate policy for consistency with its goals and mission, such as equity and inclusion; also its perceived competitive advantages, such as increased enrollment, are identifiable. The immediate benefit to students

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**Table 1.**

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Students with Disabilities (and families)</th>
<th>Students without Disabilities (and families)</th>
<th>Faculty</th>
<th>Institution</th>
<th>Other Members of Society</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to more courses of study</td>
<td>+</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Additional programs and support services</td>
<td>+</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Increased earnings potential (from greater education)</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Improved instruction</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>PR value</td>
<td></td>
<td></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demonstrated commitment to mission of increased access</td>
<td></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Attract more students (revenue growth)</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Feelings of pride from communitarian involvement</td>
<td>+</td>
<td></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Net +/- Categories</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>
Web Accessibility Policy for Students with Disabilities in U.S. Postsecondary Distance Education

Table 2.

<table>
<thead>
<tr>
<th>Costs</th>
<th>Students with Disabilities (and families)</th>
<th>Students without Disabilities (and families)</th>
<th>Faculty</th>
<th>Institution</th>
<th>Other Members of Society</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel time and expense</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Personal equipment (hardware, software, peripherals, assistive technology)</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Utilities (electric, internet access)</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faculty training time</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specialized staff needed</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Institutional infra-structure and overhead</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Net +/- Categories</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Transfers

Welfare Provided Reduced

Welfare Benefits Received

Net +/- Transfers

Net Benefits – Costs

with disabilities (and their families) includes greater access to courses because they are no longer limited by geography or mobility. Future benefits include improved job prospects resulting from higher levels of education. For these students and their families, costs such as travel time and expense are reduced. Universally designed instructional material immediately benefits all students, not just those with disabilities, because various formats accommodate different learning styles.

Faculty benefit in the present and in the future because students learn more from the same amount of instruction and material when it is presented in different formats. Universally designed online materials can be used repeatedly to teach future sections of a course. There is a time and economic cost to train faculty and staff to develop accessible instructional materials. Training may have to be outsourced if the expertise is not available in-house.

Institutions with Web accessibility policies and initiatives serve distance students more cost effectively compared to campus-based services because both current and future overhead is reduced. Future benefits include growth from broadening market bases globally; avoiding penalties if legislation mandating Web accessibility is enacted in the future; enhanced institutional credibility and standing in the community; and pride from increasing equity, diversity, and inclusion of an underserved population.

If institutions comply with Web accessibility standards in advance of a legislative mandate, the government may realize a future benefit due to fewer compliance audits. A transfer is expected via reduced welfare payments to disabled people who are able to better support themselves after receiving more education, but this is offset by the loss of that benefit to the disabled person. Overall economic output occurs because of higher productivity from students who are not employed and the taxes they pay on the expanded output. For those who participate in the program, positive feelings may result from helping disadvantaged members of the community.
Costs

For students with disabilities, and their families, the immediate costs of this approach include equipment and utilities to participate in distance education courses (e.g., computer, software, Internet access, electricity, and possibly assistive technology). Students without disabilities may experience loss of funding for extracurricular activities, infrastructure improvements, and financial aid if some of these funds are diverted to Web accessibility compliance. Institutions incur the costs of institutional change, including restructuring student support services, staff development, cultural change, and infrastructure to support Web-accessible distance education. There may be a net loss to society if the net costs of providing Web accessibility are greater than the net benefits, especially if many of the benefits are future benefits that must be discounted.

TECHNOLOGY

Unless one is a Web designer, or an information technology professional, it can be difficult to understand everything involved in complying with Web accessibility guidelines. This makes the concept of Web accessibility somewhat abstract for non-technical policymakers.

High Game, Low Game

Issues that have politically and bureaucratically acceptable solutions are the ones that ultimately make it onto the agenda. The “high game”, described by Laurence Lynn (1981), involves agenda setting; the “low game” involves implementation. A solution needs to be predetermined at both the high and low levels or it will not be tackled because it may not get solved.

Web accessibility is viewed as a technical issue involving software and technology solutions, and advancing Web accessibility policy is challenging because solutions involve technology that is difficult for many policy makers to understand. This creates a situation where the high game actors cannot comprehend the low game solution, so no agenda is set. Administrators may understand the high game, but the complexity of the low game makes the issue untenable for most operations managers. Web accessibility is avoided because of the perception that it is too difficult to understand and therefore cannot be solved.

High game policymakers need to understand the overall concepts of the technology involved and the broader impact of Web accessibility barriers. Two technology issues to consider for their common use in distance education are learning management systems and multimedia.

Learning Management Systems

U.S. postsecondary institutions commonly employ learning management systems (LMSs) in distance education. LMSs are password-protected Websites that allow faculty and students to communicate and collaborate, complete coursework, post material online, submit assignments, and post feedback and grades. Therefore LMSs are also susceptible to accessibility challenges like other Websites.

Multimedia

Audio and video media are used regularly in distance education, but these formats constitute potential access barriers for students with disabilities, who may not be able to see or use multimedia content due to sensory, physical, psychological, or multiple disabilities. Of U.S. postsecondary degree-granting institutions offering distance education in 2002 many indicated plans to start or increase the number of courses using multimedia as the primary instructional delivery vehicle. Forty percent planned to start or increase the number of courses using two-way video with two-way audio (video conferencing), 23% planned to start or increase the number of courses using one-way
prerecorded video (vodcasts), and 13% planned to start or increase the number of courses using one-way audio (podcasts) (Waits & Lewis, 2003).

Multimedia use in online content should continue to increase along with the availability of greater bandwidth, and the emergence of Web 2.0 (and 3.0) technologies, because it is relatively inexpensive to create. Consequently, as multimedia use proliferates in general, and in instruction specifically, UID becomes even more critical to accessibility.

LEGAL CONTEXT

The federal government has made it clear that postsecondary institutions in the U.S. must provide “reasonable” accommodations to ensure that otherwise qualified students with disabilities have access to educational opportunities. There is no exact legal definition of “reasonable.” With advancements in technology, state and federal mandates, and improved awareness about disability, students with a wide range of disabilities are now able to participate in every institution of higher learning (Burgstahler, 2004).

The case of National Federation for the Blind (NFB) v. Target Corporation (2007) brought a claim that Target Corporation violated the ADA (42 U.S.C. § 12182), California Unruh Civil Rights Act (California Civil Code § 51), and California’s Disabled Persons Act (California Civil Code § 54.1) because its Website (Target.com) was not accessible to the blind. Federal District Court Judge Marilyn Hall Patel issued two landmark decisions in this case: first, certifying the case as a class action on behalf of all blind Internet users, and second, ordering that Websites such as Target.com must be accessible according to California law. In its decision, the court decided:

The Unruh Act and the Disabled Persons Act reached the Website as a kind of business establishment and an accommodation, advantage, facility, and privilege of a place of public accommodation, respectively. No nexus to the physical stores needed to be shown. Because the DPA (Disabled Persons Act) enumerated both physical places and non physical places, the phrase “other places to which the general public is invited” could not be limited solely to physical places. (NFB v. Target Corp, 2007)

This interpretation of a “place of public accommodation” to include non-physical spaces is a precedent and is likely to impact future decisions concerning accessibility of Websites owned and operated by private entities. If an institution is subject to physical site compliance under the ADA, according to recent legislative action and intent it should expect to be subject to non-physical site compliance as well. Legislation often lags, but eventually is revamped as needed to redress misinterpretations by the courts or misapplication in society.

When Congress passed the Americans with Disabilities Act in 1990, the Web as we know it today did not exist. The potential barriers created by poor Web design were certainly beyond the horizon of legislators and federal administrators. Thus, it is no surprise that the ADA, while mandating equal access to an institution’s resources, does not specifically address the design of Web-based information services (Schmetzke, 2001).

There are direct and indirect impacts on Web accessibility policy from legislation such as the ADA, and Section 504 of the Rehabilitation Act of 1973, and Section 508 of the Rehabilitation Act Amendments of 1998. Although current federal legislation does not explicitly require postsecondary institutions to comply with specific Web accessibility guidelines, there is the possibility of such a mandate in the future. Section 508 was amended in 1998 to require federal agencies to make electronic information accessible to people with disabilities.
Reauthorization of the ADA

The ADA Amendments Act of 2008 (ADAAA) was signed into law on September 25, 2008. It clarifies and broadens the definition of disability and expands the population eligible for protection under the ADA of 1990. The ADAAA demonstrated inadequacies in the original ADA and showed how advances in our society and our values are reflected in legislative changes. The ADAAA takes effect January 1, 2009.

The purpose of the new legislation is to increase enforcement and broaden the definition of eligible complainants under the law. It redresses earlier judicial interpretations of the ADA and resulting decisions that were not favorable to many plaintiffs who were excluded under the then-narrower interpretation of eligibility. As a result, postsecondary institutions should be aware that they may be required to provide additional accommodations unless they can prove that compliance would create an “undue burden.” After this legislation passes, it will be more difficult for an institution to claim “undue burden” when faced with accommodation requests, including Web accessibility.

International Compliance

Some nations are more progressive than the U.S. when it comes to Web accessibility. Several have implemented laws and policies designed to guarantee access to digital content for individuals with disabilities. For instance, the United Kingdom has extended the requirement for Web accessibility into the private sector. The UK Parliament enacted the Disability Discrimination Act (DDA) in 1995, which, like the ADA, does not specifically mention Web accessibility. Technically, Web accessibility falls under Section III (the requirement to make “reasonable adjustments” for persons with disabilities). Although the DDA does not specify Web accessibility, the supporting materials (the Code of Practice) specifically mention it. The standards document for this policy was published March 2006. Rowland & Margier (2007) found, “In the wake of their formal report, the DDA issued a warning that organizations will face legal action the possibility of paying out unlimited compensation if they fail to make their Websites accessible for people with disabilities”

Several other countries have detailed policies concerning Web accessibility, including Australia’s Disability Discrimination Act (1992), which applies to education, and Canada’s “Common Look and Feel” for Canadian government Websites, which includes accessibility provisions (Barstow, McKelly, Rothberg, & Schmidt, 2002).

RECOMMENDATIONS

Web accessibility is not an all-or-nothing proposition, but it can be improved by progressive steps. Institutions without experience, or with limited resources, can start with the basics, or what Tom Brink (2005) calls the “low hanging fruit” level of accessibility. This level can be achieved from good, basic Web design that includes descriptive text for images, scalable font sizes, and visual color contrast. As institutions ramp up, they can set policy to advance to the next level of standards and guidelines compliance, then universal accessibility focused on ease of use, and finally to the optimized accessibility level where the Website works very well for most users. It should be noted, however, that with each level comes increased cost, technical complexity, and greater management.

U.S. postsecondary institutions are advised to implement Web accessibility policy even in the absence of a legislative mandate to do so. Creating a policy that emphasizes social benefits and is tied to the mission of increased access (if applicable) or to other appropriate social justice values such as equity, inclusion, and nondiscrimination, communicates a positive message to the entire community that the institution is progressive and dedicated to these core values.
Web accessibility policy minimizes legal risk, and can reduce costs since it is planned. Institutions can track (among others) time, training, wages, and equipment to determine the true cost of accessibility. However, it is important not to focus solely on financial cost because this leaves out important social benefits that need to be considered. Calculating social ROI and net social benefit is also needed because it captures what financial analysis alone cannot.

Selecting and citing guidelines in Web accessibility policy, such as WCAG 2.0 and Section 508 Guidelines for Web Accessibility, sets a clear direction for Web designers and technologists to follow (the “how”). Stating over-arching principles, such as UID, provides the framework and goal for the policy (the “why”). Since Web accessibility offers benefits to all users, not just those with disabilities, there is strong incentive to move in this direction. It may not be possible for all institutions to start from this point, but it is a worthwhile and achievable goal for many.

FUTURE CONSIDERATIONS

Globalization in Higher Education

Globalization in higher education results in opportunities for private and public partnerships and collaboration. International students may or may not travel to attend a course or a program, so distance education provides opportunities to serve international students. Standardization is necessary in order to deliver consistent instructional quality, especially across different cultures and languages. UID is one way to standardize distance education materials, which benefits a diverse population that includes international students and students with disabilities.

U.S. postsecondary institutions with a global vision can use Web accessibility policy to support multiple student constituencies. Today, postsecondary students and their families are more savvy consumers of education, which means increasing competition for enrollments. Institutions should be concerned with the quality of their educational experience and support the full range of services, which will help create competitive advantages. UID supports academic success for all students and is a quality differentiator when undertaking institutional marketing.

Future Legislation

Legislative intent seems clear: the bar is higher. The reauthorization of the ADA, and the NFB v. Target case are signals to private entities that there are stronger expectation that accommodations will be made, including better Web accessibility. In the future it will be more difficult to claim that such accommodations are an undue burden. The message is strong, that society sees equity and inclusion as high priorities. It is doubtful that this direction will reverse, and institutions should plan and prepare for how to meet this expectation and comply with potential legislative mandates.

The implications of the ADAAA, especially its broader definition of disability, are that employers must change their policies to provide reasonable accommodations and prevent discrimination against employees with disabilities. The legal definition of disability has been changed, and the original and fundamental spirit of the ADA has been reinforced. The burden of proof has shifted: it is not just the person with a disability who must prove discrimination, but also the employer who must demonstrate proof of reasonable accommodations and an effort to prevent discrimination.

Institutions that institute Web accessibility policy are in the best and strongest position if a legal mandate is enacted. If such a mandate occurs, institutions that have already begun the planning and implementation process will be ahead of the curve and will likely incur lower costs. As Burgstahler (2003) notes:
Both internal and external forces can pressure postsecondary institutions to be more inclusive of students with disabilities. External forces of change include a global, technological, and information based economy; legislation; and societal pressure toward a pluralistic society with equity for underrepresented groups. Internal forces include pressure from students with diverse characteristics (e.g., age, gender, ethnicity, culture, disability, part time status) and faculty who seek a more inclusive environment. (p. 34)

CONCLUSION

The nature of education has changed for non-traditional students, but policies and programs have not kept pace with this change. Growth in distance education, as well as technological changes, have created many more possibilities for non-traditional students, including students with disabilities. Institutions offering distance education need to assess their Web accessibility environment, identify risks, determine the level of institutional commitment, define the importance of this mission, and implement an appropriate allocation of resources.

People with disabilities face barriers to distance education. Why should these barriers be removed? Applying a communitarian perspective helps explain why assisting people with disabilities actually helps us all. Rawls’ distributive justice theory, the social model of disability, and similar social, theoretical, and socioeconomic perspectives (e.g., Raffo) are tools that explain why it is important, socially just, and economically rational to implement Web accessibility measures.

Competing perspectives, such as economic efficiency, must be addressed and countered. Economic efficiency cannot be the sole basis for making decisions about disability policy because applying this perspective most often results in decisions against accessibility measures based on the relatively small percentage of people who will benefit when this paradigm is applied. In fact, Web accessibility policy can be an effective way to minimize both risk and total cost to an institution.

Solutions for eliminating accessibility barriers also need to be identified, explained, and implemented. Universal design is one solution that can be framed differently at the agenda setting and operational levels by applying a macro view (strategic perspective) during the high game, and a micro view (tactical perspective) during the low game.

Web accessibility is an extension of the greater mission and commitment to basic human rights, equal access, and nondiscrimination. These principles are widely accepted and consistent with the educational mission of many institutions of higher education. In order for any policy to be adopted, it must reach the agenda and receive high level support. Involving all parties with standing in the decision-making process is important. Burgstahler (2003) sums it up well: “To create a campus environment that provides equal educational opportunities for all students, including those with disabilities, it is important that administrators develop policies and procedures be developed in collaboration with faculty, student service providers, and students with disabilities.” (p. 34)

REFERENCES


**KEY TERMS AND DEFINITIONS**

**Accommodation:** Something supplied for convenience or to satisfy a need (Merriam-Webster Online Dictionary, 2009)

**ADA:** Americans with Disabilities Act.

**ADAAA:** Americans with Disabilities Act Amendments Act of 2008.

**Assistive Technology:** devices (software or hardware) that help people with disabilities use computers and information technology. Also called adaptive technology.

**Communitarian:** Of or relating to social organization in small cooperative partially collectivist communities. communitarian (Merriam-Webster Online Dictionary, 2009)


**DDA:** Disability Discrimination Act, enacted by the U.K. Parliament in 1995

**Distance Education:** Teaching and learning involving accessing information, communicating, collaborating, and completing course work online. Students and instructors are remotely located to each other and may communicate asynchronously, synchronously (in real-time), or by a combination. Also called distance learning

**Models of Disability:** Various models of disability are frameworks applied to understand and help classify disabilities and can also be used to determine service level provisions. These include The Medical Model, The Charity Model, The Administrative Model, The Social Model, and the Service Provision Model

**Postsecondary:** The provision of a formal instructional program whose curriculum is designed primarily for students who are beyond the compulsory age for high school. This includes programs whose purpose is academic, vocational, and continuing professional education, and excludes avocational and adult basic education programs. (National Center for Education Statistics, 2009)

**Section 508 Guidelines for Web Accessibility:** Section 508 requires that Federal agencies’ electronic and information technology is accessible to people with disabilities.

**Universal Design:** The process of creating products (devices, environments, systems, and processes), which are usable by people with the widest possible range of abilities, operating within the widest possible range of situations (environments, conditions, and circumstances). Universal design has two major components, first, designing products so they are flexible enough that they can be directly used (without requiring any assistive technologies or modifications) by people with...
the widest range of abilities and circumstances as is commercially practical given current materials, technologies, and knowledge and, second, designing products so they are compatible with the assistive technologies that might be used by those who cannot efficiently access and use the products directly (Trace Center, 1996)

**Universal Instructional Design**: A method of designing course materials, content, and instruction to benefit all learning styles. The principles of Universal Instructional Design promote equal access to learning for students from a variety of backgrounds, abilities, and learning styles. Similar to Universal Design and Universal Design of Instruction for Learning (UDI)


**Web Accessibility**: According to the World Wide Web Consortium (W3C) Web accessibility means that people with disabilities can use the Web. More specifically, it means that people with disabilities can perceive, understand, navigate, and interact with the Web, and they can contribute to the Web. Web accessibility also benefits others, including older people with changing abilities due to aging (World Wide Web Consortium, 2009)
Chapter 23

Pulse!!: Designing Medical Learning in Virtual Reality

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ABSTRACT

Pulse!! The Virtual Clinical Learning Lab is designed to transfer and further develop state-of-the-art game design and technology to create subject matter for teaching critical thinking skills in experiential medical learning in virtual reality. The underlying design principles of Pulse!! include real-time feedback, repetitive practice, controlled environment, individualized learning, defined outcomes and educational validity. Pulse!! development incorporated evaluation issues early in the design cycle. The Pulse!! evaluation process ensures that the learning platform meets standards as rigorous as that required by military simulation systems and educational accrediting bodies. The Pulse!! method of case and technology development indicates that virtual-world educational platforms must be not only user-friendly, visually effective, interactively immersive and fluid but also procedurally rooted in curriculum, rich in readily-accessible information and cognizant of actual practice in the real world.

INTRODUCTION

Pulse!! The Virtual Clinical Learning Lab is a research project designed to transfer and further develop state-of-the-art game design and technology to create subject matter for clinical medical learning in virtual reality. Pulse!! is a high-tech response to a coalescing host of adverse factors compelling innovative means to provide clinical experience and practical knowledge rooted in critical thinking, not only for degree-based education but also continuing education for medical practitioners. Pulse!! problem-based case scenarios are designed for degree-based education and post-degree certification, as well as continuing education and training for health-care professionals that is pedagogically
structured for deep and rapid experience-based learning.

The underlying design principles of Pulse!! include immediate feedback, repetitive practice, controlled environment, individualized learning, defined outcomes and educational validity. An important feature of the Pulse!! development strategy incorporates evaluation issues early in the design cycle. This iterative approach begins with usability analyses and proceeds to incorporate learner reactions, cognitive change, behavior and transfer of knowledge. To this end, Pulse!! field research began with beta testing of the learning platform in medical-education institutions to establish the system’s functionality and usability. This chapter focuses on whether the apparatus and conventions of this new paradigm in medical education can be made into an effective tool that is generally acceptable to those who undergo medical training.

BACKGROUND

Pulse!! originated as a research project to determine whether sophisticated medical learning could be achieved in virtual space created by cutting-edge videogame technologies. The platform must prove itself valid and reliable according to the highest academic standards; otherwise, the medical profession will justifiably bypass virtual-world technologies as viable media for experiential learning in critical thinking and differential diagnosis.

The Crises and the Research

The need for low-cost, portable educational media for medical education is driven by a host of contemporary factors, including but not limited to:

- Deaths due to medical error estimated between 44,000 and 98,000 annually with related costs estimated at $17 billion to $29 billion, according to the Institute of Medicine (Kohn, Corrigan & Donaldson, 1999, pp. 1-2);
- Baby-boom retirements from academic faculties and other demographic factors, which are creating looming shortages of medical personnel, especially physicians and nurses (Rasch, 2006, pp. 29-35);
- Shorter hospital stays and medical residents’ workweeks, which are reducing clinical training opportunities and expertise development (e.g., Verrier, 2004, p. 1237);
- Continuously changing warfare and terrorist technology and methods, which drive a need for rapid deployment of training for continuously evolving medical treatment (Zimet, 2003, ¶40);
- Two-thirds of battlefield fatalities from potentially survivable injuries that might have been prevented with through more effective training of U.S. armed forces’ Tactical Combat Casualty Care (TCCC) guidelines (Holcombe, et al., 2006, p. 36).

Responding to the Institute of Medicine report, a partnership of the National Academy of Engineering and the Institute of Medicine formed to conduct a study of health-care mistakes and to identify future remedies. The report concludes that the U.S. health-care industry neglected engineering strategies and technologies that have revolutionized quality, productivity, and performance in many other industries and calls for an array of powerful new tools in medicine (Reid et al., 2005, p. 1). Virtual-world simulations are among technologies being explored for use in various formats. The Pulse!! project posits that these technologies are a means of an inevitable paradigm shift in health-care education.

Entertainment has been the main use of virtual reality, but virtual-world training in various formats – the field of “serious games” – also has been explored. In the academy, there has been incidental development of human-simulation trainers
anchored to computer-assisted case presentations for surgeons, U.S. Army combat medics and electronic role-playing games aimed at clinical soft-skills education. The military originally developed the state-of-the-art America’s Army online war game for recruitment, using the “first-person shooter” videogame genre. The U.S. Military Academy successfully used a version of the game to test the effectiveness of new computer-based, interactive curricula for several levels of map reading and land navigation (Farrell, 2003, p. 5). “The result is excited and motivated cadets who take ownership of their military development, in terms of what they study, when they study it, and how both cadets and instructors receive feedback on performance” (p. 1).

Issenberg et al (2005) conclude “that high-fidelity medical simulations facilitate medical learning under the right conditions” (p. 3). The “right conditions” noted by Issenberg ratify the underlying principles of the Pulse!! learning platform development, including immediate feedback, repetitive practice, controlled environment, individualized learning, defined outcomes and educational validity (p. 26). This first comprehensive review of 34 years of research on the efficacy of simulation in medical training found that “high-fidelity medical simulations are educationally effective and simulation-based education complements education in patient care settings” (p. 4).

Issenberg notes that the medical community’s increasing interest in simulation and virtual reality is driven in part by “the pressures of managed care” that lead to fewer clinical opportunities for medical learners, including practicing physicians constrained by shrinking financial resources to spend less time keeping abreast of developing medical topics. A 1997 study by Mangione and Nieman found a decline in bedside acumen and urged “the use of simulation systems for training,” according to Issenberg (p. 8).

Watters et al (2006) propose that substantial learning occurs through what has become standard entertainment-game architecture, including instantaneous feedback, a rising scaffold of challenges, visible goal indicators, personalization and customization, fluidity and contextual grounding. Watters and Duffy (2004) propose “a framework of motivational constructs” found in games that are applicable in developing interactive health-related software: self-regulation, or autonomy; relatedness that includes role-playing, narrative and personalization; and competency, or self-efficacy built upon completion of meaningful tasks.

Reznick and MacRae (2006) observe that well-established learning theory (Fitts & Posner, 1967), as it applies to surgical training, ratifies the use of simulators in the acquisition of motor skills through three stages – cognitive, integrative and autonomous. Ericsson (1997) applied a thicker description directly to surgical training with the concept of “deliberate practice,” defined in Reznick & MacRae as “repeated practice along with coaching and immediate feedback on performance” (p. 2665). Simulation and virtual reality appear to be options for medical learning as rare opportunities for deliberate practice become more so. Reznick and MacRae note: “A Food and Drug Administration panel recently recommended the use of virtual reality simulation as an integral component of a training package for carotid artery stenting” (p. 2667).

No project so far has created a high-fidelity, persistent-world platform with a template and process providing ease of use in authoring and assembling training and educational content. Lack of such a system prevents creation of complete end-to-end solutions for distance health education. While professionals will still need to demonstrate clinical thinking and skills in an actual clinical environment, Pulse!! provides a pathway to shorten time spent in a live environment. This will save money and reduce errors in the real world.
Addressing the Issues

As a virtual-reality learning platform, Pulse!! addresses the following issues in military and civilian health-care education and training.

• Flexibility, timeliness and economy: Medical education in virtual reality will stimulate a paradigm shift in clinical education and treatment that is not possible with live training. Learning from “trial and error” will move to a new level with assured safety and increased timeliness for actual development and easy deployment. For professionals in need of cross-training into new environments or post-graduation practice, this system will provide rapid, experience-based, just-in-time learning and updated specialization.

• Portability, adaptability, reliability and consistency: This system will allow for rapid development of fully-immersive training for relevant health-care professionals to provide training that is appropriate, realistic and experiential. For example, this system will provide the reserve military with a means for creating applications that allow for the verification, validation and accreditation training on field procedures in a just-in-time fashion before or after deployment. Scheduled live training, with its required logistics, costs and time frames make these training exercises error-ridden, fragmented and inconsistent.

• Independent, marketable learning: Caregivers require an environment to learn and practice treatments with dynamic feedback, resulting in rapidly-acquired competencies. Virtual simulations create opportunities to rehearse, replay and sharpen the critical skills needed in events such as bioterrorism, and from new patterns of complex injuries.

• Efficiency and future application: There exists a dual problem in career counseling and recruitment. Pulse!! will hasten recruitment by immersing prospective career applicants in a high-fidelity virtual environment that simulates specific skills and situations for various health-care professionals. This system enable a significant upgrade in the future quality of health professions in the nation and in the world.

The Center for Virtual Medical Education

The Texas A&M University System has created a Center for Virtual Medical Education at Texas A&M University-Corpus Christi with Pulse!! as its signature project.

The center has been created to provide cross-disciplinary expertise and resources to educational, governmental and business entities engaged in meeting looming health-care crises with three-dimensional virtual learning platforms that are iterative, providing unlimited, repeatable clinical experience without risk to patients; portable, for training anywhere there is a computer; asynchronous, for training anytime; and immersive, providing first-person experience leading to critical thinking and practical knowledge. Center products will be grounded in research and equipped with tools and generators that enable clients to author their own cases and create their own scenarios within a variety of virtual environments. The Pulse!! platform is being rigorously researched and tested extensively for reliability and validity, which will yield a product for delivering curricula with confidence for medical and other health professions. New products will be created on that sound foundation.

Virtual medical education research will be continuous at the center with further refinement and development of the Pulse!! platform, including voice-recognition technology and further research.
in how to replicate true-to-life physiological and patho-physiological states in three-dimensional virtual space. The center also will develop an entrepreneurial dimension through collaboration with other entities engaged in developing virtual medical education platforms, which in turn will generate revenue for the center’s continuing support.

The center is expected to become a pool of resources for medical training, professional certification and credentialing, professional development and graduate medical education. By their very nature, center products will produce efficiencies of operations and economies of scale as a source and distribution point for clinical training materials transmitted electronically anywhere in the world.

The field of medical simulation is expected to provide a virtually inexhaustible array of projects for the center. Pulse!! fundamental technology – its proprietary engines and features – has almost limitless applications, and its continued development will keep the Pulse!! learning platform at the cutting edge of development.

The Pulse!! project has created a unique development interface between academe and a growing sector of videogame industry – the so-called “serious games” sector – and has resulted in a licensing agreement for its private-sector partner, BreakAway Ltd. of Hunt Valley, Md.

The Pulse!! Platform

The Pulse!! learning platform looks and acts like a videogame. Users navigate the platform’s three-dimensional space using a standard computer “mouse” and keyboard in a manner familiar to videogame players. The virtual space is totally navigable: Users can “walk around” within it and “look” at its various features. The original virtual environment replicates in detail the intensive care unit of a major military hospital.

Users interact with a high-fidelity virtual patient and with other virtual medical personnel to conduct examinations, order tests and administer medication. The “patient” is modeled to respond accordingly in real time.

Two core engines drive the Pulse!! platform – the simulation engine for patient traits and environmental reaction (SEPTER) and the visual interface and scaffolding for total acuity (VISTA). Additional engines provide rules, customization and case authoring. A scene editor assembles physical objects in the virtual learning environment. Intelligent tutoring by the learning platform provides feedback and direction. Layered together, these complex core engines generate a virtual world that is persistent and capable of dynamic change to reflect new medical knowledge.

Pulse!! compiles a database for medical education, training and continuing education based on medical lessons learned. As the database becomes more sophisticated – broader in scope and deeper in immersive description – its usefulness as an educational/training tool addresses complex issues of military and civilian medical care across the education/training continuum; e.g., fewer military physicians and paramedical personnel will be seeing their first clinical battlefield cases in-theater, as most will have had broad, immersive virtual-world training to supplement traditional didactic curricula.

Pulse!! medical cases are generated by cadres of subject matter experts. The first set of cases simulate multiple types of shock resulting from an improvised explosive device (IED) and began rigorous beta testing and evaluation in 2007 by the medical communities at Yale University School of Medicine, The Johns Hopkins School of Medicine and the National Naval Medical Center. Usability and training effectiveness were measured in 2007. Transfer of training and knowledge acquisition with educational outcomes will be assessed in 2008.
THE EVALUATION PROCESS

The Pulse!! evaluation process ensures that the learning platform meets standards as rigorous as that required by military simulation systems. Evaluation is guided by the Accreditation Council for Graduate Medical Education standards (ACGME) and military guidelines for Pre-hospital Trauma Life Support (PTLS) and Tactical Combat Casualty Care (TCCC). Pulse!! training for each protocol tests core competencies by demonstrating that the learner knows, knows how, shows how, and does.

Purposes of Evaluation in Training

Training evaluation can serve multiple goals, and the nature of data collected and conclusions drawn from evaluation activities are related to the particular goal at hand. For example, training evaluation may be conducted to:

- Determine whether training (learning) objectives are being met;
- Assess the efficiency and cost effectiveness of training;
- Validate new training content;
- Determine whether training methods are effective/optimal;
- Evaluate instructor/trainer effectiveness;
- Assess a trainee’s readiness for training;
- Provide a basis for instructional decisions: feedback, remediation, lesson progression;
- Determine a trainee’s readiness for the job (certification);
- Assess the impact of training on overall organizational outcomes;
- Determine whether other training-related goals are being met: trainee development and progression, trainee self-efficacy and confidence.

Any one or a combination of these purposes can motivate a training evaluation. Hence the strategies, measures, data collection methods and resulting conclusions involved in a training evaluation can vary widely according to its purpose and goals. Effective evaluations are those that make their goals explicit, and are planned early and so that measurement activities can be specified in advance. Another distinction common in evaluation is whether the purpose of the evaluation is summative or formative. Formative evaluation collects effectiveness data as the system or program is being developed as a means of providing feedback into the design process, which provides iterative corrections. Summative evaluation collects data indicating the overall effectiveness of the program or intervention by assessing outcomes.

Our goals for the evaluation of Pulse!! are multifaceted, employing both formative and summative components. Our overarching goal, and a summative goal, is to demonstrate that simulation-based gaming is an effective method for teaching shock trauma and related skills in medical personnel. The bulk of evaluation activities we are planning feed directly or indirectly into this goal. Beyond this, we are also interested in using early evaluation results to inform subsequent design (a formative goal); determining how best to provide feedback, remediation and lesson progression within the game (a formative goal) and how the system might be used to augment certification classes/exams (a summative goal). We also would like to assess the impact of training on overall organizational outcomes, such as reduced error and better operational performance (a summative goal).

The Measurement Challenge

Training evaluation is a difficult process that requires extensive planning and commitment of resources. There are many variables that can affect the success of a training program, including design of the program itself as well as the way it is implemented. Our focus in this chapter concerns mainly the former, as implementation of the Pulse!! system is not planned until later phases of effort.
Hence we are primarily concerned with how well the system is designed and whether it has the potential to achieve desired learning outcomes.

Given the focus of Pulse!! to train complex medical decision-making and procedures, a well-conceived evaluation plan must address issues associated with measuring higher-order skills that manifest themselves in complex environments. Measuring learning is difficult in such settings because such environments typically involve:

- Complex, multi-component decisions: rapidly evolving, ambiguous scenarios, information overload;
- Severe time pressure;
- Severe consequences for error;
- Adverse physical conditions;
- Performance pressure;
- Sustained operations/fatigue;
- Distributed, multi-operator (team) problems.

These characteristics complicate measurement for several reasons. First, there is often no “right” answer; i.e., performance may proceed down different paths before arriving at a correct decision. Moreover, the specifics of the case used in training will never be identical to the actual episodes that occur in real practice. For this reason, the emphasis on training must be to teach sound, generalizable processes and strategies, so trainees are able to recognize and adapt them to novel situations they may encounter.

A second measurement challenge in complex environments is to track ongoing performance meaningfully. In many cases, actions and events occur so rapidly that simply keeping track and making sense of the trainees’ behavior is a challenge. In a system like Pulse!!, the opportunity exists to automatically record performance as trainees interact with the system. The mechanisms for accomplishing this must be well designed and coupled tightly to the measurement strategy. Related to this, a full picture of ongoing performance requires that many sources and types of data are recorded and interpreted; e.g., the state of the patient model when the action is taken. In addition, such interpretation must be accomplished quickly if it is to provide a basis for continuous feedback.

A final difficulty in measuring complex performance is related to the nature of decision-making and other higher order skills that need to be trained. Specifically, it is often difficult to discern a trainee’s knowledge state based solely on observable performance. Simply put, much of the important processing happens in the trainee’s head and is not easily available for inspection or evaluation. Hence, strategies must be developed that help to infer a trainee’s state of mastery based on observed actions. In some cases, carefully designed triggers can be embedded into the game to elicit a particular action or response. The nature of the response can then be used to indicate knowledge state.

Taken together, these challenges contribute to the difficulty of evaluating the impact of a training program that targets higher-order skills. However, the use of simulation-based games provides unique opportunities that may actually foster the evaluation process. For example, as noted, performance tracking is relatively easy in a game-based format since trainees’ actions and corresponding system states can be automatically recorded. In the case of Pulse!!, it will also be possible to anticipate and incorporate measurement and evaluation concerns in the initial conception and design of the game, since we are addressing evaluation issues early in the project’s life cycle.

**Evaluating Training Effectiveness**

As noted, our goal is to implement a comprehensive, multi-component approach to evaluating Pulse!! Hence we are crafting a plan that spans a variety of system design and training issues. These involve the following.
Assess the Soundness of System Design

This includes a variety of evaluation questions that are required to ensure that the system is developed as planned and can be easily used by trainees. Among the concerns here are: determining whether the underlying physiological models are valid, and whether they interact with one another in a realistic way; comparing actual system functionality to design specifications to ensure that it performs as intended; and ensuring that basic usability issues are resolved. This latter category involves both an expert review to ensure that usability standards are being met, and collection of empirical data demonstrating that the system and tutorials are easy to use.

Assess the System’s Incorporation of Sound Learning Features

Using the extant literature into the science of learning, synthetic experience, game-based learning and scenario-based training as a guide, this part of the plan determines whether the system embodies sound learning strategies and features. These include:

- Specific, measurable learning objectives;
- Appropriate scenario design, including trigger events;
- Sound instructional strategies/elements;
- Accurate performance assessment and data recording strategies;
- Sound diagnosis routines and models;
- Appropriate feedback and AAR strategies.

Establish Training Effectiveness

We advocate a modified version of Kirkpatrick’s (1976) hierarchy. This model is used extensively throughout industry and the military. It includes the following elements.

Pre-training Assessment

Determine the degree to which the trainee is prepared to benefit from the training. Research has shown that trainees who lack the cognitive or affective prerequisites for training do not perform as well as trainees who are better prepared (Tannenbaum et al, 1991). Some of these prerequisites include: Aptitudes such as cognitive and physical ability; prior knowledge and experience; and attitudes such as the motivation to train and the instrumentality of training. Assessing readiness for training is valuable because it can indicate whether a trainee needs remedial attention prior to entering training or how training might be tailored to the his or her specific needs; e.g., by starting with less-challenging scenarios.

Reactions/Motivation

Reaction measures are the most common method of measuring training effectiveness but not necessarily the most informative. Reactions typically take the form of a “did you like it?” survey at the completion of training. While this is a relatively cheap and easy measurement strategy, research has shown that simple reaction measures are not necessarily correlated with actual learning. This does not mean that motivation is unimportant, only that reaction measures, by themselves, are insufficient. In addition, reactions that involve trainees’ beliefs about the value or utility of training have been shown to predict performance better than purely affective reactions. Hence, measuring reactions is recommended in this project.

Learning

For our purposes, learning can be defined as permanent cognitive change. Learning is the second most popular training effectiveness measure, and is typically assessed by paper and pencil tests. However, particularly when dealing with higher-order skills, recognition or recall tests are not sufficient to capture whether appropriate learning has occurred. In fact, evidence suggests that the way experts organize knowledge may
be crucial to task performance. Recent work into mental model development and measurement has yielded several candidate strategies for assessing knowledge organization in this project.

**Training Behavior**

Even when trainees know how to perform a task, it does not necessarily mean that they have developed the skills to actually do it. “Training behavior” in this model refers to the extent to which the trainee can demonstrate mastery of crucial skills. Behavior is more difficult to measure than learning because it usually involves a concrete demonstration of skill mastery, which is not amenable to written tests. Instead, training behavior is typically measured through work sample tests or simulations. In the current case, the nature of the learning system being built is such that this kind of assessment can be done relatively easily by preparing several test scenarios that contain no hints, feedback or other performance enhancing features.

**Transfer of Training**

Transfer of training is a complex phenomenon that encompasses a variety of factors (e.g., see Baldwin & Ford, 1988). A consistent finding from past work indicates that even when trainees have mastered the competencies for effective performance, it does not necessarily mean they will use those skills in practice. For example, supervisor support has been found to be related to the degree of transfer of learning to the job (Cromwell & Kolb, 2004); many other such factors exist. These findings complicate the assessment of transfer because it is often not clear why trainees fail to transfer what they learned; i.e., it could be because the training was inadequate or due to some other environmental factor. The best strategy to overcome these challenges is to collect data from different sources (supervisors, peers, archival records) and augment quantitative measures with surveys to determine if barriers to performance exist in the operational setting.

**Organizational Results**

The final level in Kirkpatrick’s hierarchy involves determining whether the organization’s goals were served due to training. It poses questions such as: “Did we solve the initial problem?” and “Did training help us achieve our goals?” The types of measures that organizations are typically concerned about include safety, productivity, reduced costs, reduction of errors, quality/quantity of performance, profit, job satisfaction, personal growth and the like. However, the link between any given training program and these outcomes is often weak. It is unclear whether results can or should be measured in this program.

**USER-CENTERED DESIGN AND UsABILITY**

Developers of serious games are confronted with significant challenges as they try to create useful, usable products. There is very little design guidance regarding game usability in general (Federoff, 2002; Song & Lee, 2007). There is even less guidance regarding the design of educational or other “serious” games (Virvou & Katsionis, 2008). However, the existing data do demonstrate that these games often suffer from usability issues that may limit their effectiveness as training tools (Panesse & Carlesi, 2007), so a user-centered design approach is important in the development of this type of software.

In developing Pulse!!, we attempted to follow a user-centered design process similar to that used in other software development approaches (cf. Gould, 1987; Norman & Draper, 1986). In the following sections, we will describe some of the lessons learned from this process and how we incorporated them into the Pulse!! platform.
Design for a Range of Users

Although one might assume that today’s young medical professionals are computer-savvy and have lots of game experience, our investigations indicate that this is almost certainly not true. In fact, users were almost as likely to be complete novices in gaming as they were to be avid gamers. It became important to not assume that learners using Pulse!! would know how to navigate in the virtual environment. Navigation aids, cues, and hints were frequently added to help novices. Rollovers indicating active elements seemed to be helpful in assisting players to choose their interactions. A tutorial was developed to assist beginning game players in using the interface. (See below.)

Use Fidelity to Create Affordances

Although it has been argued that high levels of visual fidelity are not always required in learning systems (e.g., Bowers, Rhodenizer & Salas, 1997), there are certainly some instances where an investment in fidelity can have a high pay off. The Pulse!! platform seemed to present such an opportunity. Because health-care professionals have high levels of knowledge regarding various types of equipment, high-fidelity recreation of these items seemed to create an “affordance”; i.e., the cue is so salient that users know what to do without instruction. For example, a ventilator in the platform was so faithfully recreated that doctors were immediately able to change oxygen saturation without training on a less intuitive interface. Because we anticipated having relatively little time for the tutorial, this seemed to be a good investment.

Time Matters

Pulse!! subject-matter experts emphasized the importance of representing time correctly in the game. Consequently, we were confronted with the problem of communicating the amount of time a procedure such as a CT scan would take, without actually making the learner wait that amount of time. We attempted to solve this problem by presenting a platform clock at the top of the display. A procedure requiring a lengthy delay initiates a “cut scene” in which the procedure begins and the screen fades to black. The screen then returns to its normal state, and the clock has advanced by the amount of time suggested by our experts.

Use Story to Communicate Context

An interesting aspect of our user analysis was the degree to which medical decision-making relies on a variety of contextual variables. Rather than simply present these as a list of textual information, it was decided to imbed the information into cinematic scenes at the beginning of training scenarios. It was believed that these narrative presentations would help create a sense of “presence,” which is believed, in turn, to lead to better training outcomes (Vora et al, 2002).

Usability Analyses

Although a user-centered design approach can be useful in informing design, there is still a need to do a detailed series of usability analyses. The goal of these analyses was to identify design shortcomings that might have reduced the training effectiveness of the platform. Once identified, these elements could be improved in subsequent iterations of the software. These many individual design recommendations can be clustered into the categories that follow.

Interface Issues

In general, learners worked with interface elements with little trouble. One aspect that was mildly troublesome was interaction with non-player characters. Although experienced gamers are used to interacting with these “NPCs,” most
players did not infer that they could ask the NPCs to perform tasks. This was solved effectively by adding visual cues to the game display.

Another important lesson learned was that faithfully modeling “real life” occasionally led to interface confusion. For example, the original interface required participants to purposefully move a stethoscope over each quadrant of the chest or abdomen because that was a common process discussed in our task analyses. However, participants often found the need to move the mouse over each quadrant annoying and suggested that one click be sufficient to start a process of listening to all quadrants.

Navigation Issues

One lesson learned is that hospital rooms are difficult navigational challenges for computer game environments. In real life, health-care professionals navigate around equipment and each other with little difficulty. However, this clearly did not translate well into the simulated environment. Faithful placement of items in the room is probably too much fidelity; rather, it might be more useful to increase the size of the virtual room to something larger than the actual room. It is probably also appropriate to place objects in the virtual room such that they maximize navigability rather than fidelity. Alternatively, it is possible to address this challenge by allowing ample practice time for participants. By providing practice, trainees may be able to master navigation so that it is no longer an issue.

Finally, game developers need to attend to navigation issues between characters. In real life, workers rarely physically run into one another or fail to yield. However, this behavior remains common in most computer games, leading to frustration in users trying to move quickly. Although this is a limitation of the current development platforms, it can be averted through thoughtful design of the virtual environment. Pulse!! programmers are working on improving collision algorithms.

Information Issues

Being a health-care provider is a task of managing information. Although this was a point that was heard loud and clear in our user-centered design process, it still proved challenging to provide health-care providers with all of the information they needed to be effective in the platform. This is further complicated by the difference in forms, protocols and displays from hospital to hospital. In general, we learned that more information is typically better. When choosing between forms to use as a model for inclusion in the platform, the most inclusive form is typically the right answer. Further, it is important to replace the corporate knowledge that would exist in an actual treatment room. For example, in real life, doctors could probably quickly get the blood pressure simply by asking. They could obtain this information while continuing to do other tasks. Although this information was available in original iterations of the game, it required stopping a task to retrieve it. Based on user feedback, it might be advisable to make some of the critical information constantly and effortlessly available by displaying it in the background.

It should also be noted that embedding information in cinematic scenes met with mixed success. Although participants were generally pleased with the scenes, several did not appreciate their importance, so that they missed critical information presented in these scenes. Consequently, there is a need to explore other techniques for presenting these data in a way that is engaging and salient.

The Tutorial

The Pulse!! tutorial grew through several phases in tandem with preparation for preliminary testing. A printed users’ manual was drafted by the industry contractor, but researchers concluded that it would be inadequate across a broad spectrum of study participants. Consistent with user-centered design principles, researchers opted for an interactive,
in-platform tutorial to introduce basic functional concepts and actually bring participants into the platform itself before they encountered a virtual clinical case. Due to insufficient time to develop such a tutorial prior to scheduled testing at Yale and Bethesda, researchers developed and produced a battery of videos that would show rather than tell participants how to navigate and interact with the Pulse!! platform. Six segments totaling more than 27 minutes proved cumbersome though somewhat more effective than the printed manual. By comparison, the in-platform tutorial in place for tests at Johns Hopkins can be completed in far less than half the time with the added dimension of interactivity.

The in-platform tutorial appears as a menu item on the Pulse!! opening screen. Instructions are given orally by voiceover, which is cued to resume when a procedure has been properly executed. Basic training includes movement within the virtual space, interaction with other figures in the virtual treatment room, interaction with the virtual patient and various diagnostic equipment, how to order tests and procedures and how to retrieve those results. The tutorial may be repeated without limit.

Conventions of movement and menu-driven interaction are familiar to participants who have used various types of personal-computer based videogames. Simple keyboard/mouse conventions make Pulse!! a two-handed platform for navigating in the virtual-world environment, but a mostly mouse-driven platform for interaction with virtual personnel and equipment. For certain procedures, such as stethoscope examination, the platform becomes demonstrative rather than interactive, showing how a procedure is done rather than allowing users freedom of movement.

The relatively brief, in-platform tutorial is key to users’ success in the virtual learning space created by Pulse!!

Summary

Overall, we are confident that the user-centered design approach taken in the creation of Pulse!! was successful. By forming a multidisciplinary team and incorporating subject-matter experts as design partners, even early versions of the software received positive user reviews. Through careful application of usability analysis, we were able to identify critical design shortcomings early in the development process and to create solutions that could be incorporated into later versions. The result is a product that now seems usable for a wide variety of health-care professionals.

TESTING THE PLATFORM

Usability test results reported here are from preliminary tests of the Pulse!! platform at Yale School of Medicine and National Naval Medical Center Bethesda, which were preliminary to tests at The Johns Hopkins School of Medicine of a modified version of Pulse!! incorporating changes indicated by the previous test sessions.

Preliminary Studies

Participants from four samples participated in preliminary studies. The samples represented different specialties and levels of training: Yale Sample 1 comprised six anesthesiologists who used the platform with no experimenters present; Yale Sample 2, four anesthesiologists with experimenters present; Yale Sample 3, six neurosurgeons, no experimenters present; and Bethesda Sample 1, seven trauma surgeons, experimenters present.

Participants were given instructions on how to use the platform, then they completed several interactive cases requiring them to diagnose a simulated trauma patient. Participants completed a survey about their perceptions of the Pulse!! platform.

In general, participants reviewed the platform
positively. For the most part, the pattern of responses was similar among the various specialties and levels. Participants also responded to several open-ended questions about the software. A summary of participants’ responses follows.

The Johns Hopkins Study

A usability analysis was conducted on an early iteration of the Pulse!! system to evaluate the degree to which users from the targeted population could infer how to use the interface. Attention was also paid to the effectiveness of the system’s tutorial, information needs, and system fidelity. Nine physicians participated in the Johns Hopkins usability study. Each was offered continuing medical education credits for participating. Participants were told about the purpose of the study and were asked to provide informed consent. After agreeing to participate, participants were asked to complete the Pulse!! tutorial.

The tutorial instructs the participant in using the interface to accomplish necessary actions such as ordering medications or taking the patient’s temperature. Following the tutorial, participants were asked to accomplish a variety of tasks to assess the degree to which they could extrapolate from information in the tutorial to other necessary user interface tasks. These tasks were designed by experimenters to explicitly determine whether potential trainees would be able to interact with the system well enough to allow learning to occur.

Clearly, it would be ill advised to expect trainees to learn targeted material if they are struggling to understand the interface. The performance of each participant on these tasks was observed and recorded by experimenters to identify issues in the design of the user interface. It took approximately two hours for participants to complete the analysis.

Tasks

Fifteen tasks composed Pulse!! basic training immediately following the tutorial. These included: reviewing intake information, ordering tests, ordering and checking intravenous fluids (IV), ordering a second IV, checking the trachea, adjusting oxygen delivery, listening to the abdomen, checking femoral pulse, ordering an x-ray and CT scan, checking blood-test results, checking CT results, checking awareness, turning the patient and checking his back, entering a diagnosis and identifying visual clues toward a diagnosis.

Preliminary Findings

Our initial goal for this preliminary study was twofold: to gather specific comments for necessary updates to the system; and second, to make a global assessment of participants’ reactions. The results of this analysis yielded numerous recommendations for changes to the interface and simulation. Reaction data indicated that the overwhelming majority (82%) of participants reacted positively to using the Pulse!! platform. Over 80% also reported that engaging in the platform held their interest, and all but one respondent reported that the platform was visually appealing.

Participants specifically commented that the platform provided for fun problem-solving; provided for real-time actions; was realistic and highly interactive and realistic; had excellent graphics; fostered applied problem-solving.

Taken together, these comments suggest the motivation to learn on the Pulse!! platform is high. This conclusion is bolstered by comments participants made to experimenters, many of which expressed great enthusiasm for the platform. A few negative comments were also voiced, and we tried to carefully probe these participants so we could address their concerns.

With respect to usability, a majority of participants also reported that the system was easy to use. In addition, for the most part, menus were deemed
Pulse!!

acceptable by participants as was the overall user interface. A majority of participants reported that they believed the platform could provide training that was relevant to their jobs and that they would recommend the platform to a colleague.

Our expert, anecdotal assessment was that the menu design was relatively easy for participants to master and that most were able to interact effectively with the system after a few minutes of familiarization. We also observed that the biggest challenge for participants was “walking” through the space, i.e., moving around in the virtual world. This was mostly the case for participants who had little or no video-game experience.

Overall, our preliminary results indicate that the Pulse!! platform appears to be a viable environment in which to embed instruction. Participants responded well to the technology and expressed enthusiasm regarding its utility as a learning tool. Our approach of iteratively collecting specific usability data and making needed upgrades has helped ensure that the interface is easy to use and not a hindrance to learning.

As with initial studies, subsequent evaluation efforts will involve a variety of learners, from medical students through residents and practicing physicians in a variety of specialties. In this way, we will be in a position to assess whether meaningful differences exist among varying group of learners, based on past experience, age, specialty, comfort with video games and the like.

FUTURE TRENDS

Preliminary findings and anecdotal success of the Pulse!! learning platform suggest that Pulse!! development methods represent a robust model for future projects of its kind. It is unlikely that medical education or any species of education requiring critical thinking will adopt virtual-world technologies as media for learning without integrated testing and evaluation indicating their validity and reliability. The Pulse!! method of case- and learning-platform development is well under way to establishing a viable development model.

We believe Pulse!! is plotting a new course for educational technology that will change rapidly as virtual-world technologies continue to develop and become more realistic as hardware and software methods continue to develop at their current pace. As these preliminary studies suggest, however, it will be critical to integrate learning-evaluation and user-centered design methods with technological development across all curricular fields. Some usability issues may become less problematic as so-called “digital natives” (e.g., Prensky, 2001; & Gee, 2003) become the dominant in the education system, but it is our sense that there always will be a significant sector of any student body that will be unfamiliar with the rudiments of virtual-world technology to the degree that, in order to “play the game,” they will have to be taught how. In any case, however, virtual-world technologies are likely to represent a significant paradigm shift in how education is acquired.

CONCLUSION

Pulse!! usability studies indicate that sophisticated learners are amenable to using virtual-world technologies in acquiring critical thinking and clinical skills, and that the learning platform provokes learning that is experienced not only as useful and productive but also as fun – recreational in a broad sense. The Pulse!! method of case and technology development indicates that virtual-world educational platforms must be not only broad – user-friendly, visually effective, interactively immersive and fluid – but also deep: procedurally rooted in curriculum, rich in readily-accessible information and cognizant of actual practice in the real world.

Furthermore, we believe that our experience in developing Pulse!! reinforces the notion that user-centered design approaches were not only
effective for developing this learning technology, but for the development of other technology-based learning environments. By working with a multi-disciplinary team, we were able to design an interface that was effective. We were also able to anticipate, and eliminate, usability problems. We recommend this approach for others trying to develop training products for this complex and challenging domain.

REFERENCES


**KEY TERMS AND DEFINITIONS**

**Curricula:** Established, accredited educational content to be delivered experientially in virtual reality by which yardstick the effectiveness of a learning platform must be evaluated

**Usability:** A quality inherent in user-centered design of a virtual-reality platform determined by quantitative and qualitative data.

**User-Centered Design:** A concept of platform design virtual space by which users participate in
the design process in a variety of ways to ensure four basic principles, (1) ease of determining what actions are possible at any moment, (2) clarity of the visible workings of the system (3) clarity of the current state of the system: (4) clarity of mappings of intention and action, e.g., visible information and interpretation of the system state.

**Virtual Reality:** Three-dimensional space created by various virtual-world computer technologies that is navigable by users as though they were actually within that space.

**Virtual-World Technologies:** An array of computer programming conventions that compile mathematical algorithms with images to create the likeness of three-dimensional space on a two-dimensional surface.
Section 4
Sociocultural Aspects of Instructional Technology
Chapter 24
Multicultural e-Education: Student Learning Style, Culture and Performance

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INTRODUCTION

Students across 21 ethnic backgrounds are empirically studied to investigate the research question: Can an integrated model of a priori global culture and learning styles predict online multicultural university student academic performance? The aim is to explore the ethnic interdependence with study styles of multicultural students, in terms of the actual impact on final grade. The proposed benefits of this study are: To create an interdisciplinary learning model (using multi-method statistical techniques), to inform students and their professors about the relationships between culture, learning style and academic performance, as well as to advance educational psychology. As conceptually drawn in Figure 1, an interdisciplinary design links global culture from anthropology/industrial psychology

ABSTRACT

Academic performance of international university students was predicted using an interdisciplinary model, built by integrating theories from educational psychology and cultural anthropology. Approximately 2,500 online undergraduate business degree students from 21 countries were sampled from an Australian university. An a priori learning style instrument was used to assess their study strategies, which was integrated to a global culture taxonomy using ethnic demographic data. Multi-method statistical techniques for multivariate data were triangulated (confirmatory ordinal factor analysis, multiple regression and structural equation modeling) to analyze empirical evidence. The instrument was validated (eigen-values>1; cumulative factor variance captured >60%; GF, LR, factor loadings acceptable; p<0.01, RMSEA<0.1). A statistically significant interdisciplinary model was created showing culture and learning style predicts grades (n=715, normal theory WLS X²=20; df=9; r²=0.57, p=0.018; RMSEA=0.041, NFI=0.99, GFI=0.99, AGFI=0.97).

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to learning style theory grounded in educational psychology.

BACKGROUND AND RATIONALE

There are very few empirical studies that integrate a priori culture and learning style models; none could be found in the literature that test dependent performance outcomes. There have been four relevant studies that tackle parts of this research question, namely DeVita (2001) that used both culture and learning style, but ethnic background was arbitrarily set to two categories of national or international, and performance was not assessed. Contemporary studies have explored adult learning and culture (Toledo, 2007; Abril, 2006; VanOord, 2005) but nothing was measured, concluding only ethnic culture was a latent yet unproven factor.

From a multicultural perspective, behavior and learning differ across cultures (Hofstede, 2007; Kolb & Kolb, 2005; Strunk & Chang, 1999). Factors beyond teaching method, student intelligence and study strategy, affect learning (UNESCO, 2005; Schunk, 2004; Mayer, 2003). Several recent empirical multicultural learning style studies found instruction methods and learning styles predicted a significant difference in student success (Strang, 2008a; Smith, Sadler-Smith, Robertson & Wakefield, 2007; Manikutty, Anuradha, Katrin and Hansen, 2007; Litzinger, Lee, Wise & Felder, 2007), but they did not specifically isolate and measure the cultural factors. A global meta-analysis of learning styles complained there was “no extensive research in the UK on learning styles and social class, or on learning styles and ethnicity” (Coffield et al., 2004, p. 84). Some writers rhetorically ask if there is a right learning style for multicultural students (2008, Valiente; Carroll, 2005)? Other researchers argue learning styles are not measurable or predictive (Mitchell, 1994; Curry, 1990).

A major catalyst for this study was that meta-analysis reviews have complained learning style and/or culture models lack statistical proof (Coffield, Moseley, Hall & Ecclestone, 2004; Reynolds, 1997). Meta analysis reviews indicate
most of the empirical literature on learning style relies on small samples, single statistical method (principal component or factor analysis), as well as inadequately documented techniques and/or statistically insignificant results (Coffield et al., 2004; Hedeker, 2005). Even when empirical evidence is given, there is a “bedlam of contradictory claims” (Reynolds 1997, p. 116). There are numerous empirical instrument validations that incorrectly apply normal parametric analytic techniques on forced-choice or Likert-style survey responses that are binomial or ordinal data types (Freedman, 2005; Jöreskog & Moustaki, 2006). Few studies use method triangulation to corroborate findings (Coffield et al., 2004; Keppel & Wickens, 2004; Capraro & Capraro, 2002).

Therefore, a robust design was desired to test this interdisciplinary model.

LITERATURE REVIEW

Since this is an empirical study (testing theory in practice), the literature review focus is on relevant empirical culture and learning style theories. First the interdisciplinary term is defined, and then relevant empirical studies are explored. Finally the selected culture and learning style measurement models are explained.

Interdisciplinary Theory

The introduction and this literature review are interdisciplinary in the sense that separate contributions from different fields of research are cited. It is argued that an interdisciplinary research design that combines separate theories and triangulated statistical methods will provide a credible answer to the research hypotheses, beyond what existing studies have documented. Interdisciplinary research is a methodology that:

Integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice.... it is pluralistic in method and focus. (CSEPP, 2005, p. 188).

One key philosophical view should be disclosed: The interdisciplinary consensus is intelligence that has no relationship with culture and/or learning style. The best quote capturing the above and the theoretical rationale for this interdisciplinary study, is from the United Nations Educational and Scientific Cultural Organization (UNESCO) global meeting many years ago: “Whatever classification the anthropologist makes of man, he never includes mental characteristics” (Levi-Strauss, Montagu, Ginsberg, Kabir, Beaglehole, Comas, Pinto & Frazier, 1950, p. 7). Thus the goal in this study is to link ethnic culture with learning styles (not intelligence). Likewise, learning style is grounded in early educational psychology, such as “mathemagenic behavior” (Rothkopf, 1965; 1970, p. 332): A meta-cognitive learning strategy study technique and instructional approach (Kolb, 2000). Often theories become diluted via citations so going to the original source provides accuracy.

Interdisciplinary Studies of Culture and Learning Styles

A detailed search of the peer-reviewed literature databases indicates culture and learning style have not been empirically studied together by using a priori theories (analyzing direct and/or quantitative evidence), grounded in their respective disciplines (anthropology and educational psychology). Nevertheless several relevant empirical culture and learning style papers offer a credible starting point. DeVita (2001) used the Index of Learning Styles (Felder & Soloman, 2001) to assess domestic versus international students at a UK university, but culture was categorized based on assumptions - not measured (DeVita, 2001, p. 168), and his statistical evidence was sparse (pp. 169-170).
Multicultural e-Education

Hayes and Allison (1996) provided an interesting theoretical discussion of learning style and culture, then developed the Cognitive Style Index (CSI) that measures a two factor model of intuition and analysis (Allison & Hayes, 1996). CSI is unique in the learning style literature because it has been validated, and according to meta-analysis reviews it “has the best psychometric credentials” (Coffield et al., 2004, p. 56), but it does not assess culture. Smith, Sadler-Smith, Robertson & Wakefield (2007) applied a self-directed learning construct to assess professional learning across twelve companies in Australia – although their ethnographic study was revealing, it did not specifically isolate culture, and the learning construct did not produce statistical evidence of the key factors.

Rival theories and non-empirical studies are worth mentioning as several theoretical papers develop useful integrated culture and learning frameworks. Manikutty, Anuradha, Katrin and Hansen (2007) proposed a multicultural interdisciplinary taxonomy relating the Approaches and Study Skills Inventory for Students (ASSIST) model (Entwistle, 1998) with Hofstede’s Global Culture Model (1991) for students in India. The ASSIST model assesses deep, surface and strategic cognitive learning approaches (Entwistle, McCune & Walker, 2004) but according to meta-analysis reviews the instrument has not been validated (Coffield at al., 2004, p. 25), and some ASSIST items are ambiguous, such as: “When I look back, I sometimes wonder why I ever decided to come here” (Entwistle, 1998, p. 122). Toledo (2007) presented an interesting conceptual perspective of her reflections using another author’s theoretical taxonomy “digital natives and digital immigrants” (p. 85). She suggests age and experience are key factors influencing multicultural student learning styles, meaning that young people growing up with digital technologies tend to have a different way of processing information as compared to older generations (empirical studies of this may prove useful).

Global Culture

While culture is deeply rooted in anthropology, it has been successfully modeled within industrial psychology by studying business projects (Tan & Snell, 2002; Watson, Johnson & Zgourides, 2002), as well as in management education contexts (Hofstede, 2001). Learning styles has been studied in education and business contexts around the world (Litzinger, Lee, Wise & Felder, 2007; Hofstede, 2007), in many languages and cultures (Felder, 2008). Albeit studies have been published comparing culture with communicating style (Gudykunst, Matsumoto, Ting-Toomey, Nishida, Kim & Heyman, 1996), as well as with leadership (House, Hanges, Javidan, Dorfman & Gupta, 2004; Dimmock & Walker, 2000), the two disciplines of culture and learning style have not been empirically tested together (except as noted earlier). East-west cultural differences are well documented in the literature (Trompenaars & Woolliams, 2003). Western cultures are seen as concrete and individualistic; eastern cultures are abstract and collective (Palazzo, 2002; Triandis & Gelfand, 1998). The consensus is a “[western] focus on the explicit metaphysics for the former, and tacit for the latter [eastern], and from a western infatuation for measuring, controlling, and process-improvement, whereas the eastern emphasis is on the cognitive, sensing and social interaction aspects” (Strang, 2003, p. 4). These are generic west-east inferences yet there have been questions raised about the world-wide reliability of western-origin culture models (Leung & Bond, 1989). This triggers the inquiry: About cultures and learning styles outside America? Alexander (2000) has shown a plausible solution by fusing principles from sociology and educational psychology to provide a compelling discourse of how “in different countries and within any one country, history, culture and teaching come together to create very different pedagogies” (p. 99).

There are three well-cited and similar empirical global culture models in the literature: The
Hofstede (1980; 1991) world-wide 40 country IBM study (n=116,000); Trompenaars and Woolliams (2003) international manager study across 28 countries (n=15,000); and Global Leadership and Organizational Behavior Effectiveness (GLOBE) study (House et al., 2004) of 951 non-multinational organizations (in food processing, financial services, or telecommunication industries), across 62 societies/countries throughout the world. There are alternatives and variations, along with supporters and objectors to the validity of each. Hofstede has continued to extend his model over the years (2007; 2002) and defended its validity (Hofstede, 2003; 2002), for example, citing for proof the “over 400 significant correlations” (Hofstede, 2001, p. 520).

Hofstede’s (2007; 2001; 1991; 1980) global culture model was designed by conducting ethno-graphic studies of IBM employees around the world, directly and using research colleagues over several years (2006), to cluster countries across four dimensions as enumerated below. His data resulted in indexes on every dimension for 40 countries. He later added a fifth long-short time index but it used a separate 23 company Chinese Value Survey, and it has not been fully evaluated in all countries used in this sample frame (1987). It is worth noting that Hamden-Turner and Trompenaars (2000) created a similar cultural construct with six dimensions: (1) universalism-particularism, (2) individualism-collectivism, (3) affective-ascribed (neutral) status,(4) specific-diffused, (5) sequential-synchronous time orientation, and (6) inner-outer directed. Trompenaars later added a seventh: Task performance-affective sensitivity.

To answer the research questions, Hofstede’s (2006; 1991; 1981) seminal work on global culture will be leveraged, in hope that his data intersects with the ethnic origins of the sample respondents and their learning styles. The key reasons the Hofstede model was selected here are: Its parsimony, proven/defended construct reliability with large sample sizes, and coverage of all countries in our sample. The theory is explained below.

- **Power Distance Index (PDI):** Extent members of a certain culture accept that power in institutions and organizations is distributed unequally, whereby a lower index signals a more equal-rights society;
- **Uncertainty Avoidance Index (UAI):** General intolerance of ambiguous situations; the higher the intolerance for ambiguity, the less the willingness try things, lower = accept more risks and ambiguity;
- **Individualism-Collectivism Index (ICI):** Individualism exemplifies tendency to primarily care about oneself and immediate families, while lower = collectivism, need to belong to and function within groups, organizations, or collectives; a lower index means more team identity and clan type behavior;
- **Masculinity-Femininity Index (MFI):** Masculinity (high) is “a situation in which the dominant values in society are success, money, and things”; while femininity (lower) is “a situation in which the dominant values in society are caring for others and the quality of life” (Hofstede, 1980, p. 420).

**Learning Style**

Learning style is ambiguous. “Learning style differences can be linked to relatively stable person or aptitude variables, but they also vary within individuals as a function of task and situation variables” (Cronbach & Snow 1981, p. 51). A ‘learning style’ is not a fixed trait, but “a differential preference for learning, which changes slightly from situation to situation... the same time, there is some long-term stability in learning style” (Kolb, 2000, p. 8). Learning styles are defined within this research context as “characteristic preferences for alternative ways of taking in and processing information” (Litzinger et al., 2007, p. 309).

Like culture yet more voluminous, there are 71-103 learning style models recently cited in the
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literature (Boström & Lassen, 2006; Coffield et al., 2004, p. 1). Relevant empirical studies (Zwyno, 2003; DeVita, 2001) found the most internationally suitable and proven learning style theories are the Learning Style Inventory (Kolb, 2005) and the Index of Learning Styles (ILS) model (Felder & Soloman, 2001; Felder & Silverman, 1998). There are competing opinions in the literature about the ILS reliability and most refute its internal validity (Reynolds, 1997) albeit there is very little, mostly confusing, statistical evidence in both the negative and positive claims. Nevertheless there is strong empirical evidence the ILS model is valid (Litzinger et al., 2007; Livesay et al., 2007; Abril, 2006; Güneş, 2004; Zywno, 2003; DeVita, 2001). Several studies indicated the ILS is simpler to understand for multicultural English Second Language students (Strang, 2008; Zywno, 2003, p. 14; Cooper, 2001). Felder (2008) wrote online that the ILS “gets close to a million hits per year and has been translated into Spanish, Portuguese, Italian, German, and several other languages” (p. 1).

The ILS is a questionnaire designed using a four dimension model that “classifies students according to where they fit on a number of scales pertaining to the ways they receive and process information” (Felder & Silverman, 1998, p. 674). The original ILS was subsequently revised to remove a fifth organizational dimension and to change the wording of the input dimension from visual/auditory to visual/verbal (Felder & Brent, 2005), then released as a free open-source online format (Felder & Soloman, 2001). The 44-item ILS instrument is designed on four dimensions (latent factors), each representing two subscales: Visual-verbal, sensing-intuitive, active-reflective, and sequential-global, tested by 11 questionnaire items per dimension. The ILS borrows upon Myers-Briggs as well as Kolb’s theory for some of the underlying principles (Felder & Brent, 2005). The four dimensions and subscales of the measurement model are briefly enumerated below.

- **Input:** Visual (prefer visual representations of material, such as pictures, diagrams, flow charts) or verbal (prefer written and spoken explanations);
- **Perceive:** Sensing (concrete, practical, oriented toward facts and procedures) or intuitive (conceptual, innovative, oriented toward theories and underlying meanings);
- **Process:** Active (learn by trying things out, enjoy working in groups) or reflective (learn by thinking things through, prefer working alone or 1-2 familiar partners);
- **Understand:** Sequential (linear thinking process, learn in incremental steps) or global (holistic thinking process, learn in large leaps); (adapted from: Felder & Spurlin, 2005, pp. 104-106).

**RESEARCH DESIGN AND METHODOLOGY**

First the factorial structure is explained, with respect to how the hypotheses will be tested. Then the sampling configuration is described along with how the data was gathered. The section closes with a short discussion of the methodology and rationale for the selected statistical techniques (to encourage others to extend this work).

**Instruments and Sample Variables**

To test the research questions defined in the introduction, ten specific hypotheses were created, conceptually represented as ‘effect’ factors (arrows) creating the “Interdisciplinary ... Model” in Figure 1. Each of the four cultural indexes: PDI, UAI, MFI, and ICI (in the leftmost portion of Figure 1) are hypothesized to be valid and reliable factors derived from a latent taxonomy identified as Culture, which will be measured by the a priori Global Culture Model. The four learning style dimensions: Input, Perceive, Process, and Understand (right side of Figure 1) are hypothesized to represent the latent construct
Learning, which can be assessed from the a priori Index of Learning Styles Model. All four culture index variables are positive intervals (can be considered ratio, continuous); all four learning dimension factors are ordinal (treated as discrete intervals). The final grade point value (GPV) is a ratio variable stored with the international student demographic data.

The interdisciplinary concept (center of Figure 1) is designed as a ‘reflective measurement’ structural model of the latent Culture taxonomy and Learning construct. This means the latent theoretical components “culture” and “learning” are hypothesized to be interdependent and give rise to (predict) the measured factors: PDI, UAI, MFI, ICI; and Input, Perceive, Process, Understand; respectively. Statistically, the coefficient paths would indicate the latent constructs Culture and Learning are derived from the four indexes and the four dimensions, respectively; therefore, these eight elements become the measured factors. To relate this to the hypotheses, a structural path model would reflectively measure these factors by conceptually reversing the arrows in Figure 1. The ninth hypothesis is global culture and learning style can predict academic outcome. The tenth hypothesis is the Interdisciplinary Multicultural Learning Style Model is a statistically significant representation of the phenomena explaining international university student studying behavior in the sample frame. The level of confidence is set to 95% (but extended to 90% for some tests), and the exact alpha error probability reported by the software is given. Random error is captured as the inability to explain variance.

The sample frame was approximately 2,500 multicultural and domestic students enrolled at an Australian university for one term (2007-2008), taking various subjects in a four-year undergraduate business degree program. Demographic data was gathered during student enrollment, capturing many attributes such as age, gender, immigration details (if not a domestic student), current location, language(s) spoken, and so on (mandatory for a university to report to the NSW state and Australian commonwealth government). Ethnic culture is identified from student demographic data element 346 “COUNTRY-BIRTH A code representing the country of birth of a student” (DEST, 2008, p. 13), which can be cross-referenced to the Standard Australian Classification of Countries using the Asia-Pacific Economic Cooperation convention (ABS, 2008, p. 12). Ethnic culture code can then be linked to national culture code (Hofstede, 2001; 1991; 1983).

All students were invited by email (following proper ethical procedures and disclosure) to complete the online version of ILS (Felder & Solomon, 2001). Their student number was captured to prevent duplicate submissions (also enforcing statistical non-replacement), as well as becoming the foreign key to access the demographic data. A small prize worth $100 AUD was offered and the cutoff period was 30 days. The ILS survey contains 44 items, with 11 testing each of the four learning style dimensions using different brief questions, having forced-choice binary outcomes. All items must be answered to submit the survey. The learning style dimensions are calculated using a transformation algorithm producing a 0 to 12 interval variable data type. The sampling procedure was random without replacement, imputation was not used (only complete survey responses accepted), and the sample frame was assumed to approximate a normal distribution.

Analysis Plan and Statistical Methods

The interdisciplinary culture and learning models are a priori factored models with nine components in total, with eight interval data type independent (exogenous) factors, and one ratio data type dependent (endogenous) variable. Despite there being interdependence in the hypotheses, the independent factor relationships are reflective, and expected to have congeneric properties (low covariance between or within latent construct er-
ror variances). Both parsimony and measurement best practices are enforced in the design since at least four factors are used per latent construct, yet only nine elements are needed in total to present the structural model.

The first step with a priori models is to validate each with the sample data using confirmatory factor analysis for internal reliability and content validity, and secondly (if the sample size is large enough or a retest is possible), replicate using a split in the sample (or retest) to verify external validity. The second step is to confirm the normality of the critical sample variables using descriptive estimates and univariate tests. Since the sample results are forced-choice, without replacement, survey item completion controlled, and based on knowledge of the underlying theoretical learning style model, there will not be any identifiable outliers.

Structural equation modeling (SEM) is a multivariate statistical technique that can test all of the hypotheses: (Strang, 2008b). Nevertheless, separate confirmatory factor analysis (CFA) provides method triangulation (Hedeker, 2005), and although it uses regression, a different algorithm - minimum residuals (MINRES) - along with the correlation matrix, can be used to complement SEM (Ullman, & Bentler, 2003). SEM, by default, uses weighted least squares or maximum likelihood with a covariance matrix (Jöreskog, 2003).

The SEM approach can be used to confirm each side the interdisciplinary culture and learning style model by measuring the data to the construct variables (triangulation of separate CFA). Then the structural model can be assessed with multiple regression, using goodness of fit indexes and error approximations to validate the cause-effect hypotheses (Figure 1). SEM will be performed with LISREL, which facilitates modeling by allowing most parameters to be iteratively respecified (Jöreskog, Sörbom & Wallentin, 2006).

**ANALYSIS AND DISCUSSION**

The statistical procedure started with ensuring the sample was normal, then we tackled the more complex phases of validating the ILS instrument, as well as testing the interdisciplinary culture and learning model.

**Descriptive Statistics and Sample Normality**

Generally-accepted algorithms were applied to calculate estimates on all interval and ratio variables, to prove sample normality (Keppel & Wickens, 2004), with the key evidence shown in Table 1.

Since data was available from the relevant population (over several terms), a z-test was used.

### Table 1. Sample descriptive statistics and univariate tests of normality

<table>
<thead>
<tr>
<th>Key Demographic Measures</th>
<th>Country Frequency %</th>
<th>Country Frequency %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size 715</td>
<td>Philippines 140 0.20</td>
<td>Australia 16 0.02</td>
</tr>
<tr>
<td>Mean Age 21.8</td>
<td>India 122 0.17</td>
<td>Italy 10 0.01</td>
</tr>
<tr>
<td>Standard Deviation 0.18</td>
<td>Singapore 97 0.14</td>
<td>Austria 9 0.01</td>
</tr>
<tr>
<td>Kurtosis** -0.01</td>
<td>HKChina 57 0.08</td>
<td>Israel/Gaza 9 0.01</td>
</tr>
<tr>
<td>Skewness** +0.03</td>
<td>Pakistan 55 0.08</td>
<td>Germany 9 0.01</td>
</tr>
<tr>
<td>Gender F=52% M=48%</td>
<td>Thailand 35 0.05</td>
<td>Turkey 8 0.01</td>
</tr>
<tr>
<td>Countries 21</td>
<td>Japan 29 0.04</td>
<td>Nigeria 8 0.01</td>
</tr>
<tr>
<td></td>
<td>Slovenia 27 0.04</td>
<td>France 7 0.01</td>
</tr>
<tr>
<td></td>
<td>Taiwan 24 0.03</td>
<td>Greece 5 0.01</td>
</tr>
<tr>
<td></td>
<td>NewZealand 22 0.03</td>
<td>SouthAfrica 5 0.01</td>
</tr>
<tr>
<td></td>
<td>Korea/South 21 0.03</td>
<td>(countries are sorted by student count).</td>
</tr>
<tr>
<td>Grade Score (GPV) 77.652</td>
<td>Sample &amp; Population Comparison</td>
<td>** p &lt; .01 (2-tailed)</td>
</tr>
<tr>
<td>Standard Deviation 12.202</td>
<td>Mean GPV z-score +1.597</td>
<td></td>
</tr>
</tbody>
</table>

**p < .01 (2-tailed)**
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To confirm normality, in particular grade (GPV) was a key indicator (+1.597, p<.05; M=76.8, SD=14.3). The sample grade skew was slight at -0.011 with a flat kurtosis peak of 0.001; both are acceptable. Typically the kurtosis should be less than or equal to ±3 (Tamhane & Dunlop 2000, p. 118), and skewness should be at or below ±1 (Bluman, 2004, p. 293). There were 715 valid responses from the online ILS, with a survey response rate of 28% (715/2513). Originally, 723 responses were saved, but the ethnic data from eight of the student demographic profiles could not reliably pinpoint a dominate global culture, so the records were excluded. Finally, demographic variables (such as age, gender) make sense (from experience) as representing this university population over several recent terms. There were 21 cultures represented (countries), with domestic Australians comprising 2% of the sample (New Zealand students also constituted a small portion, 3% of the total ethnic cultures in the sample).

Instrument and Theoretical Construct Confirmation

Confirmatory ordinal factor analysis and split sample testing were the main procedures used to verify the ILS. Since the 44 items in the ILS are dichotomous discrete-choice (binary outcomes), ordinal confirmatory factor analysis was the chosen technique to validate the instrument instance. Most empirical learning style studies incorrectly apply confirmatory factor analysis (CFA) to validate instruments (Jöreskog et al., 2006); CFA is inappropriate where multivariate linear regression assumes a normal distribution of continuous unbounded variables, as opposed to ordinal or binary values (Freedman, 2005). “In practice, the manifest variables are often ordinal. However, ordinality is most often ignored and numbers such as 1, 2, 3, 4, representing ordered categories, are treated as numbers having metric properties, a procedure which is incorrect in several ways.” (Jöreskog & Moustaki, 2006, p. 6-1).

To apply confirmatory ordinal factor analysis, a bounded multivariate regression on a logistic distribution model was utilized, to confirm the four ILS latent factors (learning style dimensions). Technically, the ILS construct was treated as a “Latent Class Model” (Jöreskog & Moustaki, 2006, p. 4), and the Full Information Maximum Likelihood ordinal factor analysis was applied in PRELIS version 2.8, specifying the POM logistic response function (Jöreskog & Moustaki, 2006, 5-8). In the COFA-POM analysis, the key estimates are the significant factor loadings (>=0.3 on one factor, no cross-loading, using oblique and orthogonal rotations). Most important are the two model-fit chi-square ratios: LR and GR – these latter two should be similar, respectively, between factors (Jöreskog & Moustaki, 2006, pp. 17-18). COFA was performed outside the SEM procedure for triangulation, and as explained, using a more robust ordinal logistic function utilizing the minimum residuals method. SEM performs a CFA as a first step in measuring the data with the model, using the maximum likelihood method, less robust than COFA-POM for binary item responses (Jöreskog, 2004).

Three different rotation solutions were used to examine the COFA-POM, namely: Varimax, promax and instrumental/reference variables. These methods shift the loading comparisons across the polychoric correlation matrix. Varimax is a robust oblique technique which eliminates correlations, and it tended to produce acceptable factor loadings for all four dimensions. In comparing the two oblique solutions (promax and reference), for each dimension, promax produced moderate positive correlations. In the promax solution, each key factor loading was above the 15% variance captured benchmark of ±0.3 loading (most loadings >±0.5), and overall the COFA-POM supported the theoretical four dimension ILS construct very well.

The chi-square goodness-of-fit and likelihood-ratio indexes are most relevant to prove the COFA-POM model supports the ILS construct fitted with
this sample data. The key benchmark sought was that the univariate and bivariate indexes roughly equal one another, across the statistical methods, respectively, and this was the finding here. The input dimension univariate LR-Fit practically duplicated the GF-Fit (29.467 versus 29.588), while the bivariate LR-Fit also was close to the GF-Fit (259.602 versus 262.107). With respect to the perceiving dimension, the univariate LR-Fit versus GF-Fit were a fair match (38.009 and 37.907), and much the same for the bivariate LR-Fit approximating GF-Fit (278.093 compared with 274.034). At this point it was no surprise to see the processing dimension list the univariate LR-Fit statistic close to the GF-Fit (13.704 versus 13.926), and the bivariate LR-Fit just behind the GF-Fit (132.741 versus 134.052). Finally, the univariate LR-Fit approximated the GF-Fit (194.719 to 224.205) for the understanding dimension, with a bivariate LR-Fit paralleling GF-Fit (1018.974 and 1164.802). All COFA-POM statistics were significant (p<0.01, RMSEA<0.1). A principal component analysis was conducted (software makes this easy), to confirm the construct validity (using method triangulation), with good results: Eigenvalues all >1 (all but input dimension >3), variance captured for each dimension was >60% (50% is a benchmark and most were >70%).

All the above results, and a random split-sample replication (for invariance proof), confirmed the ILS a priori construct validity for this sample population data. Convergent and nomological validity were proven through the factor rotation solutions, factor correlations, and principal component analysis (PCA). In terms of confirming the ILS instrument, the 44 survey items converged through the factor rotation solutions, adhering to the a priori model specifications. Discriminant validity (extent to which four ILS factors are distinct from other possible combinations), was proven mainly by the PCA variance extracted estimates being larger than the squared correlation estimates from the COFA-POM promax rotation solution. External ILS construct validity (with face/content validity) was proven in other studies (Litzinger et al., 2007; Livesay et al., 2002; Güneş, 2004; Zywno, 2003).

**Interdisciplinary Multicultural Learning Style Model**

Figure 2 shows the final structural model solution, measured and fitted with the sample data, using the Maximum Likelihood regression technique (imported from LISREL then augmented with explanatory dotted-red-call-out-comments). The model proves the hypotheses (shown in Figure 1), and it is statistically significant, as indicated by the low Chi Square ‘perfect model difference’ using Weighted Least Squares regression method (20), by the low number of required factors (9), and by the error measurements (p=0.018; RMSEA=0.041). All these model estimates meet the study goals and generally accepted research benchmarks.

The center portion of the model in Figure 2 shows a predictive path of learning style and culture on academic performance, with coefficient beta estimates of 0.19 (t=7.50, p=0.025), and 0.69 (t=13.63, p=0.051), respectively, explaining 57% of the cause-effect variance. The culture-learning-style-performance solution is theoretically and statistically significant (especially since this is an interdisciplinary structural equation model created by applying the robust maximum likelihood regression method after the instruments were validated). Each of the two interdisciplinary culture and learning latent constructs are estimated with coefficient paths to their factors (coefficient betas are shown in Figure 2 and listed in Table 2). The error covariances and error variances (unexplained error residuals) are pointing to each factor (for example, error variance of the Input learning dimension is 0.00, while error covariance of ICI and MFI is 0.41). In a complex model like this,
each of these estimates must be interpreted by considering the whole context, and by examining key measurements.

The path estimates in Figure 2 show interrelationships, representing factors of a multinomial linear regression equation, of which more details (such as beta coefficients, t-test estimates and p-values) are listed in Table 2 (with key estimates bolded).

Subsequently, each factor of the Figure 2 model is shown in Table 2 as a linear regression component, along with the proof. On the left side of Table 2 are the learning style dimensions, with global culture taxonomy in the middle, and the outcome performance construct on the right. Each factor’s regression beta coefficient is shown in Table 2 (such as UAI -23.74), which represents a multiplier in the regression equation.

**Table 2. Interdisciplinary multicultural, learning style & performance – SEM measurements (sorted by effect size)**

<table>
<thead>
<tr>
<th>Learning Style Regression Coefficients</th>
<th>Global Culture Regression Coefficients</th>
<th>Performance Regression Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Dimension = +2.28 * Learning Style</td>
<td>Uncertainty Avoidance Index (UAI) = -23.74 * Culture</td>
<td>GPV = 12.09 * Perform (r² = 0.57)</td>
</tr>
<tr>
<td>(r² = 0.99, t = 37.88, p = 0.060)</td>
<td>(r² = 0.94, t = -14.80, p = 0.016)</td>
<td>Perform = (+0.19 * Learning) + (+0.69 * Culture)</td>
</tr>
<tr>
<td>Understand Dimension = -2.48 * Learning Style</td>
<td>(error variance = 38.10, t = 0.570, p = 66.601)</td>
<td>Learning Construct</td>
</tr>
<tr>
<td>(r² = 0.99, t = -37.93, p = 0.065)</td>
<td>Power Distance Index (PDI) = +12.69 * Culture</td>
<td>(r² = 0.57, t = 7.50, p = 0.025)</td>
</tr>
<tr>
<td>Perceive Dimension = -2.01 * Learning Style</td>
<td>(r² = 0.45, t = 15.26, p = 0.083)</td>
<td>Culture Construct</td>
</tr>
<tr>
<td>(r² = 0.46, t = -16.71, p = 0.012)</td>
<td>(error variance = 196.04, t = 19.23, p = 10.210)</td>
<td>(r² = 0.57, t = 13.63, p = 0.051)</td>
</tr>
<tr>
<td>(error variance = 4.70, t = 19.40, p = 0.210)</td>
<td>Individualism Collectivism Index (ICI) = -11.12 * Culture</td>
<td>(common error variance = 0.43, t = 7.60, p = 0.056)</td>
</tr>
<tr>
<td>(error variance = 19.70, p = 0.012)</td>
<td>(r² = 0.37, t = -12.21, p = 0.091)</td>
<td>Correlation Matrix Covariance Matrix</td>
</tr>
<tr>
<td>Process Dimension = -1.19 * Learning Style</td>
<td>(error variance = 211.83, t = 11.44, p = 18.510)</td>
<td>(independent factors) (latent variables)</td>
</tr>
<tr>
<td>(r² = 0.23, t = -10.54, p = 0.011)</td>
<td>Masculine Feminine Index (MFI) = -0.13 * Culture</td>
<td>Learn. Cult. Perf. Learn.</td>
</tr>
<tr>
<td>(error variance = 4.71, t = 19.70, p = 0.240)</td>
<td>(r² = 0.01, t = +0.25, p = 0.051)</td>
<td>Learning 1.00 Perform 1.00</td>
</tr>
</tbody>
</table>

Correlation Matrix Covariance Matrix

<table>
<thead>
<tr>
<th>independent factors</th>
<th>latent variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learn. Cult. Perf. Learn.</td>
<td>Learning 1.00 Perform 1.00</td>
</tr>
<tr>
<td>Culture 0.22</td>
<td>1.00 Learning 0.34 1.00</td>
</tr>
<tr>
<td>(t=6.87, p=0.03)</td>
<td>Culture 0.73 0.22</td>
</tr>
</tbody>
</table>

Chi-Square=20.00, df=9, p-value=0.01794, RMSEA=0.041
The coefficient of partial determination ($r^2$), t-test statistic, and p-value, are the critical estimates to interpret the significance of each factor. A higher $r^2$ indicates more effect size explained, and following generally accepted benchmarks, 0.80 is a very large effect, 0.50 corresponds to a medium-to-strong effect, while 0.20 is considered small but significant in social science research (Keppel & Wickens, 2004, pp. 162 & 174-176). The well-known benchmark for the t-test is $|t| \geq 2$ (Carlson and Thorne 1997, p. 106), and the level of significance for the SEM hypotheses testing portion of this study is relaxed to 0.1; all critical results in Table 2 were statistically significant. Each of the SEM regression measurements (columns in Table 2) are sorted by descending order of effect size and statistical significance. The correlation and covariance matrices are added to the bottom right of Table 2 for completeness (again with key estimates bolded).

Further proof of the model is given in Table 3 which shows fit indexes as compared to a theoretically perfect model, again with most important estimates bolded. While Table 2 shows structural equation measurements using the maximum likelihood regression method, Table 3 shows how the structural model compares with an idealized culture and learning style ‘normal theory’, fitted with the sample data using a weighted least squares regression method. The key indicators showing a good fit are: GFI (0.99), AGFI (0.97) and RMSEA (0.041).

### Technical SEM Interpretation

The technical interpretation of the interdisciplinary multicultural and learning style performance model is best discussed by referring to Figure 2 (showing interrelationship estimates), cross-referenced by exogenous factors (culture and learning) as well as endogenous variable (GPV perform) in Table 2 (listing partial coefficient of determinations $r^2$ and null hypothesis probability values). Each construct factor’s regression beta coefficient is shown in Table 2 (such as ICI -11.12), which represents a multiplier in the structural regression equation. Larger partial coefficient of determinations ($r^2$) indicate higher effect size of each component when it is assumed all factors are used together in the model, while larger t-values indicate more unique difference among factors (as long as $t$-value $> 2$ and $p<0.05$). A few coefficients are barely statistically significant (such as ICI $p=0.091$), but as noted earlier, the confidence level was relaxed to 90% for SEM.

The interdependence between culture and learning style, and their effect on performance, can

### Table 3. Culture & learning style - structural equation model proof

<table>
<thead>
<tr>
<th>Structural Equation Model Proof</th>
<th>Chi Square Proof</th>
<th>Goodness of Fit Index Proof</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degrees of Freedom = 9</td>
<td>$X^2$ Independence Model (df=36) = 2617.53</td>
<td>Root Mean Square Residual (RMR) = 3.04</td>
</tr>
<tr>
<td>Minimum Fit Function $X^2 = 19.96$ (P = 0.018)</td>
<td>Independence AIC = 2635.53</td>
<td>Standardized RMR = 0.031</td>
</tr>
<tr>
<td>Normal Theory Weighted Least Squares $X^2 = 20.00$ (P = 0.018)</td>
<td>Model AIC = 92.00</td>
<td>Goodness of Fit Index (GFI) = 0.99</td>
</tr>
<tr>
<td>Estimated Non-centrality Parameter (NCP) = 11.00</td>
<td>Saturated AIC = 90.00</td>
<td>Adjusted Goodness of Fit Index (AGFI) = 0.97</td>
</tr>
<tr>
<td>Minimum Fit Function Value = 0.028</td>
<td>Independence CAIC = 2685.69</td>
<td>Parsimony Goodness of Fit Index (PGFI) = 0.80</td>
</tr>
<tr>
<td>Population Discrepancy Function Value (F0) = 0.015</td>
<td>Model CAIC = 292.60</td>
<td>[Parsimony refers to goal of having least number of factors/variables in model to best explain theory].</td>
</tr>
<tr>
<td>Root Mean Square Error of Approximation (RMSEA) = 0.041</td>
<td>Saturated CAIC = 340.75</td>
<td>*All values significant at p&lt;0.05</td>
</tr>
<tr>
<td>90 Percent Confidence Interval for RMSEA = (0.024 ; 0.039)</td>
<td>Normed Fit Index (NFI) = 0.99</td>
<td></td>
</tr>
<tr>
<td>P-Value for Test of Close Fit (RMSEA &lt; 0.05) = 0.69</td>
<td>Non-Normed Fit Index (NNFI) = 0.98</td>
<td></td>
</tr>
<tr>
<td>Expected Cross-Validation Index (ECVI) = 0.13</td>
<td>Parsimony Normed Fit Index (PNFI) = 0.25</td>
<td></td>
</tr>
<tr>
<td>90 Percent Confidence Interval for ECVI = (0.12 ; 0.15)</td>
<td>Comparative Fit Index (CFI) = 1.00</td>
<td></td>
</tr>
<tr>
<td>ECVI for Saturated Model = 0.13</td>
<td>Incremental Fit Index (IFI) = 1.00</td>
<td></td>
</tr>
<tr>
<td>ECVI for Independence Model = 3.69</td>
<td>Relative Fit Index (RFI) = 0.97</td>
<td></td>
</tr>
<tr>
<td>Critical N (CN) = 776.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
be more fully explained at a lower level of analysis through the latent constructs. At the highest level of analysis in the model, the multicultural-learning-style interdisciplinary latent constructs (with eight factors included), directly explains 57% of the cause-effect variance of learning style and culture on academic performance (GPV).

At the next level of analysis, in comparing the two constructs with their factors included, culture has a higher beta coefficient of 0.69 (t=13.63, p=0.051), versus learning style beta of 0.19 (t=7.50, p=0.025). The interpretation of these are that since both are positive, they have an additive effect on performance (no negative correlation), with culture forming approximately three times the beta coefficient multiplier.

At the lowest level of analysis, since the learning style and culture factors in Table 2 are sorted by the partial coefficient of determinations (r²), higher positions illustrate more effect size (higher importance) in the model. Obviously those factors with high effect sizes (r²) and high positive or negative beta coefficients, will have the most mathematical power in the regression equation (and are most meaningful in the interdisciplinary model). The interpretation of effect sizes in the latent constructs is to explain how much variance captured for the particular factor. The beta coefficient is the regression line y-axis, which in effect is a slope multiplier. The sign of the coefficient (similar to correlation) indicates the direction of the effect: Positive multipliers magnify while negatives have an inverse impact. For example, a +10 becomes x=y×10, where “x” is the total effect on the factor increased by 10; therefore, if the “y” measured item was 5, the total effect on “x” would be 50. In the example above, if the coefficient were -10, the total effect would be -50. The “y” in the culture model substitutes for each of the four indexes.

To extend the example above, with an ICI multiplier of -11.12, a particular student’s ICI can be estimated by retrieving the index value (using their ethnic culture code), then it would be reduced (multiplied) by -11.12. The two sides of the model form a regression equation; subsequently, if total culture index ‘effect’ is high, then the learning style total effect would be lower, but only by a factor of about 1/3 (the ratio difference of the beta coefficient for culture versus learning). The mathematical explanation for this multiplier ratio difference is due to the much larger culture scales as compared with the ILS (0-150 versus 0-12).

The model is a balanced structural equation; thus a positive sign for any factor multiplier on one side (notwithstanding the multipliers multiplier on one side) means that the other side would need to decrease to balance the structural equation. A negative sign for any factor multiplier decreases one side, making a decrease effect on the balanced equation. The same reasoning applies to the value of the measured factor. Factors with smaller point estimates have a lower net effect on the structural equation, which is multiplied by the beta coefficient, thus factors with large negative coefficients, would have a larger decrease on the net quantitative model’s value. The magnitude of the multipliers has a larger range in the culture construct as compared with learning styles (which makes it easier to focus on culture to explain the theoretical deduction of the interdisciplinary model).

**Theoretical Model Interpretation**

Theoretically, a simple rule applies to the above technical explanation. The positive beta coefficients in Table 2 will increase performance, while negatives decrease (subject to the culture and learning construct betas, while also considering the r² effect size). The only two positive betas in the culture and learning style latent constructs are PDI (+12.69) and Input dimension (+2.28). Another consideration is that certain factors have very low betas and often low r² effect sizes, such as MFI (beta=-0.13, t=0.25, r²=0.01, p=0.051); in this model the masculine-feminine index has the least effect of the cultural factors. The most
significant factor in the model is clearly UAI (beta=-23.74, t=-14.80, r²=0.94, p=0.016), followed by PDI and ICI.

Interpreting the model is further complicated by the theoretical meaning of the constructs. In culture, lower indexes are interpreted as follows: Lower PDI means more equality focused (higher PDI suggests authority acceptance), lower UAI means more risk taking (higher is risk avoidance), lower ICI means more collective (higher is individualist), lower IMI means more caring/quality focused (higher is masculine, tangible focused). In learning styles, lower input dimension suggests verbal orientation (higher are visual), lower perception suggests sensing (intuitive is higher), lower processing values indicate active (versus reflective when higher), with lower understanding dimensions signifying sequential (as compared to global when high).

Based on this model, if a student were from an ethnic culture with a high PDI (meaning more acceptance for authority), then with all other factors being constant, this would increase academic performance. If a student preferred a visual input learning style (high interval on input dimension), this would also increase academic performance, if all other factors were held constant. The inverse applies to the other factors, UAI, ICI, MFI, perceive, process and understand, meaning that if a student exhibited a high value any of these factors (while everything else held constant), it would decrease academic performance. For example, if a student recently immigrated from a culture with a high uncertainty avoidance (such as Greece or South Korea), this would tend to decrease academic performance, where if they were from a risk-tolerant country (UK or Singapore), this would tend to increase academic performance (again, if all other factors were held constant).

**Generalizations and Implications**

If this interdisciplinary culture-learning-style-performance model were generalized to this university population, it might suggest multicultural students with ethnic backgrounds favoring collectivism, risk-taking, authority-acceptance (and to a lesser extent caring) would be likely to have higher academic grades, at the 90% confidence level. Similarly, if a multicultural student exhibited a learning style profile of visual input, sensing/facts-based perception, hands-on active processing, and methodical sequential understanding, there is a 90% likelihood they would tend to have higher academic grades. The opposite could be inferred on those multicultural students having high individualistic, uncertainty-avoidance, equal-rights beliefs, and tangible outcome focused culture, being that they may tend to have lower grades. Conversely, if multicultural students in this population favored a verbal input, intuitive perception, reflective processing and global understanding learning style, they would be 90% likely to have a lower grade.

Taking this a step further, one could extrapolate these generalizations to people in countries that have been assessed by this study (using both global culture and ILS). Nations tending to have strong collectivism, and at least some preference for risk-taking and caring as well as authority acceptance, would include Singapore, South Korea, China/Hong Kong, Nigeria, and Thailand – therefore multicultural students are likely to perform well in this context. The same could be said of the individual student (regardless of the ethnic culture), being that anyone favoring visual input, sensing perception, active processing, and sequential understanding learning styles, would likely have a higher academic performance result. At the other end of the spectrum, when a multicultural student’s culture historically exhibits strong individualism, accompanied by at least some uncertainty-avoidance, equal-rights beliefs, and usually a tangible value focus, such as Australia, Italy, and New Zealand – these students may have lower academic performance. This might suggest, according to the model, multicultural students from ethnic backgrounds
that particularly tend to avoid taking risks, expect equal rights, and are individualistic, may have more problems with academic performance regardless of learning styles, yet if there may be some balancing (compensation) for those with a preference for verbal input, intuitive perception, reflective processing and global understanding learning styles.

The practical application of this interdisciplinary culture-learning-style-performance model, is to serve as a guide in learning or problem-solving situations where these cultures and learning styles intersect. This is more likely to be the case in the academic environment when a multicultural student has the extreme opposite culture indexes and learning style as compared to their professor or student peers. This obviously could result in a less-favorable learning context. Subsequently, this model could at least highlight the potential difficulties that could arise, when there are extreme differences between cultures and learning styles.

The model may also have utility from a curriculum design perspective. If a professor were designing or simply lecturing multicultural students, the model could be used to inform the approach and materials used. Certainly it would be difficult to begin surveying students or team members then running SEM routines! However, one could focus on the most powerful factors – UAI, PDI and ICI – using those as indicators, either to predict the student may have lower academic performance (and may need additional tutorials), or, if the learning style profile could be identified, the student could be counseled to try other study approaches.

This model could be used in the business/organizational context, particularly for leadership of multicultural teams. For example, when an executive is managing/developing a multicultural team, the model suggests that learning outcomes might be higher for those members that have collectivist, uncertainty avoidance, and acceptance of authority. The other part of the model suggests that employees that have visual input, sensing perception, active (hands-on) processing, and sequential understanding, are likely to have higher (maybe faster) outcomes. There is also potentially a snowball effect, in that people with individualistic culture, dislike for uncertainty, and reject authority, while also having verbal input, intuitive perception, reflective processing, and global understanding, may indeed be challenging employees to develop into a high-performing team!

**CONCLUSION**

This study makes a contribution to global culture and educational psychology research in several ways. A critical and current interdisciplinary literature review of applied culture and learning style studies (including rival theories, proven instruments and their limitations) encourages further research. The confirmatory ordinal factor analysis and structural equation modeling (SEM) methods were explained (with benchmarks) to facilitate replication, extension, and/or criticism of this study. The sample was verified to represent a normal distribution of multicultural students across 21 countries (n=715) and the instrument was validated using triangulated statistical methods. SEM was used to create a statistically significant and parsimonious interdisciplinary multicultural-learning-style-performance model, with two latent reflective constructs (culture and learning), each having four interrelated factors, that were able to predict academic performance (X²=20, df=9, p=0.018, r²=0.57; RMSEA=0.041, GFI=0.99, AGFI=0.97). All of the research hypotheses were proven.

In terms of theoretical conclusions, the global culture and learning style were interrelated and they could predict academic performance for these multicultural students. While all factors were significant, those with the most mathematical impact on the model were (according to r² effect
size, then beta coefficient multiplier): UAI, PDI, ICI, input, understanding learning styles (with the other factors – perceive, process, and MFI - having much less impact overall). The effect of these key factors on academic performance is such that higher academic performance tends to follow from cultures of risk-taking, authority-acceptance and collectivism.

With respect to inferential conclusions, it was generalized for this population that multicultural students from collectivist, authority-acceptance, risk-taking cultures are 90% likely to have higher academic performance. Similarly, multicultural students with a learning style slightly favoring visual input, sensing perception, active processing, and sequential understanding will likely have higher grades. The opposite argument could be posed for those with an ethnic background of individualism, uncertainty avoidance, authority-rejection; as well as learning styles showing a slight preference for verbal input, intuitive perception, reflective processing and global understanding learning styles. While this is a scientific conclusion, it is given to remain objective. A subjective conclusion is that interdisciplinary culture and learning style do predict academic performance, at least as observed from these diverse international students; perhaps this is a starting point others will extend.

Limitations

As mentioned, this interdisciplinary model is a guide to better understand global culture and learning styles of international students, in terms of casual impact on their academic outcomes. It is not a predictive factor-to-factor algebraic regression formula. The cultural factors were inferred through a surrogate ethnic background variable. Albeit confirmatory factor analysis validated the a priori construct, and researcher observations of the sample concur with its reliability, more testing of culture is needed. Finally, as with any sample, despite approximating a normal popula-

tion, there is no guarantee replications would be homogeneous to this study.

Future Research

Hopefully other researchers will refine this statistically significant interdisciplinary culture-learning-style-performance model. Surveying students with an integrated learning style and culture instrument is suggested.

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REFERENCES


Multicultural e-Education


**KEY TERMS AND DEFINITIONS**

**Global Culture:** A group of human beings whose members identify with each other, on the basis of distinctiveness measured by combinations of cultural, linguistic, religious, behavioral and/or biological traits. This definition borrows from the UNESCO (2005) philosophy, that reaffirmed their famous ‘15 points’, namely: “National, religious, geographic, linguistic and cultural groups do not necessarily coincide with racial groups: and the cultural traits of such groups have no demonstrated genetic connexion [sic] with racial traits.” (UNESCO, 1950, p. 6)

**Interdisciplinary:** Integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice... it is pluralistic in method and focus. (CSEPP, 2005, p. 188)

**Learning Style:** Not a fixed trait, but “a differential preference for learning, which changes slightly from situation to situation... the same time, there is some long-term stability in learning style” (Kolb, 2000, p. 8). Learning styles are defined within this research context as “characteristic preferences for alternative ways of taking in and processing information” (Litzinger et al., 2007, p. 309)

**Multicultural:** A sample, population or group having different ethnic backgrounds (more than one ethnic culture)

**Performance:** In this study, quantitative academic outcome, such as grade score, grade point average (GPA), grade point value (GPV), a ratio type dependent variable, with a high degree of statistical precision, used as an indicator of the effects, where were predicted by the interdisciplinary culture and learning style model, to a stated level of statistical significance, quantitative performance measures provide an indication of the effect size and usefulness of such a model for international professional business e-learning and academic practice
Chapter 25

Adaptation-Oriented Culturally-Aware Tutoring Systems: When Adaptive Instructional Technologies Meet Intercultural Education

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ABSTRACT

Modern societies have a growing need for highly specialized education and traditional educational systems have a difficult time providing solutions. E-learning applications could become an important part of the solution. With improvements in network technologies and systems’ scalability, more and more globally-distributed applications are now available. Opportunities for people from varying societies to learn synchronously have thus multiplied. This being said, systems developed in a particular cultural setting and distributed around the world without taking into account variations in learners’ cultural backgrounds pave the way for potential misunderstanding and failure of adequate teaching. How might learners’ cultural background be adequately taken into consideration? How can content displayed to learners be culturally adapted? How can the most suitable strategies of interaction in accordance with learners’ cultural specificities be selected? These are some of the questions that will be addressed in this chapter.

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INTRODUCTION

With improvements in network technologies and systems’ scalability, more and more globally-distributed applications are available. Opportunities for people from varying societies to play, exchange, confront, cooperate or learn synchronously have multiplied, resulting in many technology-mediated intercultural interactions. Furthermore, with globalization, software creation and distribution is no longer confined within borders; it can be developed anywhere and distributed everywhere around the world.

Various researchers (Hofstede, 2001; House et al., 2004; UNESCO, 2007) point out that culture can have a profound impact on the way people physically interact with their environment and peers, as well as on their cognitive reasoning, such as interpretations
and affective reactions they have when faced with specific terms, symbols and situations. In order to better take learners’ specificities into account, research in e-Learning definitely needs to improve its consideration of such an issue.

Modern societies have a growing need for highly specialized education and traditional educational systems have a difficult time providing solutions. E-Learning applications could become an important part of such solutions. This said, systems developed in a particular cultural setting and distributed around the world without taking into account variations in users’ cultural backgrounds pave the way for potential misunderstanding and failure of adequate teaching. This issue is particularly complex because the representation of the domain to be learned in e-Learning systems frequently reflects the cultural values of a given author, and these may greatly differ from those of e-learners of a different cultural background.

How might learners’ cultural background be adequately taken into consideration? How can content displayed to learners be culturally adapted? How can the most suitable strategies of interaction in accordance with learners’ cultural specificities be selected? These are some of the questions that will be addressed in this chapter.

After a brief overview of the findings of previous research on cultural awareness in e-Learning systems, especially in the sub-domain of Intelligent Tutoring Systems, we discuss a generic modular architecture for designing culturally-adaptive e-Learning systems. We then describe a rule-based process for culturally selecting culturally appropriate pedagogical resources and propose a method to determine the most culturally suitable pedagogical strategy. Finally, we investigate the potential of ontology engineering for dealing with several relevant issues when developing Culturally-Aware Tutoring Systems.

BACKGROUND

In order to clearly understand some of the problems we are facing when designing globally distributed e-Learning applications, let us begin by giving a brief introduction to intercultural education. According to UNESCO’s guidelines (2007), intercultural education should:

- Respect “the cultural identity of the learner through the provision of culturally appropriate and responsive quality education for all”,
- Provide “every learner with the cultural knowledge, attitudes and skills necessary to achieve active and full participation in society”,
- Provide “all learners with cultural knowledge, attitudes and skills that enable them to contribute to respect, understanding and solidarity among individuals, ethnic, social, cultural and religious groups and nations”.

Indeed, there are many reasons to take culture and learners’ cultural differences into consideration within e-Learning systems, and as such, discuss the development of adaptive e-Learning systems aimed at providing intercultural education. Following are some examples of important e-Learning elements that have been proven to be culturally-sensitive.

Culturally-Sensitive Elements in e-Learning: Examples

In the field of adaptive e-Learning, Emotional management has been growing in importance (Conati, 2002; Chaffar, Frasson, 2004). It appears that there are strong links between culture and emotional behaviour. According to Scollon and his colleagues (2004), the frequency with which someone feels positive or negative emotions is culturally dependent. Categorizing an emotion
as positive or negative can itself, in some cases, depend on cultural background (Kim-Prieto, Fujita and Diener, 2004). Learners’ emotional behaviour can also greatly vary accordingly (Ekman, 1972; Elfenbein, Ambady, 2003, Mesquita, Frijda & Scherer, 1997).

Human motivation is also subject to cross-cultural variations. To illustrate, Elliot and Bempechat (2002) have pointed to several research initiatives that highlight cultural differences when dealing with students’ motivation for achievement. Furthermore, many different theories discuss the causes, dynamics and consequences of human motivation per se, and within almost all of the proposed frameworks, cross-cultural variations have been reported. For example, in the Self Determination Theory (Ryan, Deci, 2002), which has been shown to be especially relevant in academic settings (Reeve et al., 2004), research indicates that autonomy support, or the need for someone to see his/her behaviour as self-endorsed, is a cross-cultural way of enhancing or maintaining the motivation of people. However, methods used to fulfill this psychological need and their degrees of efficiency are subject to cultural variations (Chirkov et al, 2003; Levesque et al, 2004; Chirkov, Ryan and Willness, 2005). Finally, and in direct relation to e-Learning, Lim (2004) has shown that motivation for online learning activities is culturally-sensitive.

According to several studies (Triandis, 1995; Hofstede, 2001), national cultures can more or less favour/recognize/encourage the development of collaborative attitudes. As a result, strong assumptions are made to the effect that a culture’s collaborative or individualistic orientation has an impact on how members of this culture generally react to given pedagogical strategies. In trying to validate these assumptions, Blanchard and Fras son (2005) have interviewed people from several countries on their preferences in view of individual or collaborative learning activities. Data resulting from their preliminary evaluation seems to reflect Hofstede’s national scores of the individualism/collectivism dimension that reflects the orientation and interest of a nation towards individualist or collectivist attitudes. Biggs (2001) also strongly advocates putting more concerns when adapting Western educational practices and strategies to the rest of the world.

Other elements that appear to be culturally sensitive in terms of e-Learning include rewards allocation, or how teachers reward students and the reaction students have to these rewards (Fischer and Smith, 2003), stress caused by academic tests (Cassady, Mohammed and Mathieu, 2004), and references (for example, public figures, historical facts, artefacts) used to illustrate lessons or to describe the environmental context of learning.

Considering culture in e-Learning leads to designing “Culturally-Aware Tutoring Systems” (CATS), an innovative and quickly expanding area of research in e-Learning. We propose two varying approaches to categorizing CATS: Acquisition-Oriented CATS, or systems trying to teach intercultural skills to learners, and Adaptation-Oriented CATS or systems trying to understand the cultural profile of learners and adapt to it. Following is a brief overview of studies related to such CATS.

Acquisition and Adaptation-Oriented CATS: An Overview

Acquisition-Oriented CATS. One of the most prominent works in Acquisition-Oriented CATS should probably be attributed to Johnson and his team at Alelo Inc (Johnson, 2007) in view of their Tactical Language and Culture Training System (TLCTS). The first version of this system was used by the US army to teach soldiers the basics of Arabic language and culture before sending them to Iraq. TLCTS has been developed as a 3D serious game that provides situational learning to users by confronting them with embodied pedagogical agents that can both express cultural gestures and “understand” a specific foreign language within a cultural 3D environment. New versions of the
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Game enable training related to other areas of the world (Afghanistan, French-speaking Africa, etc.) and should be adapted for use in business. Lane and his colleagues (Lane et al., 2007; Lane, Hays, 2008) are working on a somewhat similar system named Elect-Bilat. Theirs teaches interpersonal and intercultural skills by focusing on narrative interaction within a 3D serious game. Among other things, they have rightfully pointed out that culture remains an ill-defined domain, which Ogan, Jones and Aleven (2006) also mention in their research which consists in helping students acquire cultural knowledge and intercultural competence by engaging them in activities of target-culture film viewing. Among other things, their online system uses video clips that can be paused when pre-selected culturally-interesting moments occur (Ogan, Jones, Aleven, 2008). At such moments, discussion related to cultural differences can begin.

Adaptation-Oriented CATS. Expressing some kind of cultural intelligence can be seen as the main objective of Adaptation-Oriented CATS. Cultural intelligence is defined by Earley and Mosakowski (2004) as a “seemingly natural ability to interpret someone’s unfamiliar and ambiguous gestures the way that a person’s compatriots would”. Cultural intelligence is considered to have three facets:

- **A cognitive facet (the head):** the ability to get knowledge about foreign cultures,
- **A motivational/emotional facet (the heart):** the motivation and confidence to be able to adapt to foreign cultures,
- **A physical facet (the body):** the ability to adapt actions, behaviours and demeanours according to foreign cultures.

Based on these facets, Blanchard and his colleagues (Blanchard, Razaki, Frasson, 2005; Blanchard, Frasson, 2007) have proposed a system architecture in order to adapt displayed multimedia contents according to the cultural profile of a learner and to culture-related rules. This work will be extensively discussed later in this chapter.

Studies investigating potential variations in learners’ perceptions according to their socio-cultural profile can be seen as a first step towards cultural intelligence. For instance, Johnson and his colleagues (2005) have discussed the interest of using the Politeness Theory (Brown, Levinson, 1987) as a strategy of interaction between pedagogical agents and German or US students. Baylor and Kim (2004), for their part, have demonstrated that adding socio-cultural criteria such as ethnicity to the design of pedagogical agents had an effect on learners’ appreciation of those agents.

Much research related to Human-Computer Interaction could also be applied within ITS to equip them with cultural intelligence. For instances, Nazir and her colleagues (2008) have proposed an affective model based on personality and culture-related data of users; Huang and his colleagues (2008) are working on culturally-adaptive conversational agents, whereas Rehm and his colleagues (2008) are investigating cultural differences in non-verbal communication in order to enrich interface responses.

We now take a closer look at a possible methodology for dynamic cultural adaptation based on a generic architecture of Adaptation-Oriented CATS. This is a refined and updated version of a previously presented methodology (Blanchard, Frasson, 2007).

**Designing Adaptation-Oriented CATS**

**Design Requirements for Adaptation-Oriented CATS**

In order to correctly adapt to learners’ cultural specificities, an adaptation-oriented CATS should necessarily have the two following abilities (Blanchard, Frasson, 2005):
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- **Understanding**: the system should be able to translate a learner’s behaviour/feeling/result with regards to learners’ cultural specificities;
- **Adaptation**: the system should be able to display different interfaces and/or to start different learning strategies with regards to learners’ cultural specificities.

Kashima (2000) mentions two currently coexisting approaches to culture in cross-cultural psychology. A culture can either be seen as (a) “a process of production and reproduction of meanings in particular actors’ concrete practices or actions or activities in particular contexts in time and space”, or (b) “a relatively stable system of shared meanings, a repository of meaningful symbols, which provides structure to experience”. From our perspective, a major distinction between the two definitions is the way a culture is seen as a static (a) or dynamic (b) system. Both these definitions can present advantages for e-Learning activities and should be considered when designing Adaptation-Oriented CATS.

The first definition (a) could underline cognitive assessments that are used to better understand and explain learners’ reactions in a specific context, whereas the second definition (b) could be used when explaining variations in learning results, practices and behaviors between cultural clusters. Accepting this dual definition implies that two kinds of cultural data would have to be considered:

- **Static cultural data** obtained from readings in the cross-cultural domain. For instance: *pride can be considered a positive emotion for a learner of a Western country*. A potentially valuable source of information to this effect is research on systems of values (Kirkman, Lowe, Gibson, 2006);
- **Dynamic cultural data** obtained by analyzing system use by learners. For instance: *French learners prefer to work collaboratively*. This implies developing efficient methods for analyzing learners and group of learners’ activity as well as methodologies to culturally categorize learners.

**Modular Architecture for Adaptation-Oriented CATS**

The fore-mentioned requirements have been taken into account in designing the modular architecture presented in Figure 1.

In the proposed architecture, the design of Adaptation-Oriented CATS is centered on a Culturally Intelligent Agent (CIA) that is made of two modules: a Cultural Transcription Module (CTM – for the understanding aspect) and a Cultural Action Module (CAM – for the adaptation aspect).

The Cultural Knowledge Base (CKB) is the other main element of this architecture. As mentioned in the previous part, both static and dynamic data can coexist there. Several strategies are possible for storing and organizing cultural information: from classical rule-based modules (Blanchard, Frasson, 2007) to modules based on contextual ontologies (Blanchard, Mizoguchi, 2008; Allard, Bourdeau, Mizoguchi, 2008, Savard, Bourdeau, Paquette, 2008). Cultural data can be used to explain/ describe learners (for instance, “members of cultural group X are collaborative”) or to explain in a more or less generic manner how the system should act with learners (for instances, “collaborative activities have to be encouraged for members of collaboration-oriented groups”; “usage of resource R has to be particularly encouraged when dealing with members of cultural group X”).

Cultural awareness for the purpose of cultural adaptation is obtained as follows:

First, several parameters of the user (i.e. the learner) are monitored through a Human-Computer Interaction module. Depending on its level of embedded technology, this module can monitor...
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Figure 1. A modular architecture for adaptation-oriented culturally-aware tutoring systems

Various activities coming from the learner, from mouse and keyboard activities to physiological stimuli (Blanchard, Chalfoun, Frasson, 2007). Gesture and speech recognitions are also being considered in several research projects (Johnson, 2007; Rehm et al., 2008).

Data are then processed by the Cultural Interpretation Module (CIM) that uses cultural information contained in the CKB to dialog with the Student Model Module in order to update the model of the learner.

The CIM is also in charge of providing information on the behaviour of users to a Cultural Model Module (CMM). The CMM is in charge of eventually detecting and extracting particular, sometimes unpredicted behavioural patterns expressed by learners of a specific cultural group. Data mining and machine learning techniques are naturally being considered for this purpose. When such detection occurs, information is then stored as dynamic cultural data referring to the related cultural group of users. A possible example of dynamic cultural data could be: “given learners’ behaviour analysis, when using the system, learners that are members of cultural group X appear to be competitive”. When dynamic and static cultural data provide opposite information, dynamic cultural data are privileged because they are more reality-based than theory-based.

Interaction between the specific student model of the learner and the CMM leads to determining membership of the learner to different cultural groups; this will be further elaborated later in the discussion.

Once the specific cultural model of the learner has been updated, the Cultural Action Module
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(CAM) can use it jointly with information contained in the CKB in order to determine how to use the specific database of the system. In the case of e-Learning systems, mainly stored data are related to the domain to be learned as well as pedagogical methods.

The final result of this inter-module process is culturally-adapted interaction with the learner. This adaptation could lead to an evolution of the Human-Computer Interface (physical facet of cultural intelligence). For example, the interface could display pictures related to a given situation, reflecting how it occurs in the specific original cultural context of the learner. The cultural adaptation could also consist in a specific attitude of the system (cognitive and emotional/motivational facets of cultural intelligence). For example, the system could manage learner’s emotions in a manner coherent with his/her cultural practices.

The following part gives a detailed description of a rule-based process for cultural adaptation, within the framework of the fore-mentioned modular architecture.

A Rule-Based Example of a Process for Cultural Adaptation

The original objective of the process presented in Figure 2 is to propose a method for determining the most suitable resources to be displayed to a learner in a given learning situation in order to take into account his/her cultural specificities.

This process is based on cultural information stored as facts and rules. Several points are managed in this process, including the representation of cultural groups, the representation of an individual’s cultural specificities, the representation of the interest of using a given resource with people with a certain cultural background, and the dynamic evolution of all those representations according to interaction within the system.

Modelling cultural groups. In Figure 2, two cultural groups A and B are considered. As previously mentioned, this process is grounded on a knowledge base of cultural rules. An Attribute Weight Vector (AWV) is associated to each cultural group. An AWV is a set of weights that are associated to attributes used to illustrate the various characteristics of learners that can be considered by the system. “Collaborative attitude”, “Competitive attitude”, “Risk taker”, or “Conservative attitude” are examples of possible attributes. Weights are initialized according to cultural knowledge base rules. For instances, one rule could express that being from Western countries positively correlates with “Competitive Attitude”. Some rules can also illustrate positive or negative correlations between attributes. AWV are dynamic structures: weights associated to attributes will evolve after the original initialization to better fit users real behaviour. Dynamically-deduced rules will be used for such purpose.

Each weight consists in a value between 0 and 1. If, in the AWV of a cultural group G, the weight of an attribute is near 0, the related attribute is not a good categorizer for members of G. On the other hand, if the weight of an attribute is close to 1, members of G will tend to reflect this attribute.

An important issue needs to be taken into consideration when dealing with the concept of cultural groups. Members of a cultural group aren’t necessarily alike nor do they express/endorse in the same manner all the behaviours related to their culture (Sharifian, 2003). In other words, culture doesn’t have a uniform impact on the individual members of their associated cultural group. An AWV of a cultural group describes tendencies within this group. Though it can be used to suggest several attitudes that can be adopted towards a learner, it cannot be used to clearly predict what the reactions of each member of the particular group will be. To this effect, individual modelling of learners’ cultural specificities as well as their level of endorsement to specific cultural influences are needed.

Modelling learners’ cultural specificities. Elements that need to be considered to represent learner cultural specificities are illustrated in the explanations of Figure 2.
As previously mentioned, cultural groups are described by an AWV. In a similar manner, each learner model within the system has a personal AWV made with the same set of attributes used for cultural groups (pas clair). Similarly also, associated weights represent how learner attitude and behaviour relate to each attribute.

Membership Scores (MS) are determined to illustrate the strength of the relation between the learner and each of the cultural groups defined in the system. MS are basically a distance value between the AWV of the learner and the AWV of the targeted cultural group. Thus, in Figure 12, given the fact that two cultural groups A and B are defined, personal MS.A and MS.B are dynamically computed in each student model, using the following formula:

$$MS.G = \sum_{i=1}^{n} \frac{1 - |L.AWV_i - G.AWV|}{n}$$  \hspace{1cm} (1)$$

In formula (1), n refers to the number of attributes in AWVs of the system, $L.AWV_i$ is the weight associated to attribute I for learner L whereas $X.AWV_i$ refers to the weight associated to the same attribute within the AWV of cultural group G. According to this formula, MS.G for each learner has a value between 0 and 1. If the MS.G of learner is superior to a given (arbitrarily determined) threshold, the system considers the learner as a member of G. Of course several
thresholds could be determined to reflect various membership levels.

To summarize, this fore-mentioned methodology allows the representation of cultural specificities for each learner (i.e. AWV specific to each) as well as the cultural influences to which each is subjected (i.e. MS).

**Expressing the cultural interest of a resource.** Most e-Learning systems use “resources” as basic building blocks. In this case, resource refers to any kind of document, movie, image, multimedia file, used to transmit information related to the domain to be learned. Many of these resources are culturally-flagged because they are grounded in cultural references, practices, or illustrations. For instance, the architecture of cities, thus their appearance, differs from one country to another. Using badly culturally-selected pictures of cities to situate the action of a learning activity may appear unnecessarily exotic to some learners and, in some cases, it could even distract them from learning goals. In the same way, alcohol and specific food are well accepted and considered as symbols of celebration in some cultures whereas they are prohibited in others. Thus it is important to express whether or not it is appropriate to use a given resource with members of a specific cultural group. This is the aim of Cultural Interest Scores (CIS). CIS are dynamically computed for each resource to express whether it is suitable to use it with each of the cultural group, which means there are as many CIS for a resource as the number of cultural groups. CIS have a value between 0 (not suitable at all) and 1 (very suitable). If no value is mentioned, CIS of a resource are set at 0.5 for each cultural group. However, when adding a resource to the system, authors can mention explicitly that it should/should not be used with people with certain specific cultural attributes. Consequently, CIS of a resource transform according to results gained from analysis of learners: if it is determined that a learner of a given cultural group has had success in a learning activity after using a specific resource, then the CIS of this resource related to this cultural group is increased. If a learner has failed, the CIS is lowered.

**Dynamic evolution of learner’s AWV.** AWV are not static structures. As mentioned earlier, they are initialized according to rules and facts that are present in the Cultural Knowledge Base. But they also need to reflect learner activity. Hence, when an attribute is used by the system to adapt its interaction with the learner, the weight of this attribute is raised if the learner has success, but it is lowered if the learner fails in the activity.

**Dynamic evolution of cultural group’s AWV.** A cultural group is indeed a set of cultured individuals. The AWV of a cultural group reflect the general tendencies of its members. Thus its value depends on the evolution of AWV of members of this group. The system frequently retrieves the AWV of learners who are members of a cultural group (i.e. their MS is higher than a given threshold) to update the AWV of this cultural group. The new AWV will be obtained by computing the average weight for each attribute within the members of the cultural group. The computation of this new AWV results in change in MS of learners. For instance, if a member of a cultural group G has atypical attitudes and results compared to other members of G, distance between his personal AWV and the AWV of G will rise. At one point, the value of MS.G for this learner will be lower than the determined threshold. Thus this learner will no longer be considered as a member of G by the system.

**Unsupervised determination of new cultural groups.** The system will frequently run an unsupervised technique such as Kohonen’s Self Organization Map, to determine new cultural groups. Learners’ AWV will be used as entries. Results will be clusters of learners with slightly similar AWV. If this cluster has enough members and if its AWV is sufficiently different from the AWV of already existing cultural groups, then this new group will be introduced in the system. Related MS will be determined for each learner. CIS linking resources to this new group will be initially set at 0.5.
Culturally selecting resources. The process of cultural adaptation presented in Figure 2 refers indeed to the process of selecting the most culturally suitable resource. It is thus implied that there is more than one possible resource to illustrate a given concept. This system is based on the notion of cultural templates (Blanchard, Razaki, Frasson, 2005; Blanchard, Frasson, 2007). A cultural template is a descriptive file where general information (that is not culturally flagged) is mixed with Tags for Cultural Adaptation (TCA). A TCA refers to a concept and the type of resource that is needed to illustrate it. For instance, “IMG:CITY” is an example of TCA that expresses that a culturally-suitable image of the concept of “city” should be displayed. Basically, TCA are inserted in the skeleton of an HTML page. Once the cultural adaptation is performed, the result is an HTML page where multimedia resources are selected according to the profile of the learner watching it.

Following are the details of the process of selection illustrated in Figure 2:

a) The request for finding a type T resource for a concept C to be displayed to learner L is initialized.
b) The system computes all MS of learner L.
c) The system retrieves CIS of all existing resources of type T related to concept C. For each of those resources, using previously computed MS, a Cultural Interest Score for learner L (CIS.L) is determined, using the following formula:

\[ CIS.L = \sum_{i=1}^{n} (MS.G_i \times CIS.G_i) \]  

In this formula, \( n \) is the number of currently existing cultural groups, \( MS.G_i \) is the Membership Score of learner L for the cultural group \( G_i \) and \( CIS.G_i \) is the Cultural Interest Score of the resource for the cultural group \( G_i \).

d) The chosen resource, i.e. the one with the biggest CIS.L value, is displayed to learner L.

To summarize, this process is used to answer the question of “what” has to be presented to a learner in order to take his cultural specificities into account. Based on that, a short methodology is proposed in the next part to answer the question of “how” this should be presented: this point discusses the culture-based adaptation of the pedagogical attitude (i.e. the selection of the most culturally-suitable pedagogical strategy) within an Adaptation-Oriented CATS.

A Methodology for Culturally Selecting Pedagogical Strategies

The methodology used to determine which strategies should be used with a learner, according to his cultural profile, is directly inspired from the previously described process for the selection of culturally-relevant resources.

When a pedagogical strategy is defined within the system, it is more or less linked to any of the existing pedagogical attributes i.e. each attribute is associated with a value \( \omega \) that expresses the strength of its importance for the strategy (the sum of all \( \omega \) equals 1).

Furthermore, a cultural rule may be specified by the author for any strategy. Depending on the cultural specificities of a learner (for instance, the learner is from a Western country), the rule determines a multiplier \( \sigma \). For example, the resulting \( \sigma \) should be 0 if the learner has some cultural specificities that result in the proscription of the related strategy. But if this strategy is particularly relevant given the learner’s cultural profile, \( \sigma \) could be set to 1.5, 2, 3 or even more. If there is no specified cultural rule, \( \sigma \) is set to 1. Figure 3 describes a method for obtaining the Cultural Interest Score (CIS) of a strategy S for a learner L.

Function used to obtain the CIS of a strategy S for a learner L is the following:
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In formula (3), n refers to the number of attributes in AWVs of the system, \( L.AWV_i \) is the weight associated to attribute i for learner L whereas \( S.\omega_{AWVi} \) refers to the importance of attribute i for the strategy S. Finally, \( L.\sigma_s \) is the cultural coefficient obtained from the rule associated to strategy S, according to the profile of learner L. The selected strategy will be the one whose \( C_{IS_sL} \) is the highest for learner L.

**Issues Related to Cultural Data**

Existing cultural data are not always reliable for educational use. This is a major issue. Indeed, preeminent cross-cultural studies have mainly been developed for and within the context of leadership or business research (Hofstede, 2001; House et al., 2004). Legitimate concerns can be raised as to how (and whether) findings can be transferred and used within educational settings. Furthermore, there is no consensus on the reliability of these studies and their respective methodologies (Earley, 2006; McSweeney, 2002; Smith, 2006) even though many empirical studies discuss and “validate” their correctness and usefulness (Kirkman, Lowe, Gibson, 2006).

Representations of cultural data as well as the focus given to specific categories of cultural data vary from one research domain to another. All domains addressing cultural issues (sociology, psychology, management, anthropology, statistics, etc.) have particular ways of dealing with them. This can cause information consistency problems within CATS if data are obtained from several sources that don’t have a common method of formalization.

A given culture is too complex to be fully modelled. What cultural data are consequently sufficient to circumscribe a decent model of a given culture? How could acceptable results be obtained from a given model? These are crucial questions for the development of CATS.
Culture-related research/development may be biased by authors’ personal profile. It is well-known in cultural research that analysis of a culture by a person foreign to that culture may be biased by interpretation based on that person’s cultural values even if methodologies such as participant observation (DeWalt, DeWalt, Wayland, 1998) have been proposed to minimize such bias. As cultured agents, course authors and designers are prone to such cultural bias. In some cases, authors may simply not consider possible categories of behaviour because they may not be aware of their existence. One solution is that authors be members of the culture being modelled, which still raises the problem of ensuring authors’ objectivity. Because CATS are dealing with critical information on how people perceive the world (and thus how they will interact with it), reliability of data is especially important. This means that stereotypes, interpretations and propaganda must be proscribed, to the extent that this is possible. Furthermore, teaching intercultural skills within Acquisition-Oriented CATS should be based on learners’ original perception of the targeted culture (i.e. the understanding and appreciation of the targeted culture within the learner’s culture) in order to express how this differs from “reality.” For instance, teaching about French culture should differ according to whether learners are German or Japanese because they don’t necessarily share similar knowledge and beliefs about the French culture.

These are a few of the many issues that have to be considered when designing CATS (Blanchard, Mizoguchi, 2008). We now discuss how the use of techniques related to the domain of conceptual ontology engineering could lead to interesting solutions to better design CATS.

Conceptual Ontologies for Representation of Cultural Knowledge

According to the IEEE Standard Upper Ontology Working Group (SUOWG: http://suo.ieee.org/), an ontology “is similar to a dictionary or glossary, but with greater detail and structure that enables computers to process its content. An ontology consists of a set of concepts, axioms, and relationships that describe a domain of interest”. By “conceptual” ontology, we mean that the identity of a node (concept) is related to its parts and properties, whereas its semantic label is secondary (even if a correctly chosen label remains helpful) (see Guarino, 1998; Mizoguchi, 2003; Mizoguchi, 2004, Sowa, 1995). In other words, conceptual ontologies refer more to the philosophical essence of concepts than semantic-oriented ontologies.

One of the potential interests of conceptual ontology should be to determine trans-disciplinary core concepts of culture and the relations existing between them. This is the aim of the currently being developed Upper Ontology of Culture (UOC - Blanchard, Mizoguchi, 2008). According to the SUOWG, an upper ontology “is limited to concepts that are meta, generic, abstract and philosophical, and therefore are general enough to address (at a high level) a broad range of domain areas. Concepts specific to given domains will not be included; however, this standard will provide a structure and a set of general concepts upon which domain ontologies (e.g. medical, financial, engineering, etc.) could be constructed”.

The aim of UOC is consequently to identify major constituents to be considered when dealing with any kind of cultural issue. In other words, the UOC tries to elicit and define trans-disciplinary core concepts of culture and the relations existing between them. One has to clearly understand that the goal of UOC is not to directly capture cultural differences, but to capture the essence/structure of culture and culture-related elements, which in
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Figure 4. The use of an upper ontology of culture for CATS development

There are three kinds (specializations) of cultural entities:

- **Socio-cultural entities** whose members are related to each other within a social structure, and whose history can be discussed. Civic nations, ethnic nations, area-related entities (for instance the citizens of a specific city), companies and communities are specializations of socio-cultural entities.
- **Quality-based cultural entities** are virtually-created cultural entities, based on some shared qualities of their members. Such entities don’t have a real history. For instance, the entity associating soccer players with the shared culture related to soccer is an example of a quality-based cultural entity.

Figure 5. The concept of cultural entity and its specialization in UOC
• **Hybrid cultural entities.** For instance, the entity related to “African-American” is based on a non-social criterion (the “African” criterion refers to people with very different socio-cultural origins and history, that share non-social attributes such as skin colour). However, African-American have organized themselves in the course of history and developed a social structure (it is sometimes referred to as a community).

Structures determined in the UOC and in similar initiatives linking researches on CATS and ontology engineering (Allard, Bourdeau, Mizoguchi, 2008; Savard, Bourdeau, Paquette, 2008) already hold valuable information to be used in processes aiming at providing cultural intelligence. Those structures also could be used as formalisms to improve the elicitation of cultural data, as guidelines for defining data structure to be used to represent various kinds of cultural knowledge and their specificities (artefacts, beliefs, norms, behaviours, traditions, rituals, references). Processes for peer-validating cultural knowledge could also profit from this shared cultural corpus.

**CONCLUSION**

Adaptation-Oriented CATS development is a very promising field that aims at humanizing computer-assisted education by considering the cultural background of learners as well as the cultural context of learning sessions. In this chapter, we have defined several important notions related to those systems. We have proposed an architecture as well as processes for bringing cultural intelligence in tutoring systems. We have reviewed how the use of ontology engineering techniques could help researchers on CATS deal with several inherent issues related to culture-related software, especially by providing structures and norms for dealing with the ill-defined domain of culture.

In addition to what we have discussed in this chapter, several other issues related to CATS design could be tackled. Ethical considerations, assessment of the quality of cultural data, distinctions and management of appreciations of members of a cultural group compared to perceptions of foreigners, are some of the many points that will necessarily have to be addressed in the future.

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**REFERENCES**


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**KEY TERMS AND DEFINITIONS**

**Intelligent Agent:** An intelligent agent is generally described as an autonomous software which has different capabilities such as reactivity, the ability to perceive its environment and to adapt to changes, proactiveness, the ability to take initiative to have a specific behavior, and social ability, the ability to communicate/interact with other agents.

**Multi Agents System:** A Multi Agents System (MAS) is a software system composed of several agents that can be more or less complex and “intelligent”. Most of the time, these agents act together in order to reach a common goal that accomplishes more than what they could achieve individually.
**Intelligent Tutoring System:** An Intelligent Tutoring System (ITS) is a computer-supported learning system which uses Artificial Intelligence Techniques in order to adapt to the learner. An ITS is composed of four inter operating modules: the curriculum or expert model that contains the domain to be taught among other things, the student model that is the representation of the learner, the planner that organizes the learning session and the tutor that gives the course.

**Pedagogical Agent:** A pedagogical agent is an intelligent agent that provides interactive teaching on a subject matter according to pedagogical strategies. In virtual worlds, a body can be assigned to a pedagogical agent. This variant is called an “embodied pedagogical agent”

**Culturally-Aware Tutoring System:** A Culturally-Aware Tutoring System (CATS) is a specific kind of Intelligent Tutoring System, whose purpose is to provide intercultural education. CATS that try to teach intercultural skills to learners have to be distinguished of CATS that try to adapt to learners’ cultural specificities. Mixed systems are also possible.

**Intercultural Education:** According to UNESCO, intercultural education should respect “the cultural identity of the learner through the provision of culturally appropriate and responsive quality education for all”, provide “every learner with the cultural knowledge, attitudes and skills necessary to achieve active and full participation in society” and, finally, provide “all learners with cultural knowledge, attitudes and skills that enable them to contribute to respect, understanding and solidarity among individuals, ethnic, social, cultural and religious groups and nations”

**Ontology:** According to the IEEE Standard Upper Ontology Working Group, an ontology “is similar to a dictionary or glossary, but with greater detail and structure that enables computers to process its content. An ontology consists of a set of concepts, axioms, and relationships that describe a domain of interest”

**Upper Ontology:** According to the IEEE Standard Upper Ontology Working Group, an upper ontology “is limited to concepts that are meta, generic, abstract and philosophical, and therefore are general enough to address (at a high level) a broad range of domain areas.”
Chapter 26
Asian American Perspectives on Education and Technology

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ABSTRACT

This chapter, based on fieldwork conducted in 2007 at a large public university in Hawaii, explores Asian American college students’ relationships with education and technology, and the role of educational and technological factors in their process of negotiating professional and cultural self-identities as contemporary Americans of Asian descent. The chapter elaborates upon the following key factors in this regard emerging from the study: (a) Education; (b) Access; (c) Prestige; (d) Survival; (e) Avoidance; and (f) Transnationalism. The chapter subsequently outlines a theoretical framework – based on Willis’ (1977) reformulation of the Marxian concept of “praxis” – characterizing the informants’ educational and technological endeavors as proactive attempts to create an empowered self-identity in response to their socio-cultural environment.

INTRODUCTION

This article seeks – with the aid of insights obtained from in-depth interviews conducted among informants sampled from a large public university in Hawaii – to describe the complex issues pertaining to the negotiation and development of professional and cultural self-identity among Asian American college students. From the perspective of our field, investigating the roles played by education and technology in this regard should be of particular interest, given that Asian Americans collectively exhibit some of the highest levels of educational attainment and technological access amongst the different cultural groups making up U.S. society – and display a disproportionately strong presence in the technical professions – all while simultaneously facing a plethora of socio-economic, political and cultural challenges owing to their ethnic minority status in their country of citizenship.

Policymakers, researchers, and educators have historically ignored Asian American issues; the
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traditional scholarship about race in the U.S. has for long focused primarily on the dichotomy between black and white, with occasional forays into Latino/a and Native American issues (see Yu, 2001; Wu, 2002a). Particularly within our discipline of educational technology – a field long distinguished by its remarkable neglect of racial and cultural factors (as documented in Subramony, 2004) – issues facing Asian American learners have received little to no attention whatsoever (see Subramony, 2007). This article may be seen as an attempt to set the ball rolling in this regard. It seeks to examine the place of education and technology in the lives of young Asian American college students pursuing a variety of academic and professional career paths, with a view towards understanding their relationship with these realms, and the role that educational and technological factors might play in the latter’s process of negotiating their self-identity in a society wherein they occupy a rather unique place (as detailed below).

**A “HYPENATED” CONDITION**

Citizens of Asian ancestry – constituting 4.3 percent of the U.S. population in 2005 (U.S. Census Bureau, 2007) – form an important part of the U.S. social fabric, and – from the perspective of scholars interested in exploring the complex intersection of education, technology, race, culture, and power – must clearly constitute one of the most remarkable groups of learners and technology users in the country, given how they occupy such a distinctive position within the U.S. socio-economic system, one that is “hyphenated” just like their label sometimes is.

On the one hand, commentators have frequently described Asian Americans as a “model minority,” given their impressive aggregate socio-economic, educational, and technological achievements in comparison to other racial groups (see Humes & McKinnon, 2000). Specifically education- and technology-related factors named in this regard include: (a) Asian Americans constitute the best-educated ethnic group in the nation (Humes & McKinnon, 2000); (b) Asian American students’ enjoy a disproportionately strong presence in elite educational institutions (Yin, 2001; Stafford, 2006); (c) Asian American students are overrepresented in the high-status STEM (science, technology, engineering, and mathematics) fields (Farrell, 2005; Schmidt, 2006); (d) Asian Americans display the highest levels of access to computers in the nation (Rohde & Shapiro, 2000; Cooper & Gallagher, 2004; Borja, 2005); (e) Asian Americans count among the heaviest Internet users in the nation (Spooner, Rainie, & Meredith, 2001); and (f) Asian Americans are over-represented in specialty professional and technical occupations (Humes & McKinnon, 2000; Ong, 2004).

On the other hand, much has been written about the evil effects of the “model minority” label (see Prashad, 2000; Cheryan & Bodenhausen, 2000; Yin, 2001; Wu, 2002b). Meanwhile, a host of other socio-cultural factors also serve to offset the economic, educational, and technological gains made by Asian Americans and consign them into the margins of society. They include: (a) the “perpetual foreigner syndrome” – which, based on the traditional view of real “American” being exclusively white, places an indelible stigma of foreignness upon Asian Americans, even those who have been in the country for generations (Takaki, 1993; Wu, 2002a; Wu, 2002b; Osajima, 2003); and the closely related problems of (b) “invisibility” – referring to the disproportionately small presence of Asian Americans in U.S. news media, popular culture, and national consciousness (Zia, 2000; Wu, 2002b); and (c) the so-called “bamboo ceiling” – referring to the virtual absence of Asian American leaders within the nation’s corporations and government (Saigo, 1999; Gupta, 2006).
METHOD OF INQUIRY

This article is based on dialogical data generated via in-depth open-ended interviews conducted with 20 native-born Asian American students at a large public university in Hawaii in 2007. The final sample included eight undergraduate and twelve graduate students; seven were male and 13 were female; five were pursuing majors in various education-related fields, three were majoring in physical science disciplines, five in life science disciplines, and seven were pursuing professional degree programs. The informants comprised individuals of Japanese, Chinese, Filipino, and mixed Asian ancestry. Ten had at least one parent who had obtained a college education at a bachelor’s degree level or higher. The informants’ parents ranged from first- to fifth-generation immigrants. Fifteen informants described their family socioeconomic background as being “middle class” or higher.

All informants were recruited on a purely voluntary basis, using a snowballing or chain-referral sampling technique – beginning with a small number of initial informants and subsequently enlarging the informant pool by means of referrals from previously-recruited informants – which is considered particularly suited to sampling racial and ethnic minority informants (see Kalsbeek, 2000). Informants were questioned with the assistance of an interview protocol based upon noted critical ethnographer Phil Carspecken’s (1996) model, which aims to provide sufficient structure to guide questioning while retaining adequate flexibility to permit customization. All interviews were digitally recorded and transcribed. All informants cited here have been given pseudonyms.

HAWAII’S ASIAN CITIZENS

At 41.5 per cent in 2005 (U.S. Census Bureau, 2007), Hawaii’s figure of Asians as a percentage of its total population is the highest in the nation. Hawaii also features one of the longest histories of Asian settlement among the 50 states. The ubiquitousness of Asiatic faces across the state – 45.3 per cent of firms within Hawaii in 2002 were Asian-owned (U.S. Census Bureau, 2007), and Asian Americans form 60 per cent of the student body at the University of Hawaii (Grant & Ogawa, 1993) – and the relative visibility of Asians within the state’s political and administrative circles have encouraged the view that Hawaii’s Asians enjoy more security, harmony, enfranchisement and belonging than Asian Americans living in the “Mainland.” Hawaii has traditionally been depicted as a multicultural island paradise with little social conflict (Jung, 1999), a mid-Pacific melting pot where no one race dominates others, an East-West crossroads imbued with the spirit of aloha (Grant & Ogawa, 1993). Consider how Brian – a Chinese-American graduate student in architecture – compares the social scene at his local university with that at the Mainland school where he obtained his undergraduate education:

There is much more mixture of friends and associates here than it was in the Mainland ... When you walk into the food court here, there are just so many different ethnicities there that you can pretty much sit with anyone and be OK with it. And they are a lot more accepting of people according to who they are, not what ethnicity they are, it is a culture of hey, there is a seat here, just sit down. I have never felt racism or any type of discrimination here ... Because our culture and the way we are brought up, we are brought up on that aloha spirit, everybody is your friend ... you did not really point that out like “Oh, you guys have that one token black guy in your group,” it was always by name, that is so-and-so. So there is a big distinction ... I have seen it in my friends who are Asian and from the Mainland, they would remark like “Oh yeah, stay right here,” there is a lot of fear of hanging out with different groups, because they do not want to be grouped into them or be talked about...
An examination of historical and demographic data, however, reveals a much more complex picture of Hawaii’s society and ethnic Asians’ place within it. While aggregate figures suggest that Asian Americans form the largest segment of Hawaii’s population, works like Jung (1999) remind us that, in contrast with the Mainland, collective, pan-Asian categories like “Asian American” hold little social meaning in Hawaii – and if such a label is used, it often does not include Filipino-Americans. In his assertion that there are no “Asians” in Hawaii, Jung emphasizes that immigrants of different Asiatic ethnicities have had distinct socioeconomic and political experiences during the course of the history of Asian settlement there; they have traditionally occupied distinctly different positions in Hawaii’s racial hierarchy.

Even today, Japanese and Chinese-Hawaiians continue to enjoy higher levels of economic security and higher occupational status than Filipino-Hawaiians (Grant & Ogawa, 1993), and display significantly higher college graduation rates than the latter (Makuakane-Drechsel & Hagedorn, 2000). Different Asiatic immigrant groups in Hawaii have also historically experienced fundamentally different racisms; while Filipinos faced contempt and condescension from white Hawaiians, the Japanese faced xenophobia and suspicion (Jung, 1999). White plantation owners – who dominated Hawaii for most of its history – also actively promoted ethnic separateness and encouraged preexisting prejudices between the various Asian ethnic groups as part of a divide-and-rule management policy (Grant & Ogawa, 1993).

The last point above underlines the truth that – notwithstanding the large number of Asiatic peoples in Hawaii – whites have always controlled the state politically, socially and economically. Traditionally, Hawaii’s racial hierarchy has involved Anglo-Saxons, Portuguese, Japanese, and Filipinos occupying positions in descending order of power (Jung, 1999). Even today, whites actually form the largest racial group in Hawaii – at 33 percent of the population – and firmly hold on to the reins of power. They control management of the vital tourist industry and dominate other critical policymaking arenas; even at the University of Hawaii, where over 60 percent of the student body is Asian American, 75 percent of the faculty is white (Grant & Ogawa, 1993). Allan – a mixed Japanese-Chinese doctoral student in educational administration – sums up the cultural situation thus: “Hawaii they called it the “melting pot,” and while (there are some attempts here) to embrace the (non-Western) cultures, the Japanese culture, the Chinese culture, I think there is an emphasis at least at (educational) institutions that we conform to Western standards, you know, Western standards of learning, Western standards of dressing but … we would have “Cultural Awareness Month,” you know…”

KEY FACTORS

The following sections of this paper elaborate upon some of the major factors – surrounding the informants’ relationships with education and technology, and the role of educational and technological factors in the process of the informants negotiating their professional and cultural self-identities as contemporary Asian American citizens – that were unearthed from this study. These factors have been labeled (a) Education; (b) Access; (c) Prestige; (d) Survival; (e) Avoidance; and (f) Transnationalism. Elaborations of the aforementioned factors are illuminated as much as possible with “direct” informant quotes; however, as with all qualitative study reports, the author’s overwhelming desire to provide exhaustive quotational or anecdotal data is invariably tempered by unavoidable logistical issues (i.e. page limits).
Education

Much has been written about the vital role of family influences in Asian Americans’ academic and career paths and performance (see Schneider & Lee, 1990; Kim, 1993; Leung, Ivey & Suzuki, 1994; Mathews, 2000; Asakawa, 2001; Tang, 2002). It was therefore not surprising that every one of the informants interviewed for this study underscored the role that their families played in emphasizing the importance of higher education. As Nancy – a Japanese-American undergraduate student in bioengineering from an affluent background – explained:

“I know for (Asian Americans like me) it was very important to have at least a college degree, you had to have it, and my friends as well, my fellow classmates, and the friends that I hang out with even today who don’t have advanced degrees, it was very important for them to have a college degree, I know a good friend of mine spent almost ten years pursuing his bachelor’s degree, and the parents would pay every semester for him to attend a Mainland college, because they told him he could not come home until he got his college degree (laughing). So it took him ten years to finish but he did eventually have one. At least speaking for Asian Americans I think it is among the highest priorities to have a college degree.”

Meanwhile, the testimony of Corey – a mixed Chinese-Filipino doctoral student in computer science from a modest socio-economic background – also suggests similar priorities:

My parents did not make a whole lot of money, but what they did make they put into my schooling and they made me very aware of how much they were spending and why they were spending that much money even though they did not make $80,000 a year or $100,000 a year, to send their child to a private school at that price, when you are making $20,000 (a year), so it was rough, and that is why my (extended family wanted) to help, and did put in so much money for me to go to these kind of schools, hoping that I would receive a good education … Coming from experience, being an Asian American, I think it is really important to not only get a higher education degree but to succeed … you have to get a college degree, and I remember (my parents) showing me a chart, saying “With this education level you get so much in average salary, with college education you get thus much,” so you see a visual graphic of how much a person can make being a high school graduate and a college graduate…

Besides, Ellen – a Japanese-American undergraduate student in journalism – described similar expectations coming from her predominantly Asian American teachers at school as well:

There was an expectation to do well from my teachers as well as my parents. The teachers … who were also predominantly mixed Asian, Japanese, Chinese, Vietnamese, Korean … expected me to be good in all subject areas (laughing), when you go to an elite (private) institution I think every subject area you should be doing very well, and, you know, your teachers expect that, your parents expect that, since you are paying so much money to attend these types of institutions, so when you don’t meet those expectations they were very upset, and this went on for four years, so it was hard for me to deal with at the time.

Access

Asian American households are amongst the most wired in the nation: 77.7 per cent of Asian American K-12 students had computers at home, compared with 74.6 per cent of their white peers (Borja, 2005). This leadership in computer ownership persists even at the lowest end of the socio-economic scale – at income levels of less than $15,000/year, 39.4 per cent of Asian American households owned computers, as compared to 22.8 per cent of white households (Rohde & Shapiro, 2000). Hence it was
not astonishing when all 20 informants interviewed reported enjoying access to computers at home even back when it was a relatively rare phenomenon. This included informants who reported coming from less affluent family backgrounds, like Delia – a Filipino-American undergraduate student in environmental science:

It was very financially taxing for my parents to buy me that computer and the technology, absolutely, coming from a lower socio-economic status I think it is definitely much harder to put in for education for your children, it is definitely harder to have your children succeed when you do not have a lot of things, when you do not have the best place to live, you do not have access to educational materials, and access to different types of learning styles, different ways to learn ... They saw (the computer) as an educational tool that was worth investing in, and that it was worth it for me to understand how to use it, at that time having a computer in your home in the early nineties was, you would have to be somebody of a higher socio-economic status in order to have one, but for (my parents) to spend $2000 at that time was a lot of money ... and I think they see it as an investment, another tool as an investment for receiving a better education.

Corey also related a similar narrative:

My first computer I got when I was twenty. My parents bought it for me, it is a big financial sacrifice for them to do that. It was a $2,500 computer, 15-inch screen, Acer, I remember, Pentium 75, at the time it was really pricey, but I explained to my parents the value of what the computer could do, printing needs, research needs, e-mailing, it is all new to them, but I am explaining to them, I need it because of all these things, it will help further my education, which, that alone convinced them that OK, it is worth it. So it was pricey but they did see what they were investing in, that it was really an investment for my education.

Prestige

Census data, the news media, and the scholarly literature all suggest that Asian American workers are disproportionately represented in the prestigious and economically influential STEM fields and their associated technology-intensive industries/professions (see Humes & McKinnon, 2000; Ong, 2004; Chu, Mustafa, Kloberdanz, & Bower, 2006; Gupta, 2006). Leung, et al. (1994) have discussed what they refer to as the “prestige hypothesis,” suggesting that Asian American parents often encourage their children to consider occupational alternatives that are “highly valued” in U.S. society and provide many job opportunities, and describing Asian Americans as being “more likely to consider college majors and occupations in the science and technical areas than other areas because they placed a high value in selecting high prestigious career options. It was a means to attain upward mobility…” (p. 404) Accounts by multiple informants interviewed for this study appeared to be congruent with such a hypothesis, and could be heard across a spectrum of socio-economic class backgrounds. Take the words of Roger – a Chinese-American graduate computer science major– whose parents both held Associate’s degrees and worked as a mechanic and a nurse respectively:

(A) lot of us were taught (by our parents) to learn like “You have to know your math!” ... “Be strong in your math!” Your other subjects are not as important as your sciences. Your science and math are important because ... when you get into a career, you will get into one that is better ... I was good in art, my parents never told me to focus on art, they were like “Do your math homework! Let me see your math homework! Complete that!” They found that the other humanities subjects do not get you good jobs, they find them superficial, like “What are you going to do with a history degree?” That is their mentality. There are jobs for it, of course, but they never focused on it, they were more focused
on “Do your math, if you have trouble we will help you, your sciences, your chemistry, your physics.” My friends too, a lot of us, they were science and math focused … So (our parents) did rank what we did in life according to what major you were on … as long as you are doing one of those hard sciences kind of thing, they were happy with it. They saw (arts and humanities) more as, for the lack of a better word, “frou-frou,” they were more concerned about what kind of jobs were you going to get with a sociology degree, there are jobs out there, but they never saw it as, there is always a need for a nurse, if you wanted to get into nursing, there is always a need for any of the “certified” kinds of majors, there would always be a need for architects, the “professional” degrees.

Meanwhile, Karen – a Japanese-American graduate student in biochemistry – whose parents both held advanced professional degrees and worked as an engineer and an accountant respectively, also painted a markedly similar picture:

I think, as a career, there is an implicit pressure to choose something … where you can apply your skills in an industry that can pay you a decent salary … (Our parents) have seen that the successes that have come their way, monetary successes for example, have often come from technical and technically-based professions. A lot of (Asian American people they know) who are rich, are not rich because they were famous writers, they were rich because they studied computer science and (moved to Silicon Valley in California) and became entrepreneurs and their companies went public and so now they are making millions. So this idea of making money, of moving up the class ladder is very much, to them, is related to excelling in technical professions … When I was growing up, if I didn’t do that well in (math or science, my parents) would be more stressed about it than if I didn’t do well in (English). They just you know, valued those subjects more because those were what were going to give you your bread and butter…

Survival

(Asian immigrants’) only (way) out to a better life for their children is to receive an education, and I know when my great-great-grandparents first started here they worked minimum wage jobs, they worked in the sugarcane, they worked in the farming communities, and … it takes generations for that to accumulate wealth … A lot of the Asian American parents see education as a tool or a means for upward social mobility for their children, and I think it is one of the few options that they do have.

Mixed Chinese-Filipino undergraduate accounting major Sally’s account above – and also to an extent Karen’s and Roger’s in the preceding section – serve to illuminate how what comes across as an ambition for “prestige” may alternatively be seen as a struggle to survive in a land where one’s people wield little political or cultural power. Scholars have noted a desire among Asian Americans to choose occupations “that could give them the greatest survival value in the U.S. social structure” (Leung, et al., 1994, p.404). Tang (2002) describes how many Asian American parents, because of their own experiences, believed in accepting careers that were practical and financially rewarding for earning a living, and thus expected their offspring to major in engineering or medicine so as to increase their chances of gainful employment after graduation. Asian Americans, “as a minority group in U.S. society, have experienced many difficulties simply surviving or meeting basic needs … therefore, a practical job would make them feel safe. (For them) survival and financial security (are) probably the most important concerns. Jobs in science and technology areas are relatively stable and secure and, therefore, meet the needs of Asian American parents.” (p. 131) Jason – a Japanese-American elementary education undergraduate student – explained his predicament:
When I told my family my decision to major in (elementary education) my dad was like “How are you going to support a family on a teacher’s paycheck?” Even my friends were like “Dude, that is a job for white (women)! You need to go to like (medical) school…” The idea basically was that as a guy I am supposed to be like the breadwinner, the provider for my family, and I am supposed to have this high-paying job that would let me do that easily, you know ... Teaching elementary school was something that I could do if I was a married woman, if I had a rich husband who was bringing in the “real” money, and I was just doing it because I wanted to do it and I liked doing it, not because I needed to support a family or anything...

Now while Jason’s words appear to betray blatant stereotyping of occupational roles by gender, upon further discussion he revealed that his older sister was actually in medical school and that multiple female cousins were pursuing careers in STEM fields. Leung, et al. (1994) have described how Asian American women were considering occupational alternatives that were non-traditional for women, and both male and female Asian Americans were being encouraged to pursue occupations with high prestige and social recognition.

Avoidance

Meanwhile, researchers have also discussed how Asian Americans’ “perceived limitations in (upward social) mobility in non-educational types of endeavors increase the relative value or function of education as a means of achieving success in a society where they have experienced occupational discrimination” (Asakawa, 2001, p. 185). This leads them “to avoid occupations that could bring them into direct contact with racial and cultural discrimination,” and makes scientific, engineering, and technical occupations – “which were less interpersonal in focus” – more logical educational and professional choices (Leung, et al., 1994, p.404). Linda – a Chinese-American graduate student in chemistry – suggests such an outlook:

I remember my dad himself would say, “You know, no matter how many ever generations we have been in this country, we will always be (seen as foreigners)” ... He would say things like, “It is in our blood. Whatever it is we can never be the managers, we can never be the executives of these companies. We do not have that kind of built-in aggression ... We have technical expertise, we have those kinds of skills and that is what we need to use and that’s how we are going to be able to survive in this country.” So he kind of, in a way already sort of pigeonholes the capacity for (Asian) people in this country as being something of a technical nature and that, this is what we are here to do. On the one hand, I think I appreciated that comment ... because in one sense I felt like ... he is recognizing the sort of power politics, the racial politics that exists in the United States, I think that is true. On the other hand I felt like, if you are raising ... (children) in America, then why sort of preemptively, show them the (lack) of possibilities in their lives by saying that this is what we are supposed to do, when we are very capable and we are being educated in the same system as our white peers, so why is it that we should not consider things like entering politics or doing literature, and those sort of things. So I always felt that it was kind of a weird statement and not right in some sense, but I also understand where these are coming from, I think there is some truth to these things too...

Such “pre-emptive” behavior as described above might also be a result of occupational stereotyping and discrimination of Asian Americans in society. As Tang (2002, p. 131) explains, “The stereotype that Asian Americans excel in science and technology-related occupations makes young people mistakenly believe that they can only be
successful in these areas. Vicarious learning, or seeing others being successful, is an important source for individuals’ self-efficacy … When Asian Americans see many of their peers pursue careers in science and technology and very few pursuing careers in the humanities or the social sciences areas, they come to believe that Asian Americans should choose an occupation in science and technology.”

Transnationalism

Noted anthropologist Aihwa Ong (1999, 2004) discussed the concept of “flexible citizenship” in describing upwardly mobile Asian immigrants’ “diving into the ocean” (2004, p. 60) as part of a “global accumulation strategy to reposition oneself and one’s family within the global arena of competing intellectual and economic markets.” (2004, p. 61). For these modern-day intellectual, professional and entrepreneurial nomads, horizontal mobility of skills is key to fulfillment. Similar desires for transnational flexibility were noticeable in the accounts of multiple informants, all of whom saw STEM proficiencies as the answer. Take for instance the reasoning of Tania – a mixed Japanese-Chinese undergraduate computer science major:

Math and science are constant throughout, globally, education-wise, a meter is a meter, and if you fall at a rate of 9.8 m/s here in the U.S., you will fall at exactly 9.8 m/s in China, so no matter where I go, my math and science will not change … if you get the core and the basics sound, you get the fundamentals with this, you can go to any university you want … (This “universality” of STEM knowledge) allows you to move equally in a parallel motion, I guess, if I wanted to do computer programming technology or research here, if I went to Russia, I could mimic the exact same research and development, my population would change, the culture would change, but what I am researching, which is the technology, would not change. Rather than if I was doing (a humanities discipline) here in the U.S., versus Russia, it changes. I would actually need to learn the culture and the people, there is a lot more I would need to learn before I could go and start researching on it, but if you are with the sciences or technology, it is not really going to change between here and another country, Mexico or…

This, of course, would beg questions such as: Why do you need to espouse such a “global” perspective? Why is such “universality” of knowledge/skills so important? Is it assumed you are going to move out of Hawaii? Because if you are going to be here all your life it would not matter if things were different within any given profession, say, in Russia, right? Wayne – a Japanese-American graduate student in physics – had the following to say in response:

(It is) about the opportunities. So by doing something (“universal” like a STEM discipline) I can move wherever I want to. I can choose where I want to live. If I do not make enough money here in Hawaii, I can get up and move to California, I would be doing the same thing and getting paid more money. If I do not like it here, if I do not like the weather, if I like cold winters I can move to Michigan and stay there, I would still be doing the same things as here, just in a different environment. I would be able to move because of that universality of technology.

Ong’s account of the transnational mindset of ambitious Asian immigrants/expatriates, and accounts such as those of Tania’s and Wayne’s raise the question of: Might such a desire for horizontal mobility and flexible residency be fundamentally related to a particular mindset arising out of a relatively recent family history of immigration? Fiona – a Filipino-American graduate student in educational technology – shared her own experiences in this regard:
It is one of the essential things that we have been passing on throughout our family, and it is that mobility, if you move up in education, you can move away, you will get away from here. Starting with my great-great-grandparents from them not even having a school education, telling my grandparents, “If you get an education you can move up,” they never moved but they instilled it in my dad, “You get a higher education, you move away from here.” And that gets transferred to me, “Watch me how I have moved, look at all of us, we have grown because we have been educated, the more you learn, the more you will be able to move away. You can always come back, but you are giving yourself the opportunity by reaching as high as you can,” and I think that is where that influence comes from. So my dad is telling me, you know “Look at me, I come from a Third World country, I am now in America, and this is your opportunity, you do not need to stay on the Island, you go away for college, you choose where you want to go, and from there you can go and do whatever you want.” Which is what I do want to do when I do complete my (education), to know what I have learned, what I can do with my skills. I would not mind doing something in Europe, just to see what it is like there, fun!

PRAXIS: PROACTIVE IDENTITY CREATION

Thirty years ago, neo-Marxist ethnographer Paul Willis’ seminal (1977) discussion – on how disadvantaged, working-class youth invariably grew up to get working class jobs – dismissed as simplistic the contemporary descriptions of such youth as passive victims of a conspiracy by reproductionist schools to maintain social inequalities in order to support the capitalist labor process. Instead, he asserted – as Aronowitz (1981) describes – that these youth, through their own ideological acts – namely, opposing all authority, refusing to submit to the imperatives of curricula that encouraged social mobility through acquisition of credentials, and actively creating a self-affirming culture of resistance to school knowledge – reproduced themselves as working class by disqualifying themselves from middle-class professions. Willis thus argued that no amount of manipulation by society could succeed in reproducing a people’s disempowered status unless the latter themselves internalized this reproduction.

In other words, human beings “creatively develop, transform, and finally reproduce aspects of the larger culture in their own praxis in such a way as to finally direct them to certain kinds of work.” (Willis, 1977, p. 2) This expanded construct of praxis – which differs from the classic Marxian view of praxis that merely encompasses the act of work, by referring instead to the whole act of constructing one’s cultural identity in society – effectively relocates the abode of power from the social system to human agency. It implies that when a people’s experiences in society are one of rejection and alienation, they go on to actively create cultural forms that are in opposition to those unsavory conditions. Such counter-cultural self-identities, created in response to hostile socio-economic and cultural pressures, can be seen among oppressed and alienated social groups throughout the developed world – examples abound within the U.S. as well.

Now while many of these cultures of resistance, born of reactive alienation towards the dominant socio-economic system, evolve behaviors that are ultimately counter-productive and self-destructive to the actors involved, this author’s suggestion has been that the seemingly pragmatic path of educational, technological, and socio-economic success chosen by Asian Americans in the face of rejection, persecution, and marginalization at the hands of the dominant white U.S. society might also be explainable by Willis’ concept of praxis. In other words, in the case of upwardly-mobile Asian Americans – such as the college students
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who participated in this study – their (a) emphasis on educational achievement; (b) assurance of technological access; (c) aspiration for prestigious STEM-related occupations; (d) desire for survival and economic success; (e) avoidance of more culturally contextual career paths; and (f) need for horizontal, transnational mobility might all form part of collective cultural choices as Americans of Asiatic origins to construct an empowered professional self-identity in response to the exigencies they have faced in their adopted land (see Fig. 1); a self-identity that perceives high academic achievement and technological advancement as keys to socio-economic power, and perhaps as tools with which to beat the mainstream culture at its own game?

Such a proposition would also be congruent with noted educational anthropologist John Ogbu’s (1991; Ogbu & Simons, 1998) distinction between “voluntary” and “involuntary” minorities within a society in terms of the effect of a cultural group’s historical experiences of subordination and exploitation upon its members’ willingness to assert academic and professional identities. Ogbu asserted that “involuntary” minorities – peoples whose ancestors were forced into any given society via colonization, slavery, or conquest – develop an oppositional identity in which academic and professional success is seen as selling out to one’s oppressors; in contrast, “voluntary” or “immigrant” minorities – peoples who chose to relocate to a particular society on their own volition, like Asian Americans – perceive their new home to be a land of opportunity, believe that their efforts devoted to education will bear fruit, and consider academic success as key to empowerment. For such minority groups, adoption of successful academic and professional identities would not be seen as antithetical to maintenance of cultural identity; instead the two might be even viewed as complementary.

Figure 1. Educational and Technological Factors in Asian American Self-Identity
REFERENCES


**KEY TERMS AND DEFINITIONS**

**Asian American**: Label used by the U.S. Census Bureau to describe U.S. citizens having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian Subcontinent.

**Hawaii**: The 50th state of the U.S.A., located on an archipelago in the central Pacific Ocean southwest of the continental U.S., southeast of Japan, and northeast of Australia.

**Model Minority**: A stereotype of Asian Americans arising from their higher aggregate socio-economic, educational, and technological achievements compared to other U.S. racial groups.

**Perpetual Foreigner Syndrome**: A persistent view of Asian Americans as not quite “real” Americans; a view that provokes the common question: “Where are you originally from?”

**Invisibility**: Refers to the virtual absence of Asian Americans from the U.S. political, cultural, social mainstream and from the U.S. media due to their “perpetual foreigner” status.

**Bamboo Ceiling**: Refers to the forces that prevent qualified Asian Americans with all the right credentials from attaining leadership positions in corporations, institutions, and government.

**Praxis**: As redefined by neo-Marxist ethnographer Paul Willis, praxis refers to the proactive construction of one’s cultural identity in response to one’s socioeconomic and cultural milieu.

**Voluntary/Immigrant Minority**: Term used by cultural anthropologist John Ogbu to refer to peoples who chose to relocate to a particular society on their own volition.

**Involuntary/Caste-Like Minority**: Term used by cultural anthropologist John Ogbu to refer to peoples whose ancestors were forced into a given society via colonization, slavery, or conquest.
Section 5

Human Performance
Chapter 27

Key Capabilities, Components, and Evolutionary Trends in Corporate E-Learning Systems

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ABSTRACT

The chapter examines the development of online learning systems in corporations, corporate utilization of reusable learning modules, and the various forms of assessment and knowledge certification used to ensure and improve the quality of the learning outcomes. Corporations continue to embrace e-learning, at a dramatic rate. This is partly driven by a desire for cost reduction and partly to ensure that all staff to have the required skills and competencies for their jobs. Organizations are increasingly linking the e-learning/e-training systems with other modules of their human resource management systems and this chapter includes a case example to illustrate such linkages. Universities have demonstrated progress in e-learning but remain in a position to learn much from e-learning developments in the corporate world. In sum, the chapter provides an overview of corporate experiences with e-learning/e-training and how these might be transferred to the academic world; it also sounds a note of warning for the universities should they fail to observe the ongoing development of corporate e-learning systems.

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INTRODUCTION

Multiple sectors such as universities, corporations, organizations, and governments throughout the world are rapidly expanding their utilization of online tools to take advantage of faster, affordable Internet access and state-of-art technology. Universities are offering more online classes to supplement, enhance, or replace their traditional face-to-face classes and this increases student accessibility to university courses, more flexibility for instructional delivery, and a wider range of options for student-faculty interactivity (Yeh & Hsu, 2008). Corporations are reaping similar benefits from e-learning/e-training systems and have also benefitted from being to keep their employees’ skills up to date. Consulting groups expect continued increases in corporate online learning (or e-learning) expenditures. For example, in 2002, Cortona projected that corporations would spend $50 billion on e-learning/e-training systems by 2010, rising from $5 billion in 2001 (Source: eMarketer) and in 2007 Global Industry Analysis Inc. (GIA) expected e-learning/e-training expenditures to exceed $52.6 billion by 2010 (Source: Global Industry Analysis Inc.). Although caution must be exercised in using these figures due to some variation in markets covered and in type of expenditure included, it is clear that corporate attention to e-learning/e-training will continue.

This chapter looks at recent developments in e-learning/e-training in the corporate environment and examines them from an academic perspective. The authors believe that the education environment (and in particular the management education environment) is going to get much more crowded and competitive. Corporate educational offerings can be viewed as a substitute for more formal training, including university-based training, and corporations have arguably moved more quickly than the universities in fully embracing online education. The authors believe there are both lessons and warnings for the academic learning community.

The chapter begins by reviewing the development of the online learning platforms and how these integrate with other human resource management systems. The chapter continues by examining the factors driving and constraining the development of corporate e-learning/e-training systems and uses a case example for illustration. The chapter then turns to what has become a fundamental element of corporate e-learning/e-training – the reusable learning objects. Assessment (a crucial factor in all learning systems) is examined next and this is followed by a brief discussion of implementation issues. The chapter concludes by discussing some implications for more traditional educational environments.

DEVELOPMENT OF THE ONLINE LEARNING PLATFORM

Technology and the changing workplace provide opportunities to approach employees’ learning and skill base development in new ways. E-learning/e-training technologies allow employees to take online course on an “as needed” basis at times that best suit them. E-learning/e-training can also be timed to suit workplace skill enhancement requirements. The ubiquitous nature of the Internet, multimedia and communications technologies allow learning and training to be delivered in new formats at a lower cost.

E-learning/e-training systems are increasingly important components of Human Resource Information Systems (HRIS) (also called HR modules, HRIT systems, HRMS) which support human resource management processes in organizations such as HR planning, recruiting and selection, training and development, performance management, and compensation and benefits (Bentley, 2007). E-learning/e-training solutions can be acquired by organizations as stand-alone HRIS applications, as components of integrated performance management solutions, or as components of integrated human capital management (HCM).
systems linking learning management systems (LMS) with Talent Management Systems (TMS). Most e-learning/e-training solution vendors offer clients the option of implementing e-learning/e-training solutions in-house (self-hosting) or gaining access to customizable e-learning/e-training applications via a Web browser (i.e., as a hosted, application service provider – Application Service Provider (ASP) or Web services solution). The trend is toward hosted, ASP e-learning/e-training solutions such as that illustrated in Figure 1. Figure 1 illustrates that online training and development management is a key component in integrated Web-based TMS.

According to an Expertus’s study conducted in 2006 with a sample of 249 organizations, more than one Learning Management System (LMS) is used by many companies (25% of their sample) and most (75%) of these organizations plan to consolidate their systems in the near future (Bentley, 2007). Jon Ciampi, Vice-President of Marketing at SumTotal, points out that another corporate tendency is to integrate their LMS with talent management, succession planning, and performance management systems (Bentley, 2007).

Learning Management Systems vs. Course Management Systems

Many LMS products, such as Blackboard, WebCT, and Webboard are commercially available and Moodle, one of the biggest open source solutions for e-learning/e-training software and platforms, provides comparable functionality to that supported by commercial counterparts (Dean, 2008; Scher, 2007). The terms Learning Management Systems (LMSs), Learning Content Management Systems (LCMSs) and Course Management Systems (CMSs) are often used interchangeably (Yueh & Hsu, 2008) and the difference among them has been not clear. However, Carliner (2005) makes a distinction between CMSs and LMSs by pointing out that learning and training are different activities. LMSs (e.g., Webboard, WebCT, Blackboard) are platforms that can support focused corporate training for immediate application but CMSs (e.g., NetDimensions EKP, Saba, and SumTotal) are platforms designed to support long-term learning and development in courses such as those at universities (Carliner, 2005). Brown et al. (2007) note that Human Resource Development (HSD) practices in corporate environments are different from other types of training because they emphasize lifelong learning, hence CMSs may be best suited to support HSD processes.

Although distinctions can be made between LMSs and CMSs, this remainder of this chapter discusses patterns and trends that characterize both of these technologies.

Employee Performance Management Systems (EPMs)

Multiple vendors offer integrated Employee Performance Management (EPM) solutions such as that illustrated in Figure 1. Some claim to offer best-of-breed solutions with robust capabilities while others offer performance management (PM) modules as part of a comprehensive integrated package. According to McMillan (2004), the investment of hundreds of millions of dollars in research and venture capital over the last half
decade has led to the development of a number of scalable Web-based performance management solutions that lend themselves to companywide deployment. McMillan notes that usable, accurate competency management systems are the cornerstones of EPM solutions because these enable the organization to articulate, target, and measure the skills and behaviors that are vital to organizational success. Since some competencies supersede any organization, many EPM solutions provide access to competency libraries and related resources (such as the Lominger Leadership Architect® Competency Library – www.lominger.com) and/or the ability to define organizational-specific role-based competencies. The identification of critical competencies has implications for hiring, training and development, performance appraisal, succession planning, talent management, and compensation processes and applications. Because e-learning/e-training has the potential to play a pivotal role in the acquisition and development of individual competencies, a LMS is a key component of the EPM solutions offered by many vendors (McGraw, 2001).

Human Capital Management Systems (HCMS)

In today’s business environment, companies increasingly view their human resources as critical factors in their efforts to gain competitive advantage. This has led to the realization that human capital management activities are critical to achieving high levels of corporate sustainability and corresponding interest in Human Capital Management Systems (Wirtenberg, et al. 2008). As noted by Israelite and Seymour (2006), Human Capital Management (HCM) focuses on the holistic management and optimization of an organization’s workforce by striving to add value to organizations via improving the organization’s human capital over time. Israelite and Seymour are advocates for fully-integrated strategic human capital management systems that integrate learning management, performance management, and talent management (see Figure 2).

Integrated HCM systems are designed to enable organizations to identify employees with high potential for success for inclusion in suc-
cession planning, comprehensive competency assessments, the development of personalized training and development programs, and tracking of individual development progress. By combining learning management, performance management and talent management, integrated HCM systems are capable of improving the overall quality of the organization’s workforce. HCM leverages e-learning/e-training systems to provide personalized training and development processes and when learning management processes are coupled with individualized incentives that appropriately channel employee behavior toward key organizational goals, the organization benefits from enhanced productivity and effectiveness. When employees know that they are performing competently and will be appropriately compensated for doing so, they are likely more satisfied with the organization (and their jobs) and are less prone to turnover. In addition, by rewarding, retaining, and continuing to hone its talent, the organization positions itself to be able to attract more high-caliber employees.

Learning Management Systems

E-learning/e-training solutions are the centerpiece of Learning Management Systems (LMS). Schmidt (2003) outlines numerous reasons why corporations are attracted to LMSs including the ability to reduce training costs, personalize training curricula, make training delivery location independent, and provide expanded training opportunities beyond the expertise of in-house trainers.

LMSs enable employees to access training sessions at their convenience via their PCs whether they are at work, at home, in the field or even in another country. Through LMSs, organizations can significantly reduce a number of costs associated with traditional training processes, such as trainer fees, training facilities costs and travel costs for both trainers and trainees. For example, CompUSA, after adopting an LMS in 1998, dramatically reduced training costs, from over $50 per unit to less than $1 per unit (Margolis, 2007).

LMSs also enable organizations to offer more training options. Reusable, off-the-shelf e-learning/e-training modules, including those available from competency libraries, make it possible for organizations to extend training offerings beyond the expertise of in-house trainers. In addition, LMSs enable companies to track the individual employee’s learning/teaching progress by capturing each employee’s log-ins, the amount of spent training, and which training modules are completed. They also provide customized guidance to employees for developing the talents and skills required to be successful in their positions. For example, when logging into the LMS, an accountant will not see engineering courses as choices on the screen. Individual skill or competency levels can also be accommodated. For instance, more seasoned employees may be channeled to intermediate-level course modules or advanced-level reviews that help them retain and grow their individual skills sets. The end result of personalization is typically less-frequent and more appropriate training sessions for individual employees; this enables opportunity costs from training-related productivity losses to be reduced.

Most traditional training delivery approaches, typically classroom-based, are not easily customized. As a result, they typically require trainers to generalize the training that is provided, which means that issues specific to the individual trainee are often overlooked. Additional customization provided by most LMSs includes the ability to match the format of training content to the individual employee’s learning style. For example, visually-oriented trainees can be provided with training that includes high levels of video content.

LMSs enable managers to track employee training progress and many can be aligned with incentive programs to encourage employees to complete training. LMS notification systems and Web-based reminders can be used to inform
employees and managers of post-training course salary upgrades.

According to Schmidt(2003), the shelf-life of learning/training content is an important consideration when selecting a LMS. Firms that specialize in continually evolving technologies or services are likely to need an LMS that can easily support learning/training content changes; this is less likely to be an issue in firms in less volatile industries. Other important selection considerations are costs, return on investment (ROI), and ongoing support issues.

The ability to share and cross-reference data with other HRIS components can also be an important consideration. For example, an employee title change should ideally trigger automatic updates to the individual’s training and development plan. The ability for managers to access and review employees’ knowledge sets and training levels are supported by many LMS; this helps managers monitor whether an employee is qualified to keep a certification. Numerous companies are leveraging such information to assign employees to projects that utilize knowledge they have recently acquired via LMS trainings. Thus, this LMS capability makes it possible for organizations to provide “just-in-time” training—i.e. employees acquire the training they need exactly when they need it.

Some LMS products are used as customer service enhancement tools to provide remote workers, business partners, suppliers, and customers with Web-based walk-throughs of new product or service features. Because many LMS products support multiple languages, such “training” can be provided globally. While most organizations do not completely replace traditional training programs with LMSs, LMS training is increasingly being used to supplement/blend classroom-oriented training with e-training (Schmidt, 2003; Lansari, et al, 2007). Those parts of the curriculum that are best shared with live groups are maintained while those which can be easily accommodated via e-training are conducted online.

Drivers of Corporate Interest in E-Learning Systems

The foregoing descriptions of Employee Performance Management Systems (EPMSs), integrated Human Capital Management Systems (HCMSs) and Learning Management Systems (LMSs) provide support for Galagan’s (2000) observation that the “bottom line” is a primary driver of corporate online learning. Skills and knowledge acquisition is expensive, and this is why LMS are more common in large organizations than smaller ones (Brown et al., 2006). Removing staff from the workplace, hiring teaching/training personnel, using physical resources such as rooms and equipment, and the maintenance of course material all contribute to sizable corporate training expense. The ability to significantly reduce, if not eliminate, training-related travel costs and irrelevant or unnecessary training sessions also drives corporate interest in e-learning/e-training systems. LMS’s ability to offer highly personalized to employees is also attractive. For example, Jane Doe could receive tailored training that only includes those pieces of traditional training courses that are relevant to her position and pieces (or entire courses) that are not position-relevant can be omitted from Jane’s training.

A secondary, but related, corporate interest driver is improved productivity (Bullock, 2001). EPMSs, HCMs, and LMSs highlight skill deficiencies in individuals and across the organization’s workforce as a whole. The provision of the required knowledge and skills as an extension of the HRMSs is a logical next step. E-learning/e-training technology allows both the individual and the organization to take advantage of either synchronous or asynchronous learning to support learning services “24/7/365”. The ability to deliver customizable content allows the organization to enhance individual productivity in a manner that best fits their individual circumstances and current skill or knowledge levels. The ability to
provide course content in multiple languages is also attractive to some corporations.

Compliance with widely accepted e-learning/e-training standards is valued by many corporations. The American Society for Training & Development recommends LMS compliance to SCORM and AICC standards (Watson & Watson, 2007). Many LMSs comply with the Sharable Content Object Reference Model (SCORM) which is a set of technical standards that enable Web-based learning systems to find, import, share, reuse, and export content. This gives instructional designers, managers, and writers a specification whereby educational courses can be distributed in a “plug-and-play” manner. Compliance with standards developed by the Aviation Industry Computer Based Training Committee (AICC) enables e-learning/e-training programs to pass information to one another. For example, a simulation program could integrate with a quizzing program to receive results. McGraw (2001) notes that as a general rule, the technical architecture for e-learning/e-training is an open architecture, and must include standards for integrating existing elements, such as legacy learning technologies, enterprise applications, online learning, and emerging tools.

The ability to monitor and assess learning outcomes also attracts corporate interest in LMS. Performance management pages dedicated to assessment and feedback are built into most online learning systems – partly to reinforce the learning and partly to ensure a satisfactory standard is achieved before the learner moves to the next level. Such assessment and feedback can (and is) modified to report achievements to management and can be used for bonuses, performance reviews, promotions, and other incentives. Most LMS products used in corporations support gap analysis. Skill or competency deficiencies and centers or areas of excellence are identified via gap analysis or by the use of intelligent agents, and the systems recommend appropriate managerial action.

Other factors that influence corporate interest in particular LMS solutions include the ability for individuals to “sign up” for courses and skill acquisition that they view as being valuable, the ability to map learning outcomes to HR metrics, the ability to monitor/assess employee and workforce knowledge of compliance requirements (e.g. Occupational Health and Safety requirements), ease of use, and vendor reputation.

Corporate Satisfaction with E-Learning Systems

Due in part to the rapidly evolving nature and expansion of online learning, there is little definitive research relating to corporate satisfaction with, or the efficacy of, e-learning/e-training technology. However, there is some evidence that this method of learning is not necessarily the learning/training solution that employees prefer (Mowbray & Dick, 2003) and employee satisfaction with e-learning/e-training solutions may be related to the personal benefits derived from the system, and not the benefits that accrue to the organization (Dunstan & Dick, 2004). This presents particular problems for the champions of e-learning/e-training in corporations – full buy-in may only be possible when they are successful in selling the idea of online learning to the “students” who will be using it.

It is possible that the research on satisfaction and efficacy may be misdirected. In the light of anticipated increases in corporate e-learning/e-training expenditures over the next few years and the expected bottom line impacts of online learning, perhaps instead of asking “How good is online learning compared with a more traditional approach?” researchers should be asking “Is it good enough?” or “What is online training’s ROI?”

Depending upon the goals of the e-learning/e-training program, a more efficient and accessible program may be acceptable, even if the learning it imparts is inferior to that for more traditional
face-to-face methods. The key here is whether satisfactory learning outcomes can be achieved. In some instances, learning that is sub-optimal may be sufficient and, due to cost savings, may be the most reasonable approach from a purely business perspective.

ONLINE LEARNING AND THE GALLUP ORGANIZATION

The Gallup organization has over 40 offices in 27 countries, with its corporate headquarters in Washington, D.C., and its operations headquarters in Omaha, Nebraska. The Gallup organization employs approximately 2,000 world leading scientists in management, economics, psychology, and sociology to identify and monitor behavior and economic indicators for the last 70 years. The Gallup Poll, one of the company’s four divisions -- Gallup Poll, Gallup Consulting, Gallup University, and Gallup Press -- is one of this organization’s best known products/services. The Gallup organization collects data on employees and customers of its clients, mostly Fortune 500 companies; this data is subsequently fed back to client organizations for managerial decision making and assessment that helps its clients improve customer relationships and maximize employee productivity.

Gallup is both a provider and consumer of e-learning solutions and thus provides a very good mechanism for illustrating and reinforcing the key points in the previous sections. As a provider, Gallup sells online learning content to other organizations as part of its management consulting activities. Gallup University enrolls approximately 50,000 students a year. In 2008 almost all of its students were involved in some form of distance learning. While Gallup University offers some face-to-face classes, including MBA courses, most students take online courses (see Figure 3).

Figure 3. Gallup University
Gallup Online is Gallup’s external metrics and e-learning/e-training system. It is designed for high-volume use and adheres to industry-standard e-learning protocols. The e-learning supplied via Gallup Online is designed to help clients understand, evaluate, and take action on data that Gallup collects and aggregates.

As a consumer, it subscribes to instruction provided by third party vendors, however, most of the e-learning materials used to train Gallup’s new employees are developed in-house. Gallup’s e-learning/e-training content is available for use by other organizations. Gallup is also able to leverage the e-learning/e-training content that it has developed for clients to create generic courses or learning modules on topics such as leadership and the characteristics/behaviors of effective managers. In short, some of Gallup’s e-learning/e-training modules are both reusable and have commercial value. Furthermore, purposeful packaging of learning modules by Gallup and other e-learning/e-training content providers has the potential to reshape online education delivered by public, private, and for-profit universities.

**Gallup’s LMS**

Gallup’s proprietary, internal e-learning/e-training system is an exceptional example of a learning management system. Gallup’s LMS is based upon a learning object model; this means that the number and sequence of learning events that a new employee is required to complete is determined by the individual’s role at Gallup. While all new employees receive online instruction on core topics such as benefits, submitting travel expenses, and understanding one’s role at a Gallup citizen, the remainder of their initial training is customized to their job. For example, a new manager of client interviewing would receive instruction on the outbound phone system, while a newly hired consultant could receive training on how to communicate effectively with clients.

All e-learning/e-training modules are accessed via a single system. This system also enables employees (and their managers) to track training progress. The system enables individual learning modules to be updated as needed and managers can modify the number and sequence of learning modules for individual employees to support just-in-time training.

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**Figure 4. Gallup’s internal e-learning/e-training system**
Figure 4 illustrates the login page for Gallup’s internal e-learning/e-training system. When users log in, they are presented with a personalized program of instruction that is based upon their job requirements. For example, a new associate might be required to gather (or “scavenge”) information about various company activities. The “user interface” for the Scavenger Hunt system (shown in Figure 5) includes “stamps on a passport” indicating that the learner has completed all required events for a particular section tracking on each learner’s progress.

This administration component of the e-learning system was designed for use by Gallup’s managers. It allows them to add new material to the system and to create custom learning programs for their direct reports. The system includes an efficient mechanism for tracking learners and controlling what they see and do. Gallup makes extensive use of the Learning Object model, which employs Reusable Learning Objects (RLO) that can be selected, combined, and sequenced to meet the learning needs of an individual employee.

**REUSABLE LEARNING OBJECTS**

One of the main distinctions between corporate e-learning systems and comparable systems used in academic settings is the extent to which they have embraced reusable learning objects (RLOs). RLOs are much more common by corporations than by colleges and universities and corporate utilization of RLOs provides likely insights into the evolution of academic e-learning systems.

In the quest to gain ever-greater efficiency and effectiveness from their learning systems, corporations are taking a page from the object-oriented programming playbook and building libraries of focused, concise learning modules that can be deployed in various combinations to form a custom curriculum that is tailored to the individual employee. These modules, often called learning objects (LOs), are typically designed so that they can be redeployed in other contexts, in much the same way a Java object created for one application can be reused in other applications. A learning object may contain almost anything that
is required by application in technology-supported learning such as instructional media, including text, images, audio, video and interactive components (IEEE, 2001; Muzio, 2002).

Lorentz et al., (2008) categorizes LOs essential qualities into two groups, the object’s content related qualities and its additional and technical qualities. The first group is related to the degree to which LOs are reusable, self-contained, and pedagogically neutral; the second group is related to the degree to which LOs are accessible, compatible, and interoperable. Churchill (2007) proposed six categories of learning objects that is useful as a framework for designers of digital resources. The six categories are presentation, practice, simulation, conceptual models, information, and contextual representation objects. Two or more categories can be combined due to common characteristics and some categories are more likely to be used for direct instruction while others are more likely to be used to support traditional pedagogical approaches.

When learning objects support exterior form changes but do not require functions of various technologies to be changed they are known as Reusable Learning Objects (RLOs). RLOs provide learning object developers with ‘plug and play’ flexibility (Burge, 2008). RLOs hold considerable promise for both corporate and university learning systems. However, there are also a number of potential pitfalls.

**RLO Overview**

Perhaps because of their still-evolving nature (Rosson et al., 2006), the term “Reusable Learning Object” seems to have almost as many definitions as advocates; a number of authors have pointed out the plethora of definitions (Koppi et al., 2005). Fortunately, many of these definitions share some common elements. Learning objects are relatively small, self-contained modules of learning content that are focused towards satisfying a specific, well-defined learning objective (Wu et al., 2006).

Reusable Learning Objects (RLOs), as the name implies, are designed so that they can be used in learning environments other than the one for which they were originally created. In other words, a reusable learning object may be “recontextualized” (Muzio, 2002).

Driscoll (2004) points out that RLOs have three main characteristics. First, they are flexible. Because (ideally) they are designed to be stand-alone, they are independent of any particular context. Consider, for example, an RLO designed to teach non-discriminatory interviewing techniques may be used in combination with other RLOs to form an online course on recruiting. This same RLO may be used independently as a review for a manager who needs to refresh her/his interview skills. Similarly, this same object may be used as part of a diversity course for new employees. The developers of the International Virtual Medical School (IVIMEDS) note that the use of RLOs enables adaptive learning that takes into account variations in physicians’ expertise, backgrounds and educational needs (Harden, 2006).

Second, because RLOs are tagged with a common set of metadata labels, they are manageable—in many instances developers can attach high-level information to each learning object (metadata). These capabilities have enabled many organizations to adopt Learning Content Management Systems (LCMSs) that allows project members to contribute, collaborate, and interact with one another during the development of a training project (Nguyen & Hanzel, 2007). In its simplest form, a LCMS may be a database that catalogs the RLOs according to these tags. For example, a project at the Virtual Orthopedic European University uses Microsoft SQL Server to build and maintain a repository of learning objects for a medical learning system (Wu, 2006).

Third, RLOs should be interoperable. RLOs should be independent of any particular instructional technology or LCMS. The key to achieving this interoperability is to follow an industry-standard format when developing the learning objects.
There are several such standards, including IMS (from the IMS Global Learning Consortium), IEEE Learning Technology Standards Committee (LTSC), the Sharable Content Object Reference Model (SCORM) and Aviation Industry Computer Based Training Committee (AICC) standards.

When properly designed, individual RLOs can be recombined to form new curricula. For example, Cisco Systems Learning Solution Partners combine RLOs provided by Cisco to construct new courses; the same object may be reused in multiple courses. The strategy of recombining existing objects is particularly attractive for learning content providers. Providers who successfully employ a reuse strategy are able to use a given object in learning content that is customized for a number of different clients. It is not the objects themselves, but rather the combination of objects that is customized for a particular client (or individual learner).

The concept of learning objects has its genesis in the concept of object oriented programming (OOP). Those familiar with OOP may recall that improved reusability was one of the main benefits touted by its proponents. The same can be said about the RLO concept. Ideally, a learning object created for one course can be repurposed in another course. As is the case with OOP, creating reusable objects is often considerably more difficult and requires greater effort than creating a less flexible object (Parrish, 2004).

In fact, it is critical to consider reuse from the earliest stages of design; reuse does not simply happen, it must be planned for. For example, considering reuse may lead to a finer level of granularity than if the object is designed without consideration to reusability. Parrish (2004) recommends a number of tactics for taking an object oriented approach to instructional design. First, divide content into coherent, discrete units. To those familiar with computer programming, this is reminiscent of the concept of cohesion. Everything in the object (whether a learning object or computer code) should be directed at one objective. In programming, this objective is a function, in instructional design it is a learning objective. Designing cohesive learning objects makes the second reusability tactic easier, embedding metadata that provides an accurate description of the learning object. One obvious benefit of properly using metadata is that it facilitates searching. It also allows for better curriculum management through learning management systems. Parrish’s third recommendation is perhaps the most questionable. Parrish recommends designing the learning object to be relatively “context-free.” While this may well facilitate flexibility, many educational theorists would argue that learning is never context free, so it may be a mistake to design context-free learning objects.

### Advantages of Reusable Learning Objects

When properly designed, RLOs promise a number of advantages. First, just as reusable code makes computer programming more efficient, RLOs make the development of courses be more efficient. Ideally, new courses can be constructed from existing RLOs by recombining existing RLOs in new ways to create new courses. Of course, this ideal is rarely met. It is more likely that a newly-created course will be a combination of existing and newly-created learning objects. Even in these cases, reusing some learning objects may decrease development time significantly. It is challenging to create Learning Objects and it is even more difficult to apply standards to existing Learning Objects. While instructional designers can easily implement a LMS with effective use of standards, it is often the case that an LO that works well in one LMS is not used in another LMS because developers are not aware of its availability (Watson & Watson, 2007). One solution to this problem is Automatic Metadata Generation (AMG) which enables developers to search LMS object libraries for potentially useful LOs that could be repurposed for new learning applications (HMDB, 2008).
There are other, less obvious benefits to RLOs. RLOs may help increase collaboration among instructors and designers (Parrish, 2004) and RLOs may also help make learning more adaptive to the learning preferences of individual learners. When combined with proper learning management systems, RLOs may as well allow more generative learning, in which the learning management system creates individually-tailored instruction “on-the-fly.” In addition, RLOs may improve scalability, allowing instruction to be provided to larger audiences without a proportionate increase in costs (Parrish, 2004).

The fast proliferation of open source LMS tools and the Internet has the potential to take RLO use and availability to a new level. Lakhan and Jhunjhunwala (2008) have provided overview descriptions of the most widely used open source LMS tools including Moodle, Bodington, Claroline, Dokeos, .LRN, ATutor, OLAT, and Sakai. The increasing popularity of open source LMS tools translates into the available of numerous free RLOs.

RLOs and On-Demand Learning

Perhaps one of the most promising benefits of RLOs is the ability to facilitate “on-demand” learning and communication media are increasingly following an on-demand model. Prime examples of this are found in broadcasting. One of the fastest growing trends in television is the increasing popularity of digital video recording (DVR) systems, such as TiVO. These systems allow viewers to easily record programs that are later viewed at their convenience. Program schedulers no longer hold complete power over when a particular program is viewed. While video tape recorders have allowed consumers to record programs for many years, the additional capabilities of digital video recorders have brought new vitality to the practice. The growing popularity of these systems is bringing about changes in the television industry. For example, advertisers are very concerned about the DVR’s ability to allow consumers to skip commercials. Because of this, advertisers and television producers are seeking new ways to promote products. For example, more emphasis is being given to product placement strategies where advertisers pay to have their products visible in scenes or mentioned by actors during a program.

Another good example of “on-demand” media is the explosive growth of the iPod and similar devices. These audio (and now video) players give consumers the ability to essentially program their own listening experiences rather than relying on radio station programmers. Consumers can easily build custom playlists to fit their moods, activities, and listening preferences. Once again, this ability has existed for many years through the use of tapes and compact discs. The new devices, however, make the process much easier.

Podcasting is the newest example of how emerging technologies are facilitating an on-demand lifestyle. A consumer can listen to a podcast whenever and wherever s/he pleases (once the podcast is downloaded). It does not matter when the broadcaster (or podcaster) wants the consumer to listen; now the consumer is in control.

RLOs may help facilitate on-demand learning, just as MP3 files facilitate on-demand listening. Lectures, exercises, even simulated laboratory experiments (and other learning objects) can be accessed at a time that is convenient and productive for the learner. When the original lecture occurred is relatively unimportant. The learner can access the lecture through a learning management system at any time. The instructor still maintains control by specifying the sequence in which objects should be accessed, but the learner controls the time and place of access. When done properly, this may result in a win-win situation.
Corporate Use of Reusable Learning Objects

Learning objects are being used by a number of organizations, both for internal training purposes and for providing training to third parties. One example comes from the United States Internal Revenue Service (IRS), which uses a SCORM-compliant strategy to deliver e-learning/e-training in its “Link & Learn” system, which provides Web-based training to volunteers who help taxpayers throughout the U.S.

The International Virtual Medical School (IVIMEDS) uses RLOs to help achieve its goal of providing excellent medical education to a variety of health professionals including practicing physicians. As Harden (2005) points out IVIMEDS’ RLO repository enables wide-spread sharing, recombination and repurposing of RLOs. This allows the application of the RLO based courses to be deployed across a variety of learning situations and contexts.

Verizon, a provider of wired and wireless communications, uses a SCORM-compliant LMS to deliver training to its 80,000+ field-service employees. Verizon managers estimate that reusing existing content has the potential to cut course development costs by as much as 50% (Howard, 2004). Cisco Systems is also using RLOs to facilitate the development and delivery of e-learning/e-training courses. Cisco Learning Solution Partners take advantage of Cisco’s RLOs by recombining the objects to offer new courses. This strategy also allows Cisco to provide its employees and customers with personalized, on-demand e-learning/e-training (Maddocks, 2002).

Perhaps one of the best examples of a corporation leveraging the capabilities of e-learning/e-training comes from the Gallup Organization, which we discussed in an earlier section. Gallup does an excellent job of not only using e-learning/e-training resources and capabilities to manage its own associates’ personal development; it also makes extensive use of RLOs in the revenue-generating e-learning/e-training it provides to clients.

Certainly, organizations must be able to determine whether their e-learning/e-training systems are bringing about the intended benefits. One critical aspect of this is assessing whether the intended learning goals are met. Assessing the outcomes e-learning/e-training is another dimension on which corporations are out in front of universities.

Assessment

Assessment is widely-viewed as a crucial part of most learning activities including those associated with e-learning and e-training systems. From a knowledge certification point of view, assessment provides some degree of assurance that the learner has achieved a certain level of knowledge at a point in time. From a student or learner perspective it provides feedback on performance to date (and perhaps indicates readiness of the learner to take a formal certification) and assessment serves to provide a learner with a way to reinforce learning activities by integrating into the learning process tests of knowledge retention and understanding. In addition, at a higher level, the assessment, when related to learning outcomes, provides a means by which achievements against the curriculum can be determined, with this in turn being considered against the desired body of knowledge.

Hall (2002) has suggested that promoting metacognition (understanding at a deep level) depends on the alignment of the learning objectives with the teaching process and the assessment criteria. In other words online education is about much more than using the technology as simply a delivery medium. Online education provides the opportunity to develop an embedded approach and to significantly change assessment procedures and to relate them more directly to practice. To date, corporations have been quicker than universities to capitalize on this opportunity.
Knowledge Certification

Assessment is built into education partly as a means of advising external parties as to the degree of competence a learner has reached. Interested external parties could include potential or existing employers, academic institutions, professional societies and accreditation bodies. As such, the role of assessment in validating and providing a statement of certification of the achievement of a certain level of knowledge needs to be objective, but aligned to the desired curriculum.

Cleveland and Bailey (1994) argue that assessment research needs to move beyond the use of grades to measure student learning in the online environment. Hay, Peltier and Drago (2004) suggest that assessment for management education should encompass the learner’s ability to reflect upon their actions. Online education that uses discussion boards and interaction with peers can provide an opportunity for reflective consideration of various scenarios and outcomes; students’ responses and arguments developed in this way can be an important assessment component.

Knowledge certification also can be measured by how well one can transfer the knowledge acquired into the workplace. Iverson, Colky and Cyboran (2005) examined the influence of the user characteristics of self-efficacy, motivation, goal orientation and metacognition on outcomes, including the intention to transfer knowledge to the workplace (the desire to use newly learned knowledge and skills on the job). Their results indicated that those who were most likely to transfer the knowledge were those who were most motivated to learn. The implication of this study is that the intention/desire to apply the learning in the workplace provides a form of knowledge certification.

Feedback to the Learner

Dumont [1996] also argues that one of the current benefits of online learning is that student interactions are usually recorded as part of the learning process which facilitates assessment and feedback. Receiving feedback reflects a learner-centered orientation within the organization that promotes students’ further learning (An and Reigeluth, 2008). Making it easy to provide feedback incent organizations to use the capabilities of the technology to build suitable skills in students and to respond to student needs (Clarke, 1996).

In a study of Web Based Learning in Malaysia Poon (2004) found that instructors and students considered mutual assessment and feedback as vital. The opportunity to browse the work of classmates was seen as beneficial because it allowed the students to better understand what they had done well or not so well, and how it compared with the work of others. Most also felt that the quality of their work was improved when they were able to compare it with the work of their peers.

It is highly desirable for instructors to engage the students in discussion sessions in order to provide prompt feedback to the students’ enquiries since two-way communication greatly enhances assimilation and refines the quality of e-learning/e-training. However, considerable time is needed for the monitoring and advising on the progress of the asynchronous discussions (Poon 2004).

Clearly technologies associated with online learning offer significant advantages in the area of feedback and assessment -- however these are not without cost. There are high demands on the instructors’ time and the students can suffer from information overload. In addition special attention is required to deal with the ready availability of completed work in an electronic form as it raises the temptation of plagiarism. Controls to prevent this should be introduced and monitored.

Learning Reinforcement

Both small and large companies agree that e-learning/e-training courses may be more likely to be successful when undertaken in a dedicated learning center that motivates learners to be re-
sponsible for their own learning (Brown et al., 2006). Conceptual understanding is enhanced by the provision of opportunities for formative as well as summative learning (Hall 2002). An obvious example of this is to relate course material to practical examples in this way learners can appreciate both the significance and the practical application of the material. In an online environment this can be achieved by short quizzes and/or discussions relating to case studies or scenarios – choosing the right approach or solution, for example. Summative assessment can be built on the formative work undertaken as part of the learning process, so that the learner can see the basis for the unit assessment. Such a process also allows the learner to work at his or her own pace and provides opportunities for him to re-visit sections or modules that he understands less well.

Alignment of Learning to Desired Outcomes

Almost all organized learning has a set of desired learning outcomes as a goal. This is translated in a curriculum and further refined into course objectives aimed at ensuring the learners are provided with the required body of knowledge. Ideally this body of knowledge is periodically assessed in relation to the desired learning outcomes.

An example that illustrates this deals with learning about immunization practices and procedures, described by Lancaster et al. (2005). In this investigation, many possible immunization interventions were listed and learners were asked to choose the ‘best’ four. The feedback received by learners provided a rating of the effectiveness (or ineffectiveness) of each intervention, based on an extensive review of evidence from the literature. Lancaster et al. (2005) go on to suggest that future enhancements might include allowing a learner to work a cycle of implementing an immunization intervention and following up with another online assessment.

This example demonstrates how the work of professionals can be assessed as they progress through the learning cycle. If the professionals are found to be doing the wrong thing in practice, the learning modules can be re-used to ensure that the required body of knowledge is being imparted to the learners. This suggests the need for a close relationship between the learning and practice – the closer that connection, the sooner, and more efficaciously that learning is put into practice, the quicker that needed modifications to current practices can be made. This becomes especially important in online learning in the corporate environment – online learning is often specifically targeted at a “mission-critical skills” required in the corporation (Trierweiler, 2005). The ability to quickly assess the value of the learning and to take action to modify the learning to better to suit the required skill set can be critically important.

Implementation Issues and Strategies

Universities and the general public can learn much about e-learning/e-training from the corporate world. One of the first lessons is that the business drivers for implementing e-learning/e-training should be clear. E-learning/e-training should be viewed by managers/administrators as a means for adding value to the organization either directly (e.g. via workforce enhancement) or indirectly (e.g. via training/development cost reduction). Proponents should be able to crystallize the rationale for investing in e-learning/e-training systems in a compelling business case that identifies measurable organization value via traditional financial justification approaches, such as ROI and Internal Rate of Return (IRR), or a balanced scorecard approach. If a compelling business case for e-learning/e-training cannot be made in a university setting (i.e. if the business drivers are not clear), investing in e-learning/e-training may be less desirable than directing monies toward alternatives whose ability to add value is more
apparent. A problem with these measurable approaches is that intangible factors, that often are important goals of e-learning, can be ignored; also, such measurements may cause organizations to only focus on short-term results (Grant & Danziger, 2005).

A closely related issue for universities is whether the school should be an e-learning/e-training provider or consumer (or both). Numerous universities are e-learning/e-training providers, but not in the same way as Lominger or the Gallup Organization. Both public and private universities have embraced courseware development and management products such as Blackboard and WebCT to provide supplemental online support for traditional courses as well as to deliver complete courses online. Such courseware has spawned online private universities such as Kaplan University, the University of Phoenix, and Walden University that provide a wide range of degrees and certificate programs. Unfortunately, despite the prevalence of courseware development/management software, the courseware developed by both traditional and online universities limits access to the online training and education modules to enrolled students. In contrast, the reusable e-learning/e-training modules developed by Lominger, The Gallup Organization, and similar providers can be sold and used by trainees in any organization that recognizes their potential to add value, including direct competitors. As a result, many of the e-learning/e-training modules created by corporate e-learning/e-training providers have become world-class benchmarks that continue to attract clients that recognize the futility of trying to develop superior substitutes.

Consider the possibilities if colleges and universities were able to set aside intellectual property issues and “not invented here” biases (that have led to multifold duplication of online course content within higher education) and were free to consume each other’s online content. What if any university could provide interested students with the best online Political Science, Calculus, or Macro Economics course that had been developed by another university? There are obvious benefits for university students in this scenario. One of the less obvious benefits for universities is the ability to direct their resources to the things they do best—perhaps developing e-learning/e-training modules for an academic discipline whose quality would be unsurpassed in the higher education marketplace.

Numerous obstacles (including intellectual property issues) would have to be overcome for universities to evolve to an e-learning/e-training mindset similar to the one that pervades today’s corporations. “Buy” rather than “build” can arguably be said to describe the corporate e-learning/e-training landscape just as it defines today’s typical corporate attitude toward software acquisition. Universities, however, may be characterized as remaining mired in a “build rather than buy” mentality that results in the seemingly endless production of proprietary e-learning/e-training modules whose value beyond the confines of each university’s virtual presence is unknown.

An approach that has the potential to alter a university’s perspective on being an e-learning/e-training provider is to have it become a consumer of corporate e-learning/e-training products for its internal non-academic training and development. Bringing world-class corporate e-learning/e-training capabilities to the university’s non-academic staff as part of HR training and development initiatives could eventually capture the interest and attention of the academic side of the institution. This may help move the institution toward an enlightened attitude toward e-learning/e-training; one that is more consistent with the views of corporate e-learning/e-training consumers and providers.

The corporate world’s utilization of Reusable Learning Objects (RLOs) should provide further food for thought for universities and other educational institutions including secondary schools. The building and refining libraries of SCORM and AICC-compliant e-learning/e-training modules
has the potential to facilitate continuous improvement in course content. RLO libraries would enable educators to search for and use modules which best illustrate course concepts – ones that could be used to either augment or supplement traditional in-class instruction (or both). The use of RLOs could conceivably become a standard part of the instructional training of secondary school teachers and university professors. The development, customization and enhancement of RLOs are also likely to become increasingly desirable skills for educators. RLO libraries have the potential to improve the education experiences of students by helping to ensure that courses include e-learning/e-training modules that are likely to have the greatest impact on learners. Developing such libraries may move teachers toward being critical evaluators and selectors of learning modules via attentive selection the content of their courses this may be more likely to demonstrate continuous improvement. In short, RLOs may revolutionize instructional design and delivery and are likely to do so as long as iPods and competing technologies remain popular.

Educators at all levels can also learn much from corporations in the area of personalization. The ability to create personalized, portable music libraries was one of the first attractions of mobile MP3 players. Thanks to RLOs, it is now also possible to create personalized learning libraries. Some universities, including Duke University, have been on the forefront in leveraging iPods and mobile devices for learning purposes. In addition, some publishers of higher education textbooks, including Wiley, are using podcasts to supplement their print materials and online courseware. While these efforts are worthwhile and indicative that some educators and educational content providers “get it”, they fall well short of the level of personalization observed in typical corporate learning management systems. As noted previously, corporate LMSs enable companies to track individual learning/training progress and to provide customized guidance for developing position/job-requisite talents and skills. Individual skill or competency levels can also be accommodated and seasoned employees can be channeled to more advanced modules design for skill maintenance or growth. The level of personalization possible in corporate LMSs extends increasingly to the ability to support on-demand learning/training. The granularity of personalization of university-level e-learning/e-training is much coarser than that for corporate e-learning/e-training; in general, the same content is provided to all regardless of position or skill or competency level. In addition, there is little or no segmentation of review/refresher e-learning/e-training content for advanced learners that is distinct from that provided for first-time learners.

Universities and other educational institutions might also gain insights in promoting personal learning and skill development from studying the learning management capabilities of corporate LMS. Corporate e-learning/e-training systems typically provide managers with the ability to access and review individual employees’ knowledge sets and training levels. This information can be used to ensure that individual employees qualify for promotions or bonus, or whether they have the knowledge/skill levels needed for particular projects. The ability to monitor learning progress, to align learning/training to institutional goals and to reinforce learning/training outcomes could be effectively leveraged by university and secondary school educators. In the future, student tracking systems modeled on corporate e-learning/e-training management capabilities could be used for knowledge certification and assessment. As assessment gains momentum in secondary and higher education, educators and educational administrators would be wise to see what is possible by systematically studying the assessment and learning management capabilities of corporate e-learning/e-training systems.
FUTURE TRENDS

To meet the needs of today’s learners, Industrial age instructional approaches must give way to Information age approaches (Watson & Watson, 2007). Twenty-First Century Learners typically needed a customized pace and personalized sequencing of instruction that is more learner-centered. A continuing weakness of many corporate learning tools is that they operate like a distributor or a publisher that delivers too much information to all learners regardless of each individual’s level (Karrer, 2008). Support for learner-centered approaches is essential for today’s and future LMS technologies; tracking and assessing each individual’s learning continues to be important as well as providing sequence recommendations to instructors.

Collaborative software and social networking capabilities that enable learners to interact and share data will increase in importance in the years ahead because they support social constructivist learning approach (Dalsgarrd, 2006). Social constructivism advocates conceive learning as a problem-based, self-directed and collaborative process that is consistent with the personalization and individualization of learning. Dalsgarrd believes that LMSs are best used for administrative purposes and that to improve e-learning, social software tools should be added including collaborative tools such as wikis and blogs to support exchange and networking among learners (Dalsgarrd, 2006).

The use of wikis and blogs are a fairly new concept to higher education although they have been around more than a decade. Wikis and blogs are experiencing increasing use as university teaching tools. Online learning educators/trainers have started paying attention to various usages of wiki applications because they provide both collaborative convenience environments (Parker & Chao, 2007). Blogs and wikis are often compared to each other because both of them are easy publishing tools for the public. The main differences are the number of authors (single vs. multiple), time order (chronological or non-chronological), and the organization of information (by time or by topics) and so on. Although blogs are more suitable to distributing information as a publishing tool, wikis are better suited when multiple authors intend to modify and enhance the knowledge in a collaborative environment (Parker & Chao, 2007). According to Frydenberg [2008] wikis have already become a tool that complement and sometimes replace the use of LMSs and CMSs to disseminate information in today’s Web 2.0 world. Moodle (open source LMS software) and Blackboard include built-in wikis as plug-ins from third party providers in their most recent versions (Frydenberg, 2008). In the future, more wikis and blogs will be integrated within LMSs to support educators who seek constructivism, or problem-based or learner-centered approaches that maximize LMSs potential. Inviting students to build a course assignment through a wiki will give them ownership of the class and ideally students will learn more when they have to gather their thoughts to actually write something to share with other students.

Learners of all ages will be exposed to use of LMSs and LMS use by younger people will increase in the future. Not only companies and universities use LMSs or CMSs, but more high schools will offer online classes as the younger people become more familiar with computer and Internet usage. According to Shein (2008), 4,500 high school students in Gwinnett County, Georgia took at least one class online in 2007; this is a harbinger of what the future is likely to hold.

CONCLUSION

As might be expected, learning in the corporate environment is much more job specific than in the university system. Corporations also have been driven more by a “bottom line” approach and thus have been quicker to use technology to turn “lear-
ing” into e-learning/e-training. Universities have not been completely left out with many courses offered online or at least in a “web-enhanced” mode. Nevertheless, the authors believe that there are lessons for the universities in what the corporate organizations are doing.

Corporate online learning platforms are developed with a focus on short to medium term organizational needs and the way the learning can be delivered and linked back into the systems that require that learning. As such they are a ready means of ensuring that the educational offerings match the needs of the organization and the students. A similar level of emphasis on assessment and feedback might also be beneficial for academic institutions. Another important aspect of corporate systems is their functionality of combining in-house developed material with that from other organizations in a manner that is transparent to the user. Similar integration capabilities might be especially valuable for university business schools.

Corporate LMS are aimed at providing “convenient” learning – at a time and place of the student’s choice – often incorporating the expertise of instructors from other organizations. This can also reduce costs – eventually borne by the student or the employing organisation. Customization is a key too – it enables the learning to be individually tailored to the student. Similar capabilities in university LMS may be beneficial and could potentially be used by universities to keep alumni up to date with new occupationally-relevant developments—a potential lifelong “value added” element.

The focus on the reuse of modules in the corporate environment should also translate into academia – many courses have common elements that should be relatively easily transferred, rather than re-written or worse still, re-developed. However as noted earlier, this transferability does not just happen – it needs to be planned for from the earliest stages of module development.

There also would seem to be lessons for universities in the area of assessment – in particular the practical application of knowledge, motivation to learn in a non-traditional way, comparison and discussion of work with one’s peers, feedback and improvement and the availability of tests and simulations to aid in learning reinforcement. Most importantly too, the online systems linked to workplace practices provide feedback on the efficacy of the learning system itself – another useful tool for academia.

Graduate courses provide universities with an increasingly large slice of their revenue; these graduate courses are often aimed directly at business employees and working adults. Business is already moving to incorporate the essential knowledge and skills elements required of their staff into the existing e-learning/e-training systems; the learning platforms and the technology now existing and emerging soon will increase the interest of business in taking a larger slice of the education pie. Universities are well advised to consider how corporations are leveraging e-learning/e-training. Doing so may help traditional educational institutions significantly improve their online education and counter the growing competition from the business world.

REFERENCES


**KEY TERMS AND DEFINITIONS**

**Blog:** A Web site, usually maintained by an individual, with regular entries of commentary, descriptions of events, or other material such as graphics or video.

**Constructivism:** Philosophy of learning founded on the premise that, by reflecting on our experiences, we construct our own understanding of the world we live in.

**E-Learning, Online Learning:** The use of computing and/or communications technologies to provide learning in the form of courses, training or skills acquisition

**Learning Management Systems:** Computer systems that allow learners to access educational content and management the ability to monitor performance in, and use of, such learning

**Learning Objects:** Focused, concise learning modules that can be deployed in various combinations to provide a body of knowledge

**Podcasting:** The method of distributing multimedia files over the Internet so they can be played on mobile devices
Knowledge Certification: Some evidence that a certain level of knowledge has been acquired.

Learning Outcomes: The desired objectives of providing the knowledge in the form of a course.

Social Software: Encompasses a range of software systems that allow users to interact and share data.

Wiki: A collection of web pages designed to enable anyone who accesses it to contribute or modify content, using a simplified markup language.
Chapter 28
Developing a Model for Information Society Competencies Required by Managers in the Information Society

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ABSTRACT

The purpose of this research is an attempt to obtain insight into the information, communication and technological competencies that managers currently need in order to work effectively in the information society. This is obtained by creating a model for those Information Society competencies for managers. This model is based on the results of a literature review, done in combination with a case study via a survey conducted in a large non-profit organization in the Netherlands. What is found is that especially the competencies ‘Having operational knowledge and insight into ICT’, ‘Finding and evaluating information on the Internet’ and ‘Participating in a learning organization’ are important factors that influence Information Society competence. The model might have implications for the curricula in higher education, especially for management training. The model may as well be an argument towards the provision of suitable performance support for just-in-time-learning for managers.

INTRODUCTION

The information society is characterized by privatization, globalization and information and communication technology (ICT). As a consequence large amounts of information, international cooperation and networks have become part of the work environment (Boonstra, 2005; Feather, 2004; Hargrove, 2001). A digital work environment can be seen as a work environment where ICT is regularly used. In such an environment, but especially where the Internet and mobile technologies are commonplace, information security risks are increased considerably (Siponen, 2001). Furthermore, continuing changes in organizations need to be managed effectively (Boonstra, 2005: Hargrove, 2001). Dealing effec-
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tively with information and communication using the technology, have become important issues in organizations, but at the same time this has proven to be very complex and managers often struggle to define their role in the new working situation (Beijen, Broos & Lucas, 2003). Literature shows that managers especially play a vital role in implementing ICT in the organization (Boonstra, 2005; Davenport & Prusak, 1997; Hargrove, 2001). Hence the focus of this paper is on how managers deal with the changed ways of working in the information society.

The purpose of this paper is twofold. Firstly, the main focus of this paper is to provide some insight into the information, communication and technological competencies which managers need in order to work and lead effectively in the information society, by providing a model for Information Society competencies for managers. Secondly, the implications of this model for management training and just-in-time-learning support are considered. Hence, in this paper some answers are given to the two questions:

• *What are the important Information Society competencies that managers need in order to work and lead effectively in the context of the information society* and

• *What are the implications of the findings of this research for management training and the provision of just in time learning support?*

**BACKGROUND**

**Changed Ways of Working in the Information Society**

From literature it has become clear that organizations have to deal with a different way of working and employees have to deal with a changed work environment (Dhondt & Kraan, 2001; Davenport & Prusak, 1997). Labour and labour relations in the information society have changed considerably since the introduction of the Internet and globalization (Boonstra, 2005; Dhondt & Kraan, 2001; Schoemaker, 2004; Steijn, 2002). One example is that the working relationship of employees has shifted from secure employment and permanent loyalty in a transactional relationship between the employer and employee in the industrial society to reduced job security and no permanent loyalty between the employer and employee in the information society. The emphasis is currently on flexibility in the organization regarding employment, as well as on employability of the employee who is in control of his/her own career. At the same time commitment is expected during the time of contract. Mobility is essential. Work is not necessarily dependent on location and time. Effective communication is an essential competency and in the context of the information society, this includes knowing how and when to use the tools of communication. Work has increased in complexity and tasks have been broadened. Innovation and creativity are essential in order to continue participating in the rapidly changing work environment.

It is therefore necessary to continue to learn beyond initial training and employment. An attitude of lifelong learning and flexibility has become essential, but learning how to learn is vital. Just-in-time-learning and access to information when needed is paramount (Rosenberg, 2006). It thus appears to be very important for organizations to become learning organizations in order to work effectively within the information society (Hargrove, 2001; Kessels & Keursten, 2001; Senge, 1990; Wenger, 2000). Furthermore, Competency management (Nobre, 2002), ICT-security awareness management (English, 2005; Siponen, 2001) as well as Innovation and Change management have become important strategies for organizations to survive (Belasen, 2000; de Jong & den Hartog, 2005; Tijdens & Steijn, 2005). In addition, in order to deal with the changed ways
Developing a Model for Information Society Competencies

of working it has become paramount to know how to learn (Hargrove, 2001; Kommers, 2004; Yukl, 2006).

For the purpose of this research competencies are defined as a combination of knowledge and insight, skills and behavior as well as attitudes. When the term competence is used in the text it indicates a level of mastery of the competencies.

Changed Role of Managers in the Information Society

Research from Dhondt & Kraan (2001) has shown that alternative ways of working through ICT-technology require employees in general to develop new competencies. This is especially true for managers who play such an important role in organizations. They are responsible for the management of knowledge in their own unit. Furthermore, they could influence their subordinates to participate in the learning organization and the new ways of working using ICT (Hargrove, 2001). Hence it appears important to revisit information, communication and technological competencies required by managers in order to ensure that managers are fully prepared to work effectively in the information society. This notion is supported by Yukl (2006) who has called for research in this regard.

Method of the Research

A case study was conducted in a large non-profit organization using a survey with a questionnaire amongst managers with a higher education in a large non-profit organization. The questionnaire was designed based on a literature review. The different categories identified were consequently translated into statements. The respondents could evaluate the items on a 5-point Likert scale where option one represents ‘does not apply at all’ and option five represents ‘applies entirely’. The statements measure the competency of the managers in the various items by means of self evaluation.

The questionnaire was sent to 700 randomly selected managers in the organization. 246 respondents returned the questionnaire which constitutes 35% of the sample. The ratio of the relevant demographic variables of the respondents like sex and position in the organization compare sufficiently to the ratio of the demographic variables of the research population. The a-select sample is therefore seen as a suitable representation of the research population. The responses to the questionnaire were analyzed using the statistical package SPSS version 15. Factor analysis was used to obtain a set of principal components which were extracted from the results of all the items, resulting in a number of homogeneous components for the scale ‘Information Society (IS) competencies for managers’. Multivariate analysis was done to investigate the relative importance of the competencies and demographic variables in relation to the scale ‘IS competencies for managers’. The following paragraph commences with a presentation of the model for IS competencies for managers, followed by a presentation of the results of the research.

MODEL FOR INFORMATION SOCIETY COMPETENCIES FOR MANAGERS IN THE INFORMATION SOCIETY

Based on earlier research a model for information, communication and technological competencies required by managers in the information society was proposed by Broos (2007) as is illustrated in figure 1.

The model shows that a distinction was made between ICT competencies and ICT related competencies. Broos (2007) defined ICT competencies as competencies related to managers using software, hardware and networks like the Internet in their work environment, whilst ICT related competencies are defined as competencies which are related to the changed ways of working in the
Developing a Model for Information Society Competencies

Figure 1. Model for information, communication and technological competencies required by managers in the information society (Broos, 2007)

information society from a manager’s perspective and thus contain a leadership component. Separate analysis aimed at finding the information, communication and technological competencies was conducted for each of the two mentioned groups of competencies. However, for the purpose of this research report the two types of competencies are grouped together in one scale called ‘Information Society competencies for managers’, since both kind of competencies are in essence related to working with information and communication technology in the information society.

This research differs therefore from earlier research by Broos (2007) and Broos & Cronjé (in press) in the sense that the responses to the statements are analyzed in one group ‘Information Society competencies for managers’ and not in two separate groups. By analyzing the results further the author found that the two groups of competencies could indeed be grouped together. The item ‘Attitude towards lifelong learning’ was replaced by the item ‘Attitude towards learning about ICT and using the Internet effectively’, but the other information, communication and technological competencies are similar. It appeared easier to use one scale for IS Competence for managers rather than two separate scales. Further analysis was also conducted in order to obtain further insight into the relative importance of the information, communication and technological competencies.

Factor analysis was conducted in order to identify the components or factors that underpin the various items in the main category IS competence for managers. Varimax-rotation was used to reorganize the information in a more effective way so that it was easier to interpret the components (Ten Berge & Siero, 1997). The analysis then is done this way: Initially only components with a sum of squared loadings > 1 and at least three items are named. Thereafter the components with a sum of squared loadings >1 and fewer items are analyzed. When the components can clearly be identified, they are also mentioned, otherwise if they have a loading >.300 with exactly one other component, they are grouped with that other component. Some statements were omitted from the analysis since they did not clearly load with one of the mentioned components. The analysis as described was
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then redone, until the Varimax rotation could not converge in 25 iterations any longer. Thereafter no more statements were removed. This means that the scale contains three statements that did not fit into one of the main components. These statements are listed below, in conclusion of the list of identified components in table 1. Where scores of items are totaled to obtain a single score for a component, a Cronbach’s alpha was found to ensure that the questions that contribute to those dimensions are acceptably homogeneous. When the value of the Cronbach’s alpha is >= 0.7 it could be argued that the questions related to a dimension are homogeneous and the scale can be seen as reliable (Baarda & De Goede, 2001).

After the factor analysis was conducted in the way described above, 49 statements remained which were combined in one scale ‘Information Society competencies for managers’ with a Cronbach’s alpha of 0.94. The Cronbach’s alpha is an indication of reliability of the scale and shows that the internal consistency of the items in the scale is high. It is plausible that the ICT skills and ICT related components are similar enough to include them in one scale. The identified components and related statements are listed in the model for table 1 below. The result of the factor analysis is shown as a percentage of variance explained.

Multivariate regression analysis is conducted in order to obtain some insight in the relative importance of the information, communication and technological competencies in relation to the scale ‘Information Society competencies for managers’. The results of the analysis are summarized in table 2.

The table shows that the competencies ‘Having operational knowledge and insight into ICT’, ‘Finding and evaluating information on the Internet’ as well as ‘Participating in a learning organization’ are the most important factors which influence IS competence of managers. Those are therefore essential factors that need special attention in management training and in providing performance support to managers already working. Nevertheless, the other competencies are also significant.

A positive attitude towards lifelong learning is seen as important in relation to effective functioning in the information society (Hargrove, 2001; Yukl, 2006). This notion is supported by this research since a correlation (Spearman’s rho) of 0.253 (significant at the 0.01 level, 1-tailed) is found between the ‘Attitude towards lifelong learning’ and IS competence for managers.

In table 3 the correlations between ‘Attitude towards lifelong learning’ and the Information, communication and technological competencies are displayed.

The results in table 3 show that a positive attitude towards lifelong learning has a significant positive influence on ‘Finding and evaluating quality of information on the Internet’, ‘Participating in the learning organization’ and ‘Innovation and change management’ and a smaller positive influence on ‘Knowledge management in own working unit’ and ‘ICT security awareness management’. A positive attitude towards lifelong learning does not appear to influence ‘Having operational knowledge and insight into ICT’, ‘Participating in communities of practice’, ‘Competency management’ and ‘Creating an innovative work environment’. It is plausible that the last group of competencies require an amount of knowledge through training as a minimal requirement in order to develop this competence, whereas a positive attitude towards lifelong learning could influence the development of competence in the other areas by using ICT in the work environment.

In order to determine which demographic variables are important in relation to the scale IS competencies for managers, regression analysis for categorical data was conducted. Sex, Initial training and Current function are found to have a significant relationship with the scale IS competencies for managers as is illustrated in table 4.

Table 4 shows that Sex, Initial training and Current function area are significant mediating variables. Further analysis shows that manag-
Developing a Model for Information Society Competencies

Table 1. Model for information, communication and technological competencies required by managers in the information society

<table>
<thead>
<tr>
<th>Identified components</th>
<th>Statements</th>
<th>Remarks from the literature review</th>
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<tbody>
<tr>
<td><strong>Having operational knowledge and insight into ICT</strong> <em>(7 items, Cronbach’s alpha: 0.81, explaining 7% of variance).</em></td>
<td>I know enough about ICT networks in order to know what can and cannot be done. I am able to use all the software applications that I need in my work effectively. I manage my e-mail effectively. I organize my information effectively on the computer. I have enough insight into ICT in order to participate in decision-making in this regard. I lose production time because I am not familiar with the software applications (results recoded). I ask others to help me with ICT (results recoded).</td>
<td>Operational ICT competence includes knowledge about functionalities and limitations of generic and other applications, hardware as well as networks. It goes beyond mastery of applications (Martin, 2002; Steyaert, 2000; Town, 2003). Managers indicated that the generic applications that are important in their work are spreadsheets like MS Excel, presentation programs like MS PowerPoint, the Internet and the Intranet of the organization (Broos, 2007). Broos &amp; Cronje (in press) also found that managers would like to learn more about Information management systems, databases, project planning systems as well as tools to organize thoughts.</td>
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<tr>
<td><strong>Finding and evaluating quality information on the Internet when needed</strong> <em>(7 items, Cronbach’s alpha: 0.82, explaining 7% of variance).</em></td>
<td>It is important in my function to find relevant information on the Internet. I know how to obtain access to work related sections of the Internet for which you need special authorization. I know where to find information on the Internet about relevant courses and studies for myself. I know where to find information on the Internet about relevant courses and studies for my subordinates. I can always find work related information on the Internet just in time when I need it. It is easy for me to evaluate the credibility of information I find on the Internet. I obtain ideas from the work of others that I find on the Internet to improve my own work.</td>
<td>Structural ICT competence includes understanding about the structure of the Internet in order to find suitable information. The ability to recognize a need for information, the ability to locate and access the required information (Steyaert, 2000; Town, 2003). Strategic ICT competence includes evaluating the relative importance of information and sources as well as conceptual insight in ICT in order to participate effectively in decision-making in this regard (Hargrove, 2001; Town, 2003).</td>
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<tr>
<td><strong>Participating in the learning organization, incl. knowledge management in the wider context of the organization</strong> <em>(10 items, Cronbach’s alpha: 0.9, explaining 11% of variance)</em></td>
<td>I think of ways to improve the sharing of information electronically. I spend time to improve the sharing of the organizational knowledge electronically. I share the mistakes that I made and what I learnt from it with my colleagues. I play an important role in managing the knowledge of the organization electronically. I use my computer to obtain insight into the competencies needed in the organization. I reflect on the security (availability) of information in the organization. I reflect on how information can be managed more effectively. I play an important role in organizing the flow of information in my unit. It is important for my organization unit to share working knowledge and information with international partners. I implement new ways of working with information in the organization.</td>
<td>Willingness to be involved. Understanding the organizational value (Belasen, 2000; Davenport &amp; Prusak, 1997; Feather, 2004; Kessels &amp; Keursten, 2001; Steyn, 2001). Contributing towards the development of knowledge, sharing knowledge, evaluating knowledge, applying knowledge (Boonstra, 2005; Weggeman, 2000).</td>
</tr>
</tbody>
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continued on following page
### Table 1 continued

<table>
<thead>
<tr>
<th>Identified components</th>
<th>Statements</th>
<th>Remarks from the literature review</th>
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<tbody>
<tr>
<td><strong>Knowledge management in own working unit</strong> (5 items, Cronbach’s alpha: 0.9, explaining 8% of variance)</td>
<td>It is important to store the knowledge of my unit electronically. I spend time to organize electronically the working knowledge of the unit I am responsible for. I encourage my subordinates to share their working knowledge with others electronically. I discuss the advantages of sharing working knowledge electronically with my subordinates. I encourage my subordinates to participate in the thinking process about improving the work processes.</td>
<td>Taking on the role of implementing knowledge management in own unit. Thereby understanding the importance of involvement of subordinates in knowledge management (Belasen, 2000; Boonstra, 2005; Hargrove, 2001).</td>
</tr>
<tr>
<td><strong>Innovation and change management</strong> (6 items, Cronbach’s alpha: 0.82, explaining 7% of variance)</td>
<td>I consider renewal projects as a challenge. I know how to manage change effectively. I know how I can accompany changes effectively in the organization. I use creative ideas to improve the working method. I know how I can deal with the resistance my subordinates have against changes in the organization. I know how to communicate effectively during a change in the organization.</td>
<td>Knowing the effect of change and ability to deal with change as well as resistance against change constructively. (Hargrove, 2001; Yukl, 2006; Stoker, 2005). Thereby understanding the effect of the organizational culture in the organization (Boonstra, 2000; Davenport &amp; Prusak, 1997). Communication of the vision of the organization and changes required (Belasen, 2000; Boonstra, 2000; Hargrove, 2001; Yukl, 2006).</td>
</tr>
<tr>
<td><strong>Participating in communities of practice</strong> (3 items, Cronbach’s alpha: 0.7, explaining 5% of variance)</td>
<td>I do communicate electronically with other professionals about my work. I share work-related knowledge with others electronically. I benefit from colleagues who share their experiences and lessons learnt with me.</td>
<td>Understanding the need for networking and usability of sharing work experiences (Preece, e.a, 2004; Wenger, 2000; Schoemaker, 2004).</td>
</tr>
<tr>
<td><strong>Competency management</strong> (3 items, Cronbach’s alpha: 0.74, explaining 5% of variance)</td>
<td>I use my computer to store relevant information about the potential of my subordinates. I recognize development needs of my subordinates. I facilitate the development needs of my subordinates.</td>
<td>Insight in competences and talents of employees (Hockstra &amp; Sluijs, 2003). Insight in learning and training needs and designing a development plan from subordinates (Kessels &amp; Keursten, 2001; Senge, 1990). Furthering employability for subordinates (Hargrove, 2001). Thereby also considering the competencies required in the organization (Nobre, 2002).</td>
</tr>
<tr>
<td><strong>ICT security awareness management</strong> (3 items, Cronbach’s alpha: 0.77, explaining 4% of variance)</td>
<td>I know what the information security risks of the Internet are. I reflect about the integrity of the information I am responsible for. I encourage ICT security awareness amongst my subordinates. I reflect on the security (exclusivity) of information in the organization.</td>
<td>Ensuring security of information in the sense of exclusively, integrity and availability (Siponen, 2001; English, 2005). Encouraging ICT security awareness amongst subordinates (English, 2005; Siponen, 2001).</td>
</tr>
<tr>
<td><strong>Creating an innovative work environment</strong> (2 items, Cronbach’s alpha: 0.6, explaining 3% of variance)</td>
<td>I allow my subordinates to work in the way they find best. I allow my subordinates to make mistakes.</td>
<td>Providing autonomy for subordinates (De Jong &amp; Den Hartog, 2005; Kluytmans, 2005). Stimulation of innovative work climate (Hockstra &amp; Sluijs, 2003; Florida, 2002).</td>
</tr>
<tr>
<td>The three statements that do not fit the main components:</td>
<td>In my function it is important to learn all the time (3% of variance) I identify and recognize important information in an information rich environment. I allow my subordinates to learn via the Internet during work hours.</td>
<td>The statement ‘In my function it is important to learn all the time’ is seen as an indication of the attitude of the manager towards the importance of lifelong learning.</td>
</tr>
</tbody>
</table>
Table 2. Relative importance of the information, communication and technological competencies in relation to Information Society competence for managers

<table>
<thead>
<tr>
<th>Information, communication and technological competency</th>
<th>Beta (standardized coefficients)</th>
<th>T-value</th>
<th>Level of significance ** p &lt; 0.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Having operational knowledge and insight into ICT</td>
<td>0,240</td>
<td>21,873</td>
<td>**</td>
</tr>
<tr>
<td>Finding and evaluating quality of information on the Internet</td>
<td>0,233</td>
<td>21,191</td>
<td>**</td>
</tr>
<tr>
<td>Participating in the learning organization, incl. knowledge management in the wider context of the organization</td>
<td>0,388</td>
<td>27,262</td>
<td>**</td>
</tr>
<tr>
<td>Knowledge management in own working unit</td>
<td>0,121</td>
<td>9,951</td>
<td>**</td>
</tr>
<tr>
<td>Innovation and change management</td>
<td>0,177</td>
<td>14,825</td>
<td>**</td>
</tr>
<tr>
<td>Participating in communities of practice</td>
<td>0,144</td>
<td>10,176</td>
<td>**</td>
</tr>
<tr>
<td>Competency management</td>
<td>0,077</td>
<td>7,752</td>
<td>**</td>
</tr>
<tr>
<td>ICT security awareness management</td>
<td>0,078</td>
<td>6,169</td>
<td>**</td>
</tr>
<tr>
<td>Creating an innovative work environment</td>
<td>0,041</td>
<td>4,287</td>
<td>**</td>
</tr>
<tr>
<td>Sum of squares: 57,272, df: 9, F: 1229,475, p&lt;0,001</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Correlations between attitude towards lifelong learning and information, communication and technological competencies

<table>
<thead>
<tr>
<th>Information, communication and technological competency</th>
<th>Correlation with attitude towards lifelong learning (Spearman’s rho) ** p &lt; 0.01 * p &lt; 0.05</th>
<th>Significance (1-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Having operational knowledge and insight into ICT</td>
<td>-0,002</td>
<td>0,487</td>
</tr>
<tr>
<td>Finding and evaluating quality of information on the Internet</td>
<td>0,261**</td>
<td>0,000</td>
</tr>
<tr>
<td>Participating in the learning organization, incl. knowledge management in the wider context of the organization</td>
<td>0,194**</td>
<td>0,001</td>
</tr>
<tr>
<td>Knowledge management in own working unit</td>
<td>0,149*</td>
<td>0,010</td>
</tr>
<tr>
<td>Innovation and change management</td>
<td>0,241**</td>
<td>0,000</td>
</tr>
<tr>
<td>Participating in communities of practice</td>
<td>0,09</td>
<td>0,080</td>
</tr>
<tr>
<td>Competency management</td>
<td>0,082</td>
<td>0,169</td>
</tr>
<tr>
<td>ICT security awareness management</td>
<td>0,119*</td>
<td>0,032</td>
</tr>
<tr>
<td>Creating an innovative work environment</td>
<td>0,19</td>
<td>0,413</td>
</tr>
</tbody>
</table>

Table 4. Significant relationships between demographic variables and IS competencies for managers

<table>
<thead>
<tr>
<th>Demographic variables</th>
<th>Standardized coefficients (standard error)</th>
<th>F-value ** p &lt; 0.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (male/female)</td>
<td>-0,247 (0,6)</td>
<td>16,851**</td>
</tr>
<tr>
<td>Initial training (Human resource management, Administration, logistics, Information and communication systems, Planning and control, juridical, Technical and electronic design and maintenance, Production &amp; Operational)</td>
<td>0,275 (0,6)</td>
<td>20,837**</td>
</tr>
<tr>
<td>Current function (Policy and governing, Human resource management, Administration, Logistics, Information and communication, Planning and control, incl. legal issues, Education and training, Technical and electronic design and maintenance, production and operational)</td>
<td>-0,197 (0,6)</td>
<td>10,811**</td>
</tr>
</tbody>
</table>
Developing a Model for Information Society Competencies

Managers either being trained or currently working in communication and information technology score significantly higher (p<0,05) on the scale IS for managers (mean 3.7) compared to managers in other fields (mean 3.3). This is an interesting result in the sense that managers with clearly more in-depth knowledge about ICT appear to be also more IS competent in the context of their work environment. This could confirm that more in-depth knowledge about ICT makes it possible to work more effectively with ICT in the work environment in the context of the information society. This supports the notion that more attention for ICT in management training is necessary.

Since the organization in which the case study was conducted primarily trains their own managers and most of the respondents started their work in the organization directly after school, it was anticipated that the number of years working in the organization as managers could be taken as an indicator of age. As shortages in personnel are becoming more prominent in the organization in which the case study was conducted, increasingly trained managers are contracted for the organization and thus years working as manager in the organization can not be taken as an exact indicator of age. However there appears to be a small correlation between this intended indicator of age and the score on IS competence (Spearman’s rho is 0,109 (p<0,05 (1-tailed)). The expectation is that age could be an important indicator since the younger managers have grown up with ICT and the Internet. It appears important therefore to include age as a demographic variable in further research in this regard.

Managers in the case study score a mean of 3.3 (standard error 0.3) ranging from 1.8 to 4.8 on the scale for IS competence for managers. 3.3 is closest to category ‘applies partly’ which means that there is considerable room for improvement. In fact, from the results it can be deduced that fifty percent of the managers in the organization where the case study took place have a score ranging from ‘applies slightly’ to ‘applies partly’, which is much lower than can be expected.

The scores for the information, communication and technological competencies are indicated in table 5. It is plausible that a score of at least four ‘Applies mainly’ is desirable since managers play such a crucial role in implementing the new ways of working (Belasen, 2000; Boonstra, 2005; Davenport & Prusak, 1997; Stoker, 2005).

Further analysis of the extremes shows that only one respondent appears three times under the extremes, five respondents appear twice and the other respondents only once. No specific pattern for the extremes was found.

The mean score for ‘Attitude towards lifelong learning’ is high enough according to the expectation, although it appears as if some respondents have a negative attitude towards lifelong learning. None of the other information, communication and technological competencies has a mean score of four. Especially the competencies ‘Finding and evaluating quality information on the Internet’, ‘Participating in the learning organization’, ‘knowledge management in own work unit’ and ‘Participating in communities of practice’ score considerably lower than ‘applies mainly’. This could indicate that management training needs to be adjusted in order to prepare managers to working effectively with ICT in the information society. Furthermore, managers currently working in the information society could benefit by receiving additional training in the identified information, communication and technological competencies as well as receiving suitable performance support in the context of their work environment.

FUTURE TRENDS

Implications for Management Training

The development of Information Society competencies in management training could be done
Developing a Model for Information Society Competencies

either via a specific subject in this regard, or it could be done in a combination of theoretical lessons and a learning programme integrated across the curriculum in a number of subjects. In the latter scenario a number of teaching staff are to participate in a learning programme for IS competencies for managers. It is important that the teachers elected to participate are suitably prepared to participate in such a programme in order to ensure the quality (Geerligs, Mittendorf & Nieuwenhuis, 2004) and that they are motivated and dedicated to effect the end result (Fresen, 2005). From research done by Steyn (2001) about staff development, it can be concluded that existing attitudes and learning cultures do not allow for self-development and that comprehensive staff development interventions are necessary for such integrated programmes to work effectively.

Some examples of how instructional technology could be used to support the development of Information Society competencies for managers in a learning programme are described in table 6.

### Implications for Performance Support

It is a difficult and complex process to establish a learning organization in which knowledge is effectively managed (Harrison & Kessels, 2004). Harrison & Kessels argue that this will only happen if a human resource development programme deals with those aspects designated by them as a ‘corporate curriculum’. Such a corporate curriculum makes it possible to transform the daily work environment into an environment where learning and working come together and where just-in-time-learning is stimulated and supported for all employees. Kessels & Keursten (2001) claim that it is important for individuals to develop competencies through which they are able to participate in a work environment where information

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**Table 5. Scores for the information, communication and technological competencies**

<table>
<thead>
<tr>
<th>Competencies</th>
<th>Central tendency</th>
<th>Mean</th>
<th>Standard error</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Minimum</td>
</tr>
<tr>
<td>Having operational knowledge and insight into ICT</td>
<td>Applies mainly</td>
<td>3.6</td>
<td>0.04</td>
<td>1.7 2 extremes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finding and evaluating quality information on the Internet</td>
<td>Applies partly</td>
<td>2.8</td>
<td>0.05</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participating in the learning organization and knowledge management in general</td>
<td>Applies partly</td>
<td>2.7</td>
<td>0.05</td>
<td>1.0 4 extremes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge management in own working unit</td>
<td>Applies partly</td>
<td>3.4</td>
<td>0.06</td>
<td>1.0 6 extremes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Innovation and change management</td>
<td>Applies mainly</td>
<td>3.9</td>
<td>0.04</td>
<td>1.8 4 extremes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participating in communities of practice</td>
<td>Applies partly</td>
<td>3.3</td>
<td>0.05</td>
<td>1.0 7 extremes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competency management</td>
<td>Applies mainly</td>
<td>3.8</td>
<td>0.07</td>
<td>1.5 2 extremes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICT-security awareness</td>
<td>Applies mainly</td>
<td>3.6</td>
<td>0.05</td>
<td>1.25 1 extreme</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creating an innovative work environment</td>
<td>Applies mainly</td>
<td>3.9</td>
<td>0.06</td>
<td>2.0 5 extremes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitude towards learning</td>
<td>Applies mainly</td>
<td>4.2</td>
<td>0.05</td>
<td>1.0 5 extremes</td>
</tr>
</tbody>
</table>
### Table 6. Examples of using technology in management training in preparation of a digital work environment

<table>
<thead>
<tr>
<th>Item</th>
<th>Examples of integrating technology in a learning environment for managers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Having operational knowledge and insight into ICT and Office applications</td>
<td>Making self-teach manuals available to the learners on-line, whereby taught sessions are initiated when the need arises. Understanding and presenting information effectively using a spreadsheet could be encouraged in subjects like Mathematics, Statistics and Research Methods. Since searches are often done in databases using keywords – some practical experience in databases and query language appears to be important. Presentation software could be used when students need to present their work or topics to other students. Students can be encouraged to present management information in an acceptable way. Management games and simulations could be used where case and scenarios could be used with increasing complexity. Guidelines could be provided and some practical exercises could be done by students in order to master this item. When the students have a project to do, they could be required to use an application so that the students understand what such a system could mean in practice. A beginner self-teach manual could be designed. Another way of dealing with project management could be an electronic meeting room where a combination of (oral) consultation is offered as well as a number of tools are provided to support each type of process and decision forming effectively.</td>
</tr>
<tr>
<td>Information management systems Archiving of documents and e-mail Project management</td>
<td>Finding and evaluating quality information on the Internet (including the ‘Deep Web’) Online guidelines could be provided and practical exercises whereby critical search methods and critical evaluation regarding the reliability and credibility of the sources are a requirement, could be integrated in a number of subjects and projects. Furthermore, the students could be encouraged to use a variety of databases like PiCarta and subject specific on-line databases. Examples of specialized online educational resources like online periodicals or textbook supplements could be used so that learners get an idea about what is available on the Internet that could support their study and research.</td>
</tr>
<tr>
<td>Participating in the learning organization and knowledge management</td>
<td>Collaborative software like wiki’s could be used to encourage students to share knowledge with each other. A communal database like Wikipedia could be used to explain the principles of a database.</td>
</tr>
<tr>
<td>Change management</td>
<td>Students could participate in a virtual change management project. Theory about factors that influence change management could be offered.</td>
</tr>
<tr>
<td>Participating in communities of practice</td>
<td>On-line conferencing Students could participate in synchronous (e.g. a virtual workshop using Breeze web conferencing or Skype) and a-synchronous discussions. Students could be encouraged to create an online network with fellow students in a joint project across the various sub organizations. Experience in working in a virtual team could thus be obtained. A further advantage could be that students are thus better prepared to deal with cultural differences.</td>
</tr>
<tr>
<td>ICT-security awareness management</td>
<td>An online self-test could provide some insight in ICT-awareness. Such a test could include hypertext with explanations about certain ICT-security issues; students could only learn what is relevant for them.</td>
</tr>
<tr>
<td>Learning how to learn Tools to organize thoughts</td>
<td>(Online) learning journals like web logs could be used to encourage the students to reflect about what they have learnt; this enhances transfer of knowledge according to Ausubel (2000). Students could reflect about models of meta-cognition about learning and thus increase their understanding about their own learning (Yukl, 2006). Students could start a personal digital library of sources and abstracts of those sources and start creating a digital network. Students could be introduced to intelligent programs that read text and summarize its main ideas. Student could be introduced to applications that help them manage their sources digitally. Providing performance support or learning support online could also be seen as a means to improve learning how to learn (Rosenberg, 2006). Students could be asked to brainstorm in a project group, whereby a mind mapping tool is used or they could be asked to use such a tool to summarize the important aspects of a subject/topic. Interesting is that mind-mapping is seen as a creativity enhancing activity (Beijen, e.a., 2003).</td>
</tr>
</tbody>
</table>
and knowledge are paramount. Rosenberg (2006) emphasizes that such performance support could not entirely replace training, but could be seen as a means to improve performance. This notion is supported by Rosett (2007). Providing suitable performance support could thus be seen as a component of knowledge management in an organization where the learner could access knowledge and information from a variety of resources, just when they need it (Rosenberg, 2003). This could be named ‘just-in-time-learning’.

Wenger (2000) and Brown & Duguid (2000) argue that success of organizational learning is largely determined by the ability of organizations to create communities of learning and practice. Information and communication technology could stimulate such communities since it makes them more effective and flexible in terms of time and place.

**CONCLUSION**

Although the results of this research can not be generalized it could provide a basis from which further research amongst managers could be conducted. Many results might be of a general nature and emphasize the need for ICT to be given a more prominent place in management training in the information society.

This research indicates that important Information Society competencies for managers in order to work and lead effectively in the context of the information society include: Having operational knowledge and insight into ICT, Finding and evaluating quality information on the Internet, Participating in the learning organization and knowledge management both in the wider context of the organization and in their own working unit, Innovation and change management, Participating in communities of practice, Competency management, ICT security awareness management, as well as Creating an innovative work environment. Each of the mentioned competencies is further described in a model for Information Society competencies.

Each of the above-mentioned competencies is further described in a model for Information Society competencies. Furthermore, a positive correlation is found between a positive attitude towards lifelong learning and Information Society competence for managers.

This research also indicates that the competencies ‘Having operational knowledge and insight into ICT’, ‘Finding and evaluating quality of information on the Internet’ and ‘Participating in the learning organization’ are the most important factors determining Information Society competence for managers.

The mean score for the scale IS competence for managers is 3.3 (standard error 0.3) on a five point Likert scale, corresponding to the option ‘applies partly’. Since managers play an important role in implementing changed ways of working in the organization a score corresponding to ‘applies mainly’ was reasonably expected. When the responses to the scale IS competence for managers are analyzed further, it shows that especially the identified competencies ‘Finding and evaluating quality information on the Internet’, ‘Participating in the learning organization’, ‘Knowledge management in own work unit’ and ‘Participating in communities of practice’ score considerably lower than expected.

From these results could be concluded that a re-evaluation of management training is necessary and that a corporate curriculum could include suitable performance support for just-in-time-learning.

**REFERENCES**


KEY TERMS AND DEFINITIONS

**Digital Work Environment:** The digital work environment consists of all the information and communication technologies available in the work environment. This includes hardware, software and network facilities as well as mobile technologies, the Internet and the companies Intranet.

**Competency Management:** Competency management is finding a balance between the (future) needs of the organization in terms of competencies and the development plans and competence of the individuals in it. This term is closely related to human resource development.

**Information Society:** The information society is seen as a society in which organizations in modern countries currently need to operate in order to be effective and able to compete. Globalization as well as information and communication technologies are important characteristics of the information society.

**Information Society Competencies for Managers:** Information Society competencies consist of a combination of knowledge and insight, skills and behavior as well as attitudes that managers need to work and lead effectively in the information society.

**Just-in-Time-Learning:** Learning when you need to know as opposed to learning according to a preset curriculum. Just-in-time-learning does not replace traditional learning, but could enhance performance.

**Learning Organization:** The organization as an integral and dynamic system can learn, but so can the individuals in it. Knowledge management and communities of practitioners are important characteristics of the learning organization. The strategies and techniques that are available in such organization include training as well as performance support and are increasingly dependent on Information and communication technologies. However, the participation of the individuals as well as the social structures in the organization also remain important.

**Performance Support:** Performance support includes all (digital) job aids that are available and accessible in the work environment that could enhance performance. Examples are (online) work instructions and information, instructional video’s or a presentation of examples in the working context, but also via an online community of learners.
Chapter 29
How People Learn with Computer Simulations

Douglas L. Holton
Utah State University, USA

ABSTRACT
Using the four lenses of the How People Learn (HPL) framework, this chapter reviews research on the use of computer simulations for pedagogical purposes. Deciding when and how to support effective learning with simulations requires careful consideration of learner-centered, assessment-centered, knowledge-centered, and community-centered issues. By reviewing educational research on simulations from these four perspectives, one may then be better equipped to incorporate simulations into instruction and training in a manner that can align and balance all four perspectives, resulting in a more effective learning environment.

INTRODUCTION
Imagine a beginning airplane pilot, a beginning surgeon, or a teenager getting behind the wheel of a car for the first time. In cases like these mistakes could have serious consequences, and it is for this reason a great deal of effort has been spent on the development and use of training, computer simulations and other practice experiences. There is no perfect substitute for direct experience and participation, but developing simulated experiences that mimic the real thing as closely as possible saves money and saves lives. As science and technology advance too, the different domains in which we train and educate people are becoming more and more complex. Students have many difficulties learning about complex and dynamically changing systems and phenomena. There is a growing need for more powerful tools such as simulations and modeling tools to assist students and teachers with understanding these dynamic systems. This chapter reviews the use of computer simulations for this pedagogical purpose and argues that supplemental learner-centered de-

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sign strategies are needed to improve performance and learning outcomes.

First, however, one must develop a vocabulary to begin to make sense of dynamic systems, simulations, and learning and understanding. Hence, the first few sections introduce some of the terminology and concepts that will later be necessary for interpreting and applying a framework for using and designing simulations for pedagogical and training purposes.

**DYNAMIC SYSTEMS**

Dynamic systems are typically made up of multiple interacting components, such as the parts of a car engine or the coordinated activity of the human respiratory system, and are characterized by behaviors that evolve in time. When normally using and interacting with such systems, we typically do not think about the underlying dynamic interactions involved. For example, we do not usually consider nor need to consider the mechanics of breathing or the combustion processes occurring inside a car engine. We may think only of the function and purpose of a system, such as a car engine’s function in helping us transport to another location. When however the function of a system is uncertain or unfulfilled, such as when designing or troubleshooting or predicting the behavior of a system, we need to consider the underlying mechanics.

We typically construct models to better understand and predict the behavior of physical and social systems. The simplest type of model is an input-output model, or “blackbox” model. Behaviorism, for example, modeled human and animal behavior by observing relationships between input stimuli and observable output behavior. For a better understanding though we construct process models of systems that model not only external interactions but the structure, behavior and function of internal parts also. A structure-behavior-function (SBF) model consists of:

- **Structures** the stable components of a system, such as the parts of a car engine.
- **Behavior** the description an observer makes of the changes in the system over time and with respect to the environment with which a system interacts (Maturana & Varela, 1987), such as a person putting on a coat in response to colder temperatures.
- **Function** is the effect of a system on its environment (Chandrasekaren & Josephson, 1996, 2000), such as the function of a thermostat and heating system to keep a room at a constant temperature. As mentioned earlier, function is also a higher-level description of a system’s purpose and how it is expected to operate within an environment.

This SBF framework has been used before to characterize people’s descriptions of how systems and devices work (Goel, Gomez de Silva Garza, Gruć, Murdock, Recker, & Govinderaj, 1996; Hmelo, Holton, & Kolodner, 2000; Hmelo-Silver & Green, 2002).

Any system may also be characterized by certain generic structures and interactions, and this has formed the basis for the field of system dynamics. There are two basic types of components that characterize how a system changes over time, sources of effort (also known as stockpiles) and flow components (Karnoop, Margolis, & Rosenberg, 1990). In a hydraulic braking system, for example, pressing a brake pedal causes a piston to move. The piston may act as an effort source by delivering energy into the hydraulic system in the form of pressure. This may result in a change in the rate of flow of fluid through the system. Energy is transmitted through the system and converted back into pressure on brake pads, which dissipate the energy by exerting friction with the tires. Thus, energy may be stored, transmitted, or converted within a system by the effort and flow sources, but also dissipated to the surrounding environment. The speed of these energy changes, or power, is constrained by both the amount of effort and the
rate of flow. Power is computationally determined by multiplying effort with flow. For example, electrical power (measured in watts) can be determined by multiplying voltage (effort source) with current (the flow of electrical charge).

A system may also contain agents, or components that sense their environment and act on it over time to effect changes in the system, creating feedback loops (Franklin & Graesser, 1996). Humans often act as sophisticated agents within a system, but at a simpler level a thermostat may also act as an agent in a home heating system, although simpler mechanisms are more commonly referred to as controllers rather than agents. An anti-lock braking system (ABS) is another example, for it lessens the pressure applied to brake pads if it senses that the wheels have lost traction with the road.

Dynamic systems in general may also have characteristics such as nonlinear effects, hidden processes, and delayed and emergent effects (Spector, 2001). Systems may also have interacting, hierarchical levels (Chi, 2001). One can for example analyze properties of a car engine at the level of its function for the car (such as horsepower), at the level of molecular interactions and chemical reactions happening within its components (oxygen-fuel mixture), or at a macro-level of its effects on the environment (carbon emissions).

MODELS

Models, which describe or represent systems, have certain general characteristics as well. Models may employ quantitative or qualitative representations and descriptions. Quantitative models such as graphs or numeric tables present the measurable changes in some system variable with respect to another variable such as time. Qualitative models verbally describe or depict changes in terms of object properties and relationships, such as when using a concept map or a textual explanation to describe a system. The aforementioned SBF framework is one means of generating qualitative descriptions of dynamic systems and devices. Early computer simulations such as STEAMER and SOPHIE were the first to make a strong distinction between quantitative and qualitative descriptions of a system, because it was reasoned that people generally understand systems in qualitative terms rather than purely quantitatively:

For teaching purposes, the main drawback of quantitative simulation is its inability to give a full account of the causality underlying its inferences. Causality is pedagogically important because it is the main ingredient of the kinds of explanations human students can understand. In a troubleshooting context, causality, more than information content, drives the diagnostic reasoning and the decision to perform measurements. (Wenger, 1987, p.62)

Many models combine both qualitative and quantitative information to connect the two for the user when displaying how a system changes in real-time. One means of doing this is translating continuous, quantitative information to discrete, qualitative information. A continuous graph of position versus time can depict an object’s motion, but may also be discretized into qualitative statements such as “the object accelerates, then decelerates, then stops.”

A system may also be characterized by decentralized or centralized models. In decentralized models there are multiple similar agents or components acting in parallel with one another. The movement of electrical charge through heart tissue, the spread of a forest fire, or the movement of the “Wave” in a stadium crowd may be characterized by similar decentralized models even though they are quite different systems. Alternatively, a radio filter circuit, a spring and mass system, and a closed water pipe system may also be characterized by one linear mathematical...
model of their behavior. In the latter systems, parallel simulations are possible but not necessary to model their behavior.

Experts such as scientists and engineers use many different tools and external representations to help describe and understand dynamic systems. These range from representations for presenting and communicating information about dynamic systems, to tools for generating and constructing new representations of dynamic systems. One may represent an electrical circuit, for example, by a circuit diagram or a graph. A static system such as books lying atop a table may be represented with a free-body diagram specifying the forces acting on the books by gravity and the table.

Forbus and Sherin (2002) have stated that some modeling tools such as concept maps, system notations, and argumentation environments help capture certain aspects of a system, but that “none alone are sufficient for capturing the range of activities and knowledge involved in modeling.” They state three issues these static modeling tools do not address: the importance of broadly applicable principles and processes, understanding when a model is relevant, and a qualitative understanding of behavior. Often students may focus on calculations or procedural issues without connecting them to the actual behavior of the system being modeled. This leads one to question how might one overcome these limitations with traditional static modeling.

SIMULATIONS

To better understand specifically how a system changes in time (behavior), one may forgo modeling to work with the real system itself - measuring, observing, controlling, or designing aspects of the system. This also allows one to compare the real system with current models. When a system is too complex or too impractical or dangerous to analyze in person though, one may use a computer-based simulation of that system and work with that representation instead as the closest alternative to working with the real system itself. A simulation is a dynamic, manipulable model of a system that recreates some of the properties and behavior of the system it is modeling. An aircraft simulator, for example, may allow one to practice flying a plane under various environmental conditions. Simulations may also allow one to visualize invisible aspects of a system and test theoretical hypotheses by manipulating variables in the simulation.

As dynamic models of systems, simulations themselves are characterized by many of the aforementioned properties of dynamic systems and models. They may be characterized by SBF models and even exhibit nonlinear or emergent effects. The primary characteristic that distinguishes simulations from other types of models however is fidelity. Simulation fidelity is the similarity between a simulation and the system it is modeling (Figure 1). The higher the fidelity of the simulation, the more trustworthy its behavior may be to someone familiar with the actual system, in the sense that experiences using the simulation more closely resemble real-world experiences. There are three types of fidelity: perceptual, manipulative, and functional fidelity (Levine & Waugh, 1988). Perceptual fidelity refers to how a computer simulation visually resembles the system it is modeling. An airplane simulator for example will typically visually depict the view from the cockpit of an airplane. Manipulative fidelity is the extent to which a simulation user’s actions correspond to the actions performed with the real system. Using a joystick to control an aircraft in a simulation would be more realistic than only using keyboard controls. Functional fidelity refers to how well the computational model mediating user actions and perceptual feedback with the simulation resembles the underlying rules governing the behavior of the actual dynamic system. An low-budget aircraft simulator for example may not be able to accurately calculate and generate complex effects such as wind shear on an airplane, which
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would be important for advanced pilot training or for testing new aircraft designs.

The types of simulations covered thus far are computer-based representations of dynamic physical systems, such as molecular interactions, airplanes, or electric circuits. Before the advent of computers with graphical interfaces, such simulations were much more difficult and costly to implement. These kinds of simulations are *symbolic simulations* because they are encapsulated representations of an external physical system (Gredler, 1996). Most computer-based simulations are symbolic simulations, and one of the first was STEAMER (Hollan, Hutchins, & Weitzman, 1984), a simulation of a steam plant used for instruction in propulsion engineering. In contrast, *experiential simulations* are simulations in which the user or learner is a functional element, or agent, in the situation or system being modeled (Harper, Squires, & McDougall, 2000). The user plays a role in the situation and makes certain decisions. Multiple possible paths of events may occur during the experience (Gredler, 1996). These were the predominant types of simulations before the advent of computer-based simulations, and still are prevalent today. An example is Model U.N. in which students from various schools take on roles of different countries at pretend meetings of the United Nations.

PEDAGOGICAL USES OF SIMULATIONS

Educators and trainers have used simulations, including animated computer simulations, for many of the same practical reasons as experts, such as cost and safety. Schools in Nashville, TN and Berkeley, CA found it more cost effective to use a river water quality computer simulation than taking multiple field trips to an actual river (Bransford, Brophy, & Williams, 2000). Using computer simulations does not sacrifice student learning outcomes, however, which have generally been found to be equivalent to learning with hands-on activities (Shavelson, Baxter, & Pine, 1992). Overall, students successfully learn when using simulations. In a large-scale analysis of mathematics classrooms, Harold Wenglinsky found higher student achievement in classrooms using computers for simulation and data exploration activities. In contrast, achievement scores actually declined by six tenths of a year in eighth-grade classrooms in which computers were used for decontextualized drill activities instead of simulations (Wenglinsky, 1998).

Students learn more than just facts when using computer simulations. Njoo and de Jong (1993) have found that the educational benefits of simulations are revealed more in tests of intuitive
knowledge, such as reasoning about “what if” scenarios, rather than tests of more factual knowledge. Similarly, Thomas and Hooper (1991) concluded in a review of research that the use of simulations is more effective when the educational goal is for students to transfer and apply knowledge to real-world problems rather than memorize facts or procedures. This is not as surprising when considering that the primary design principle of simulations, fidelity, is designed to lower the amount of work needed to transfer one’s knowledge to the actual system it is modeling.

There are however penalties associated with learning from high fidelity simulations. The more closely a simulation models a complex dynamic system, the more difficult the simulation is for someone to learn and understand how to use. The same design principle of fidelity that makes simulations more effective for experts may hurt the effectiveness of simulations in pedagogical contexts. Instead of providing more knowledge to a learner, like a textbook or video, higher fidelity simulations require more knowledge from a learner to be properly used and understood. An aircraft simulation may be highly realistic and complex, for example, but too difficult for a beginner to use. Novice flight students may not know what effect various actions such as turning dials and pulling levers have in a simulated cockpit (referred to as the gulf of execution by Norman (1988)), and they also may not understand the feedback provided by the various cockpit displays (the gulf of evaluation, Figure 2).

Accordingly, many trainers have argued for the use of low fidelity simulations at the beginning of training in order to help students learn the basics more quickly and gradually increase the fidelity as learning progresses (Alessi, 1988). Used in the context of an aircraft simulator, this dynamic fidelity strategy, as Alessi refers to it, allows flight students to gradually learn various complexities of flying airplanes through extensive practice and by building from their basic knowledge of the control of an airplane. One might begin with only joystick and throttle controls for example. Thus, the difficulties associated with learning from higher fidelity simulations may be easily overcome in those domains in which learners already possess sufficient intuitive knowledge and experiences that do not conflict with the expert models of the domain underlying the simulation.

**LEARNING WITH UNDERSTANDING**

Pedagogical uses of simulations have had more mixed results when the goal of instruction is a deeper level of understanding of the system being modeled. Understanding how electric current is controlled in a circuit is one example that many students have a great deal of difficulty learning (e.g., Duit, et al., 1984; Caillot, 1991). In these contexts, students approach simulations with their own ideas that often may conflict with an expert’s understanding of the underlying domain (Snir, Smith, Grosslight, 1995). Students may have...
misconceptions or very limited knowledge about the domain. Effectively using and learning from simulations in such domains requires conceptual change on the part of the learners. Weller states that “conceptual change simulations are based on an assumption that the student may have a degree of previous nonscientific learning that is strongly resistant to science instruction” (1996, p.468). In these domains the effects of fidelity in a simulation may present a larger hurdle to successful understanding on the part of the learner, for the closer the simulation resembles an expert’s model of the dynamic system, the farther the simulation may be from the learner’s own model and understanding of the system (Figure 2). As Edwards notes, “When a designer constructs a computer microworld to represent some subdomain of mathematical or scientific knowledge, there is no guarantee that the user will see what the designer intended” (1998, p. 73).

Using a simulation for understanding an underlying model (learning with understanding) is different than using a simulation to learn a procedure such as how to land an airplane or how to measure voltage in an electric circuit (i.e., procedural training). Schank (1986) argues that there are different degrees to which one may learn with understanding, starting with just making sense of something, to a cognitive understanding, and finally to the level of complete empathy. Most learning in schools about dynamic systems may be limited to making sense. Students begin to learn the names of different components and some facts and relationships about a system. Students may begin to construct their own untested mental models of the dynamic system. By interacting with computer simulations, students may refine their mental models based on feedback they receive and develop a deeper cognitive understanding. Researchers have identified two parts to cognitive understanding: conceptual (or component-based) understanding and causal understanding (Reigeluth, 2002; Mayer, Mathias, & Wetzel, 2002). Conceptual understanding involves understand-
objective, not to teach or make the underlying rules of the system transparent to the user (Gonzalez & Reitman, 2001; Towne, 1995). Many of the rules and properties underlying a simulation are invisible or tacit to a learner, just as much of the knowledge used by experts in practice is tacit. Edelson, Gordin, and Pea (1997) identified three steps in converting expert tools such as simulations to pedagogical tools: 1) investigate and identify the tacit knowledge used in expert practice, 2) scaffold the practice for students by making the tacit explicit, and 3) refine the tool after trying it out with students. However, identifying the tacit knowledge used by experts and making it explicit and understandable to a novice is easier said than done. There are also other considerations involved in designing or redesigning simulations to be more effective for learning with understanding -- considerations that are not just about what students learn, but about how students learn and what counts as evidence for their learning (Bransford, Brophy, & Williams, 2000).

THE HOW PEOPLE LEARN (HPL) FRAMEWORK

A guide for evaluating and designing effective environments for learning and understanding is the framework presented in the book How People Learn (HPL; Bransford, Brown, & Cocking, 1999). The HPL framework provides four perspectives for examining learning environments, including how they are knowledge-centered, assessment-centered, community-centered, and learner-centered (Figure 3). These four perspectives need to be kept in balance for effective learning. “They need to be conceptualized as a system of interconnected components that mutually support one another” (Bransford, Brown & Cocking, 1999, p.133). The remainder of this review analyzes research on pedagogical simulations from these four perspectives separately, however, because there is not existing research on simulations that addresses all four aspects simultaneously. By reviewing educational research on simulations from these four perspectives though, the reader might be better equipped to evaluate or design more complete learning environments that incorporate simulations in one or more of these four aspects.

Knowledge-Centered

This chapter has thus far focused solely on the use of simulations from a knowledge-centered perspective, i.e., as providers of new information and knowledge to a learner. Simulations are primarily used as a knowledge-centered tool for learning. As mentioned earlier, simulations can be highly effective for this purpose, but this depends on the interaction between the prior knowledge of the learner and the domain concepts that are to be understood from using the simulation. The higher the fidelity of a learner’s knowledge is to the system being learned, the better opportunities are for learning and understanding with the simulation.

Students’ epistemological beliefs about the nature of knowledge and learning also influence how effective a simulation is for promoting conceptual change. In a study by Windschitl and Andre (1998), students with more sophisticated
epistemological beliefs learned much better with an open-ended, exploratory simulation of the human cardiovascular system. In this treatment condition they were allowed to create and test their own hypotheses about cardiovascular phenomena, in a manner consistent with constructivist principles of instruction. In contrast, students with less advanced beliefs about knowledge learned better in a more objectivist treatment condition, in which they used the same cardiovascular simulation but only for the purpose of confirming information and directions presented in a written guide.

Metacognitive skills on the part of the learner are also helpful for learning from open-ended simulations. Students learn better from simulations when encouraged to reflect on the relationships between the knowledge embodied in a simulation and their own knowledge (Lewis, Stern, & Linn, 1993). This is both a knowledge-centered and learner-centered issue. Students with lower metacognitive skills often demonstrate better learning strategies with simulations when metacognitive prompts and guidance are embedded in the simulation itself (Veenman, Elshout, & Busato, 1994), including the use of explicit heuristics (Veermans, van Joolingen, & de Jong, 2006). But adding more structure to a learning experience with a simulation in this manner may also interfere with the learning processes for students with lower knowledge but high metacognitive skillfulness (Veenman & Elshout, 1995).

Despite the influence a learner’s knowledge and beliefs has on the effectiveness of simulations, a typical symbolic simulation focuses on fidelity to the system it is modeling irrespective of the prior understanding or beliefs of the user. This is why many educational researchers have argued for the need to add various forms of support to simulations to help students overcome difficulties in learning with understanding (de Jong & van Joolingen, 1998; de Jong & Njoo, 1991; Njoo & de Jong, 1993; Wiser, 1995; Rieber, 1992). Examples include helping students with generating hypotheses, designing experiments, and interpreting data.

Assessment-Centered Issues

Simulations may also be effective environments for assessment. Simulations may provide students with immediate and realistic feedback to their actions (Alessi & Trollip, 2000), which students may use to construct and refine their conceptual and causal mental model of the system being modeled. Students may keep track of their own progress within the simulation as well (Barab, Bowdish, & Lawless, 1997).

As noted earlier, using simulations for assessment purposes is roughly equivalent to using hands-on activities and other performance-based assessments (Shavelson, Baxter, & Pine, 1992). Performance-based assessments have been effective for providing evidence for student understanding as opposed to student memorization of facts or procedures. Students are using their knowledge in a more authentic context. Additionally, a student’s understanding and performance may have little to do with their ability to verbalize their knowledge. In fact while students are working on problems that require significant conceptual change, asking them to verbalize their thinking processes may interfere with their learning (Schooler, Ohlsson, Brooks, 1993). Graesser, Person, and Magliano (1995) found that during one-on-one tutoring, when asking students “do you understand?”, answering yes was not correlated with performance, while answering no was positively correlated with better performance. This may depend on one’s definition of better performance, however. After students played a simulation game in which they “kicked” an object around obstacles on a frictionless plane toward a target, Flick (1990) found that less success in the game was associated with a better understanding of the underlying principles of force and motion. Apparently students who were nearly perfect at the game had constructed an incorrect model of object motion that was.
composed of two velocities rather than a single velocity and acceleration.

Simulations do have an advantage over hands-on performance assessments in that they are more scalable. Simulations can be easily reproduced and run on different computers, and data can be collected and analyzed about student’s real-time actions and decisions more easily (Closset, 1991).

As also noted earlier, researchers have generally not found that students learn more factual knowledge from using simulations, but rather forms of knowledge that are more intuitive and tacit (Veermans, de Jong, & van Joolingen, 2000), such as answering “what if” scenarios (Njoo & de Jong, 1993) or tests of their transfer of knowledge to other situations (Thomas & Hooper, 1991). Thus assessments that target intuitive and qualitative knowledge are often best for assessing the impact of learning with simulations (Swaak & de Jong, 2001a).

Simulations may also be a valuable resource to use for supporting the assessment of students’ qualitative conceptions of physical phenomena (Hunt & Minstrell, 1994). DIAGNOSER is a computer-based test that asks students qualitative multiple choice questions that target specific misconceptions about physics. After attempting a test question, a student is presented various animations and simple simulations for feedback on their understanding. Another group of developers converted a paper and pencil test for assessing physics misconceptions, the Force Concept Inventory (FCI), to an online testing environment in which the original static diagrams were replaced with simplified simulations (“Physlets”) during the answering of each question. The presence of the animations and simulations often influenced students’ responses when compared to the paper and pencil version of the test, but only on questions in which the dynamic representation was an integral part (Dancy, Titus, & Beichner, 2000; Christian, 2001).

Community-Centered

Symbolic computer simulations typically have no social or communicative components, as opposed to experiential simulations which are inherently social. However, this may make the community norms and school culture within classrooms even more important determinants in the effectiveness of symbolic computer simulations for facilitating learning with understanding. The aforementioned correlation that Wenglinsky (1998) found between classroom math achievement scores and the use of computers for data exploration and simulation-based activities may be due in part to a difference in the classroom norms that placed more value on those activities than learning by drills.

Computer simulations may facilitate group interactions within a classroom by providing a common focal point for discussion and gestures; however, simulations may also hinder group interactions and learning opportunities, particularly when students work with simulations in groups larger than two (Roth, Woszcyna, & Smith, 1996). In larger groups, students who are not manipulating the input device or closely viewing the simulation often must be reminded by a teacher to pay attention (Jackson, Edwards, & Berger, 1993), and they tend to be less engaged than the one or two students closest to the computer display.

Even when only two students work with a computer simulation at a time, various studies have revealed factors that affect learning with understanding. The more assertive member of a dyad may show more significant conceptual change than a less assertive member, who may be simply acquiescing to his or her partner’s directives and focusing more on the stepwise completion of the simulation activity (Windschitl, 2001). The more assertive partner takes more control over the computer mouse and makes more decisions in the simulation, demonstrating more attention to the task. This student may also ask more “what if” questions about the simulation, similar to the aforementioned assessment scenarios utilized...
by Njoo and de Jong (1993). The physical affordances of the computer itself (single mouse, monitor, keyboard…) appear to be constraining learning interactions when there is more than one student.

Scanlon (2000) found that the gender composition of student pairings can influence the productivity of learning with simulations, although much of the evidence is mixed. In different conditions different types of pairings may be more or less optimal for learning. One example Scanlon provides is from a study using a simulation on the physics of collisions (Puckland). After assessing high school aged students’ initial conceptions about the motion of pucks on ice after a collision, same gender pairs were formed between students with either similar or different views about these collisions. In contrast to other research findings with student dyads, pairs with similar views improved the most when measured on a conceptual change post-test. The researchers expected pairs with dissimilar views to improve more by having to resolve more conflicts in their understanding. All groups did significantly increase their conceptual understanding, and boys and girls were equivalent on the post-test, but the girls started with lower pretest scores than the boys. The boys had more experience with analogical domains involving collisions such as pool, football, or hockey, while the girls’ dialogs during use of the simulations showed no examples from experience with sports when making predictions with the simulations. In response to these results, Scanlon (2000) posits that pairs may learn both by resolving conflicts and questions through discussion and by using the simulation to help resolve conflicts. This might explain how even different types of student pairings may end up with the same level of conceptual understanding.

Only recently are developers beginning to research how to add support for communication and collaborative learning to the design of a simulation itself. Saab and van Joolingen (2002) added a chat window to a computer-based collision simulation, but have not yet reported the specific contributions of the communicative processes to the learning processes. They have only reported some of the same interactions found from earlier studies of pairs working with simulations, such as the influence of more assertive partners. Löhner and van Joolingen (2001) reviewed a number of different computer-based modeling tools and argued that the choices designers make in providing visual and verbal representations can influence the collaborative modeling process and the discussions elicited between learners. For example collaborative talk tends to be elicited by the most salient aspects of a representation.

One additional social context for the use of computer simulations is a classroom demonstration by a teacher. Using simulations as part of a lecture alone may present a risk though by not being sufficiently learner-centered. In one particular Australian class, twelfth grade science students all viewed the same physics demonstration by their teacher, but they all disagreed beforehand about what they expected to happen, and afterward disagreed about what they had seen and how to explain what they saw (Roth, McRobbie, Lucas, & Boutonné, 1997).

### Learner-Centered

Despite less general attention to the learner-centered aspects of designing and using simulations for education, students often enjoy using computer simulations. In a survey of junior high school students using an electrical circuit simulation, Ronen and Eliahu (1999) found that the students favored using the simulation at home and found it more interesting and effective than other homework activities: “Students realized the potential of a simulation as a source of constructive feedback that enabled them to take more responsibility for their learning” (p. 267).

A study by Kim et al. (2001) specifically showed that students achieve more when using physics simulations in more a learner-centered...
context when compared to a teacher using the simulations as a supplement to lecture. Students scored higher on a posttest after simply working with the simulations themselves with nothing more than a written study guide for support. In this case however, the simulations were very simplified, and the study guide, which is not described by the authors, may or may not have played a role in assisting their learning.

The benefits to learning that forms of extra support such as the aforementioned study guide may provide are not caused by simply constraining the learner’s use of the simulation, however. Swaak and de Jong (2001b) found that students using a circuit simulator gained the same amount of intuitive understanding regardless of whether the students were given total freedom to choose their sequence of explorations with the simulation, or if the sequence of their explorations was completely controlled by the computer environment. But one must be careful in interpreting this null effect. One possible explanation may be that the system-controlled condition overly constrained the learners’ interactions with the simulation and was not an optimal form of support for learning.

A separate study of an electrical charge microworld known as Electric Field Hockey (EFH) also illustrates that effective methods for supporting learning with simulations are not straightforward to identify. In the original version of this microworld, students add fixed negative charges to the display to guide the motion of a free floating negative charge around obstacles and through a goal similar to a hockey goal. Miller, Lehman, and Koedinger (1999) found that the constraints provided by this game context were not leading to an understanding of many of the properties of electrical charge interactions. Students understood that like charges repelled one another, for example, but were not picking up on the property that the closer two like charges are, the stronger they repel each other. The researchers compared student understanding in this context to two modified versions of the microworld. In a second version, an additional constraint was added to the game. The goal of the game became not only making a charge move through a goal, but making the charge follow a particular path, signified by a dotted line, to that goal. In a third condition, the game context and goal were completely removed, and students just freely explored the microworld in an open-ended manner. The authors found that students in these two new contexts outperformed students in the original game context, and yet the advantage to performance was equivalent for both the more constrained version and the unconstrained version of the simulation.

One may claim that the findings of this study are less generalizable because of the very simplified simulation used, but it is clear that learning with understanding from simulations is dependent on the goals and constraints of both the simulation and the understanding learners themselves possess. These results also remind us that even when simulations show learning benefits, one must still assess what students do not understand or misunderstand. There may be different learning supports one could provide that might help students develop an even richer conceptual or causal understanding.

**FUTURE TRENDS**

As computers and networks and technology get faster and more powerful, the educational possibilities for computer simulations expand, and the costs come down. However, instructional design techniques and learning theories have not kept pace with these advancements. There are some new developments in simulation technologies in which this is obvious, and yet these advances are already beginning to show some dramatic impacts on education and training: including haptic interfaces and 3D multiuser virtual environments (MUVEs), which are summarized below. There is a need for more research in the future on the
overlap between simulations and games used for instructional purposes, too, which is also summarized below.

**Haptic Interfaces**

Haptic interfaces allow the human-computer interface to expand beyond the typical mouse and keyboard and monitor. The computer can sense one’s actions, such as hand movements, or even whole body movements, and give visual and/or kinesthetic feedback. Some examples of low cost haptic interfaces include a standard force feedback joystick, the Nintendo Wiimote controller, and the Novint Falcon controller. One may also even construct custom educational haptic interfaces using microcontrollers (e.g., the haptic paddle, Okamura, Richard, & Cutkosky, 2002).

An example showing the power of these kinds of interfaces comes from microcomputer-based laboratories (or MBL). A sonic distance sensor attached to a computer allows a student move a small object such as a toy car back and forth along a track, while the computer displays a graph of the car’s motion in real time. From such an activity a student may develop a “tool perspective,” or a perspective on how the computer is interpreting the motion of the object and translating it into a graph (Nemirovsky, Tierney, & Wright, 1998). Students often have misconceptions about graphs of motion, such as confusing slope with height or interpreting a graph as a picture of the motion it represents, i.e., believing that a graph line goes up and then down like a hill depicts the motion of an object going up and over a hill (Clement, 1989). Yet after only a matter of minutes interacting with a microcomputer-based lab, students may show marked improvements in their graph interpretation skills (Brasell, 1987). Brasell’s study also showed that a group of students who had MBL feedback delayed a mere 20-30 seconds showed much diminished performance compared to students who received immediate feedback. The real-time feedback alone though does not completely explain the remarkable learning effects. An alternate technique for MBL is interactive video instruction (IVI), in which a video of the motion of an object is shown and linked to a graph of the object’s motion. This technique does not show the same level of learning gains as real-time MBL, however. Beichner states that with IVI, “students cannot control the motion. This ability to make changes – and then instantly see the effect – is vital to the efficacy of MBL. The feedback appeals to the visual and kinesthetic senses” (1990, p.812). Thus real-time kinesthetic interactions are important to the success of MBL.

Strategies to support kinesthetic participation with simulations have not been specifically studied, although researchers have found evidence linking students’ kinesthetic behavior to their understanding of dynamic systems. Monaghan and Clement (1999) observed students performing hand motions and visualizations while using a relative motion simulation, and they interpreted this as evidence for “self-projection,” or students forming their own mental model of the scenario. Roth and Lawless (2001) also observed that students’ “gestures are an important means in the construction of perception and communication as students interact over and about a computer software environment.” They suggest that learning environments that do not support students’ use of body and gesture can limit what and how students learn. Sadler, Whitney, Shore, and Deutsch (1999) allowed students using a simulation of wave mechanics to interactively control and generate simulated wave behavior, but did not explore the effect these interactions had on student understanding specifically. Students did enjoy however being able to create their own representations of wave phenomena in addition to exploring the examples included with the software.

**3D Multi-User Virtual Environments**

Three-dimensional multi-user virtual environments (MUVEs), such as Second Life, Croquet,
and Project Wonderland, allow learners to do things not possible with standard desktop software simulations. One may virtually walk inside a dynamic system being simulated, and share the experience of using a simulation with many others simultaneously. As discussed in the community-centered section above, allowing learners to share their experiences and collaborate with others while working with simulations can enhance their learning, and yet it creates new problematic issues as well.

The research on the educational implications of 3D multi-user worlds is going full steam today. Nelson & Ketelhut (2007) recently reviewed research on the use of multi-user virtual environments in the context of schooling and found that MUVEs can successfully support real-world inquiry learning that is equally compelling to girls and boys, but they also found that much of the research is uneven and there is a need for more large-scale studies. A new AERA special interest group (ARVEL-SIG) was formed to research education and training in MUVEs, and Second Life in particular was a major theme of the 2008 conference of the Association for Educational Communications and Technology (AECT).

**Simulations vs. Games**

The research on the use of video games for education and training has been uneven, also, yet on the whole quite encouraging. Vogel et al., (2006) conducted a meta-analysis of studies comparing video games and simulations to traditional instructional methods and found the games and simulations led to higher cognitive outcomes. However, there were gender differences (females showed more preference for games and simulations) and the advantages disappeared if students were not allowed their own control over the game or simulation. This echoes the research described in the previous knowledge-centered section, which found that too much structure and guidance can hurt one’s experience with a simulation.

Thus there is quite a bit of overlap between educational research on computer simulations and games, but what are the defining characteristics of both and the differences between the two? Sauvé et al. (2007) precisely answered this question in their systematic review of research on games and simulations. The essential characteristic of simulations is a model of reality defined as a system. This model is dynamic and simplified, yet has fidelity, accuracy, and validity. The essential characteristics of a game however include a player or players, conflict, rules, predetermined goals, and the fact that a game is often fictitious or artificial. Of course there are some video games which employ quasi or very realistic simulations (such as Sim City or Microsoft Flight Simulator), or one can make a fictitious game with a pure simulation, such as trying to make electrons in a physics simulation move through an artificial goal, as in the video game Electric Field Hockey. However the limits and advantages of games and simulations for training purposes have not been directly compared to one another. This is an area which has become very popular for educational researchers, and yet much remains to be explored.

**CONCLUSION**

This chapter reviewed research on the use of computer simulations for the pedagogical purpose of understanding dynamic systems and examined the findings through the lenses of the How People Learn framework. By using and integrating all four perspectives of this framework, one may develop more complete and effective learning environments when utilizing computer simulations. Providing some forms of learner-centered support may be especially critical to the success of students developing a better understanding of the system being modeled (de Jong & van Joolingen, 1998). However, deciding when and how to support students’ effective learning with simulations also requires careful design considerations of
assessment-centered, knowledge-centered, and community-centered issues. Many of the learning support strategies may complement or conflict with one another, but when used effectively one may potentially increase the “learner fidelity” of a simulation without necessarily sacrificing the fidelity to an expert’s understanding of the domain, in part by shrinking the gulfs of execution and evaluation depicted in Figure 2. The effectiveness of many strategies also depends on the knowledge and metacognitive awareness of the learner. Thus employing a strategy adaptively based on information and feedback from a learner also greatly enhances its potential effectiveness. The complex relationships and interactions between knowledge, assessment, learner, and community-centered issues on the one hand and perceptual, cognitive, social, and metacognitive design strategies on the other hand need further exploration.

REFERENCES


How People Learn with Computer Simulations


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KEY TERMS AND DEFINITIONS

Computer Simulations: Computer simulations are computer software that model the behavior of a dynamic system. One may manipulate parameters in the model and visually see the feedback.

Dynamic Systems: Dynamic systems are made up of multiple interacting components, such as the parts of a car engine or the coordinated activity of the human respiratory system, and are characterized by behaviors that evolve in time.

How People Learn (HPL) Framework: When using or designing learning environments, one should consider and balance assessment, knowledge, learner, and community-centered issues.

Model: A model is a representation of a physical or conceptual system. Certain aspects of the system may be represented in the model, and other aspects may be missing, often in the interest of simplifying the model.

Simulation Fidelity: Simulation fidelity is the resemblance between a simulation model and the actual system it is modeling. The higher the fidelity of a simulation, the more trustworthy its behavior may be to someone familiar with the actual system, in the sense that experiences using the simulation more closely resemble real-world experiences. There are three types of fidelity: perceptual, manipulative, and functional.

Structure Behavior Function (SBF) Models: SBF is a qualitative characterization of a system in terms of the stable components of the system (structures), changes in the system over time (behavior), and the effects of the system on its environment (function).

What If Scenarios: What if scenarios (also known as cases or triggers) give real-world problems to students and ask them to diagnose what happened, or predict what will happen next, or figure out what they should do next.
Chapter 30
The MORE Model for Faculty Development

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ABSTRACT
For many faculty the integration of technology and learner-centered teaching strategies or the adoption of instructional “best practices” represents innovation and change. The author visited fifteen research intensive university faculty development centers, looking at what they considered best practices with regard to improving instruction. The practices and programs described had one or more of the following components: Motivation, Opportunity, Resources and Evaluation, what I am calling here the MORE model. This paper discusses these four factors important to instructional change agents. The paper ends with a list of implications, based on the model, for that would enable faculty development centers to have more control over the factors that are important to faculty success and systemic change.

INTRODUCTION
There are a number of books on how to improve teaching, integrate technology into teaching and learning, engage students in collaborative learning, teach large classes, and other strategies that are frequently the topics of faculty development workshops. Many times the techniques written about in these books are referred to as “best practices” in teaching and learning. The question I deal with in this paper is what constitutes a best practice? What do faculty developers in other universities find to be best practices, and how do you engage faculty, at a research extensive university, in using innovative practices to improve their instruction?

BACKGROUND
In most institutions of higher learning there is an agency, office, or center whose role it is to help teaching assistants, faculty and adjunct faculty with their teaching skills, for the purpose of this paper I will call these organizations Faculty Development. For
The MORE Model for Faculty Development

In the most part, Faculty Development is focused on the improvement of teaching within the organization. Faculty members study how to do research in their doctoral programs, but they don’t, as a rule, study pedagogical skills associated with teaching. By teaching I mean constructing, delivering, and managing a course, in the classroom, online, or a blend of the two. Pedagogical research within a discipline is often referred to as the Scholarship of Teaching and Learning (SoTL). A slightly broader view of faculty development includes support of SoTL, which includes an orientation aimed at research on teaching methods that may have utility for professors at other institutions.

Faculty development centers have different names at different universities. At one university it might be the Center for 21st Century Teaching Excellence, at another it might be the Office of Teaching Effectiveness and Innovation, at my university it is the Center for Teaching and Learning. In fact, determining who and what agency at a university deals with the topic of faculty development is often a challenge in itself, and although they would all agree their job is faculty development, none of the centers use the term “faculty development” in their titles.

In general only a small percentage of faculty members at my university participate in formal faculty development activities. In my role as the faculty development coordinator for a large southeastern university, I was interested in what was happening at faculty development centers in other universities, especially research extensive universities, where publish or perish is the guiding principle of career development. While on sabbatical during the fall semester of 2005, I visited fifteen different universities, (Wager, 2005). While this might be very loosely called a qualitative study, it is probably more a set of reflections on interviews and observations made during the visits., These reflections shaped the development of a model of factors that facilitate innovation.

BEST PRACTICES IN TEACHING AND LEARNING

Best practices for teaching and learning are popular topics of discussion at faculty development conferences. In addition, “best practices” are commonly the topic of posts on list-services like POD (http://podnetwork.org). In response to queries about the best use of laptops, podcasts, or whatever the technology, many inspired list-serve subscribers freely share their knowledge and information about what is happening at their universities or provide links to activities or practices they have found at other universities. In the fall semester of 2005, I had the opportunity to take a sabbatical to visit fifteen universities, in order to take a closer look at how best practices are defined, and the context in which they are being used. This was an enlightening experience because seeing a program in operation gives you a far better feel for what it takes to make a successful practice than just reading a description of that practice.

My finding is that there are no such things as best practices – at least not ones that just can be “found and adopted” by other universities. Instead best practices are the context (course and resource) specific constructions of individual instructors within their institutions and their curriculum. I think we would be further ahead if we dropped the modifier “best” and simply look at instructional practices as alternative strategies that may or may not work in other situations. In addition, it is uncommon to find any evidence that “best practices” actually lead to quantitative (or even qualitative) improvements in student learning. Evidence of best practices is generally supported by anecdotal evidence from the students or teachers that the practice (whatever it was), improved interest in the course, but rarely are there measures of effects on learning outcomes. For example, in 2004, Gibbs and Coffey did one of the first studies of the effects of teacher training programs.
in higher education, using multiple validated instruments to measure change in practice and attitudes of faculty, and even that research does not directly measure learning outcomes (Gibbs & Coffey, 2004).

Don’t get me wrong – I too am a seeker of “best practice”. What I mean by best practice is the effective use of resources and strategies to increase student learning and to improve instructional efficiencies. Even if there are no significant differences in student performance, if a practice reduces student or instructor time, increases satisfaction, optimizes use of classroom space, or increases student retention and success in the course, it might be considered successful. However, the ultimate test of a best practice is whether someone else recognizes how they might adopt and adapt it within their context to attain similar outcomes. In order to effectively disseminate these practices evidence is needed with regard to how they improve instruction. Faculty development professionals must think about how the effects of an innovation will be assessed, and what data they will need to help other faculty understand the benefits.

Faculty development is all about change, and most faculty resist change. Why? Because they are busy and they are working hard to be productive researchers. Furthermore, although for the most part they are teaching as they were taught, they feel like they know what they are doing. If it worked for them, it should work for their students. Except for a very few faculty, there has to be a problem or an opportunity that serves as a catalyst for change. Farmer (1999) formerly Vice President for Academic Affairs at King’s College in Pennsylvania, suggests that the first step in effecting change is to raise faculty awareness of the need for change by increasing their level of discomfort with the status quo. In Farmer’s case the catalyst was said to come from a graduating student who said, “There is a lot more teaching going on around here than learning and you ought to do something about that” (Farmer, p. 90). Farmer started by asking the faculty to review the existing general education curriculum at King’s College to discover its strengths and weaknesses. The faculty concluded that students would be better served by a reconceptualization of the curriculum. This led to a discussion of developing a “learning-centered curriculum” for the general education program at King’s College.

Awareness was the first step, but it takes more than awareness to sustain an effort to change, it also requires faculty acceptance. The paradigm shift at King College from teaching-centered to learning-centered was a big change that would be in conflict with bureaucratic practice at most large universities. Practices and policies resisting change occur at all levels including university administrators, faculty and even students (Inderbitzin & Stars, 2008). What was different at King’s College than at other institutions? Farmer (1999) suggests that the reason change was embraced by the faculty had everything to do with shared values between the faculty and administration, and the administration’s support of innovation, assuming the risks of failure should it occur. In other words, instructional change requires institutional support to gain faculty acceptance. Furthermore, Farmer feels that changes fail to gain acceptance if they are introduced prematurely. “The learning style of most faculty members requires information and a rationale in order to understand and accept a proposed change.” (Farmer, 1999, p. 91).

MORE MODEL

In my sabbatical report (Wager, 2005), I tried to identify what factors were supportive of, if not necessary for, sustained change within a university. From my observations I developed what I call the “MORE model.” The MORE model is based on the premise that change involves multiple necessary conditions. These conditions are Motive, Opportunity, Resources, and Evaluation. What does this have to do with best practices at universities? The
answer is that the “best practices” identified at each of the fifteen universities included multiple components of the MORE model. However, with all four conditions the instructional change is more likely to be sustainable. Let’s look more carefully at each of the four conditions.

Motive – Why should a faculty member to spend additional time to become a better teacher? At most “research intensive” universities, faculty are rewarded for disciplinary research publications and grants. That is because publications and grants bring prestige and positive publicity to the university (not to mention money). Well published faculties attract and often support graduate students by obtaining contracts and grants. This is a highly-rewarded outcome for the university administration, and therefore faculty who publish and get grants are valued and rewarded. New junior faculty are even told to concentrate on their research and publications, and are often given a lighter teaching load when they first come to the university. While no university wants to be known for poor teaching, this is not something that administrators (in general) are interested in monitoring at a very rigorous level. I found that on my visits that the majority of the universities didn’t have a university-wide system in place for evaluating teaching.

An anonymous source put it this way, “you measure what you value.” Although there are generally a few teaching awards for outstanding professors, there aren’t enough awards to motivate many faculty to improve their instruction. In addition, even the best teachers are expected to be good researchers, and most of the merit money distributed to faculty is distributed to those with outstanding research productivity. Teaching, at most universities, only has to be “good enough” so that it doesn’t attract negative attention. Teaching, unlike research, is a private activity, but good teaching can be made public through scholarly journal articles about effective methods of teaching in the discipline, (SoTL) not only makes teaching public, but it promotes scholarship by creating a culture of evidence for the improvement of teaching practices.

Among the things the literature identifies as characteristics of a “teaching culture” are: 1) the unambiguous commitment to and support of teaching and its improvement from senior administrators; 2) shared values about the importance of teaching between administrators and faculty; 3) effective department chairs supportive of teaching; 4) interaction and collaboration among faculty; and 5) a faculty development program or teaching center (Paulsen & Feldman, 1997). So, what motivates faculty to take the time to do things differently? The best motivator for faculty is confirmation that their work is important and valued. This goes for research, teaching and/or service. Indicators of support are the ability to get resources (including money and help from the faculty development center), and the affordance of opportunities, such as release time, summer support, etc. A common perception is that faculty will only work for money -- this is not true because money alone is not a sufficient condition to generate a sustained change. If the change is not recognized and valued by colleagues, administrators and students, it will be short-lived.

A minority of faculty are intrinsically motivated to be good teachers. Csikszentmihalyi (1997) proposes that a good teacher enjoys learning and so can get students to seek the intrinsic rewards of learning. This is important because if the teacher doesn’t believe what they are doing is important how will they ever convince the students that they should take their time to study and learn? In my experience teachers who are excited about what they are teaching seek out new techniques and technologies. One type of incentive that appeals to faculty is an institutional grant for teaching innovation. Called by many different names, these grants are generally small ($1,000 - $10,000) grants that allow the instructor to buy resources, opportunity time or help to engage in a project they have identified. Also, since they are recognized for “having won an award,” instructors have the
motivation of knowing that they competed and are being recognized by someone (with resources) for their ideas. Do all faculty need to be motivated with money – of course not, but they are generally motivated by something. Programs supporting SoTL allow the faculty to publish and if the administration looks favorably on this type of publication, it may lead to rewards like recognition of participation and accomplishment.

Rewards might take the form of practices or technologies that improve instructional efficiency. If the instructor moves math homework to the computer such that it can deliver problems, give feedback, and keep score for grading, more time is available for other research or instructional activities. Technologies that allow for a single instructor to serve more students are certainly rewarding to the administration, if not to the instructor personally. However, instructors who use these technologies might be able to transfer the savings into other resources that give them an advantage in other aspects of their research or instruction.

In their paper Surry & Land (2000), apply Rogers’ “theory of individual innovativeness (1995)”, stating that faculty adopt innovation at different levels as: innovators, early adopters, early majority, late majority, and laggards. They describe the intrinsically motivated faculty as innovators and early adopters, while other levels will be more cautious and resistant to change. They also describe a framework based on Keller’s ARCS model of motivational design that suggests faculty at different levels of intrinsic motivation will respond differently to faculty development activities. ARCS is an acronym that stands for Attention, Relevance, Confidence and Satisfaction, four factors that affect human motivation (Keller, 1987). The implications are that some faculty will be open to change and will jump at opportunities, showing great confidence. For others, a more strategic plan for motivating change will have to be developed. The level of readiness to adopt has important implications for selecting participants in pilot programs because it is likely they will apply more effort in making the innovation work. The results of their efforts can then be used as evidence of effectiveness and as motivation for the next level of adopters.

Opportunity – the second condition for change is opportunity. Faculty report it difficult to find the time to become better teachers or adopt new practices. I was recently working with a faculty member who was having problems with student attention in his class. He tried to maintain a class discussion, and could barely get any of the students to participate. I suggested that he have the students engage in group activity where they get together in small groups to discuss questions that might be on the exam. They used an active learning strategy called “jigsaw”. Each group got different questions over the readings and at the end of 15 minutes they reconvened and shared answers for their questions with the rest of the class. I observed the first and second trials of this technique and it appeared to work quite well. The students discussed the questions, and gave pretty good answers during the group reports. The instructor liked the technique too, because he could now comment on answers that were a bit off the mark. A year later I decided to do some follow-up to see if he was still using this strategy. He told me he had dropped the jigsaw because the students did such a poor job on the group papers. Group papers? What did the use of the jigsaw have to do with group papers? Further, I asked if he had read anything about assigning group papers. He hadn’t. I suggested that there was quite a bit of literature on group work, and that group papers often created problems. He assigned group papers because he thought it would save him time. My point here is that if he had attended any of workshops offered by the Center for Teaching and Learning, or took the time to read about group work in any number of books we have on the topic, he would have been more successful in applying techniques that work. But he didn’t
take the extra time or make the “opportunity” for studying teaching techniques.

Lack of time is a common theme. Summer workshops for faculty are an “opportune” time for faculty development activities. The potential for summer pay provides some motivation (again, it doesn’t hurt if they have to compete for it), and the summer is generally less busy than the academic year, so faculty feel they can spend the time to learn new skills and apply them to their classroom. Other opportunities are allowed by release time from teaching or by graduate teaching assistant support while the instructor is learning new skills and/or developing new activities. Gibbs & Cofey (2004), report that in many UK institutions “substantial training of 120–500 hours duration is now well embedded, is often compulsory and is sometimes linked to probation or tenure” (p. 88). Compulsory “teacher training” in this case provides an opportunity, if not motivation, for developing teaching skills.

Rogers (1995) mentions another factor that might be categorized under opportunity, and that is trialability. “Trialability is the degree to which an innovation might be experimented with on a limited basis” (p. 16). Pilot programs or limited trials appeal to professors who are not ready to make a total commitment to change. One problem is that some innovations or technologies call for a paradigm shift, like the change in philosophy from teaching-centered to learning centered made by Kings College, and are likely to fail if employed in an improper context. This makes it important to consider where the instructor is with regard to readiness for change before suggesting an innovation that is 180 degrees from his or her present way of teaching. I believe it becomes evident that motivation and opportunity go hand-in-hand in facilitating instructional change. However, the third variable (resources) is equally important.

Resources – it doesn’t do any good to show a professor what they can do with a Smart-Board, video conferencing, or iPods if they don’t have easy access to those technologies. Today we are extolling the benefits of technologies like personal responder systems, learning management systems, wireless laptop and tablet computers, iPods, digital cameras, BLOGS, WIKIS, etc. Now, you would think that in today’s environment a personal laptop computer would be a part of every professor’s personal toolset. While most faculty members do have these technologies, many do not – or they don’t have the necessary software or knowledge to use them effectively in the classroom. Faculty feel that if the university wants them to use these technologies that it ought to provide them and make them work. Actually, the electronic resources are really the least expensive part of most instructional innovation. The expensive part is the retrofitting of the classrooms, and the technical staff to support these technologies. Fortunately, the price of technology continues to drop while the instructional capabilities of electronic tools continue to improve.

Many of the best practices I observed at different universities provided the technology as part of an instructional project or initiative. For instance, Clemson’s laptop project provided a laptop to every instructor in the project. The instructors integrated use of the laptop into their teaching, and shared the results with their colleagues. Indeed the projects completed by the faculty resulted in a book: Enhancing Learning with Laptops in the Classroom: New Directions for Teaching and Learning, No. 101 (Paperback) by Linda B. Nilson (Editor), and Barbara E. Weaver (Editor). A change in administration at Clemson terminated the funds for this program, but it was so popular that participants continued to meet and share ideas with each other.

Another angle on resources is to provide money to support individual faculty innovation, including the purchase of new technology. In most cases, the technology belongs to the university, not the individual, but it is theirs to use as long as they are employed by the university. The University of Wisconsin had an “adaptation award” where they solicited proposals from faculty who saw
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ways that they might employ podcasting in their instruction. The faculty were each given resources and 10 hours of technical staff support to get them up and running. Some of the results of this project can be viewed on-line at http://engage.wisc.edu/podcasting/index.html. UW Madison also has an “innovations award.” The award amount is flexible depending upon the project, but may include funds to support the instructor’s work on the project and/or project assistant support.

It is easy to see that opportunity and resources are closely related, and that a faculty development center with resources can provide opportunity time as well as equipment, software and/or personnel help. In addition, follow-up and publication of the effects of these projects are important. It is also important that the innovation or change be recognized by someone outside the classroom. I’d even go so far as to say that follow-up evaluation and publication of the results are necessary conditions for systemic change and accountability reports. In this way the faculty involved get recognition for the time and energy they spend in changing instructional practice, and the faculty development program has constructed a “best practice” through the work of the instructor, and the results are made known to other instructors who might like to adopt the best practice. Finally, the last but not least of the conditions for systemic change is Evaluation.

Evaluation – Participating in the process of using new technologies, adopting active learning teaching strategies, and developing collaborative learning is all well and good, but what difference did it make in student learning or what efficiencies did it provide for the institution? I define evaluation as the collection and processing of data for the purpose of making decisions. The type of evaluation needed is dependent on the types of decisions one wishes to make. Evaluation of effectiveness of accomplishing instructional outcomes makes it possible to show that not only did change take place but that the change had an effect on institutional effectiveness. Evaluating educational change is a challenge. It requires that measurable outcomes be stated, observed and assessed. The possible effects of an instructional intervention are hypotheses at best. In order to test these hypotheses a means for measurement must be made. Often instructors don’t have baseline data against which to make comparisons, so a goal is set from experience. Comparison of student performance to the desired goal is one way to document meaningful change and the possibility that the intervention was a best practice. Frey (1999) states, “Assessment derives its legitimacy from the quality of its measurements; and those being measured generally best know the area being assessed. University mission statements ought to be the place to find out what is important, and therefore what should be measured. Since student learning figures prominently in most academic mission statements, student learning outcomes may have special appeal as performance measures.” I feel that what Frey is saying is crucial with regard to determining what is and isn’t a best practice in instruction.

As mentioned previously, SoTL is not always taken seriously by professionals in the disciplines and department heads might advise young untenured colleagues, “better to be researching the content of the discipline than methodologies of teaching.” However, SoTL would seem to be a natural outcome of instructional evaluation. Kreber (2006) writes, “…pedagogical research is comprised, on the one hand, by the inquiries teachers may carry out for themselves into their own teaching and their students’ learning, and on the other hand, by the ever growing, discipline specific and generic literature on teaching and learning reporting on the research conducted by others. An educational development unit wishing to optimize the student learning experience on campus may wish not only to “tell” departments and faculty about what we know about “effective pedagogy” (and student-focused, inquiry-based learning) but also involve staff directly in exploring how best to facilitate such learning of their students within their unique disciplinary and departmental
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contexts… as a result of this inquiry-based learning about teaching, the disciplines themselves might benefit as well” (p. 11).

Evaluation should also have a qualitative component. The evaluation report should include rich description of the intervention, what it took to make it work, what student actions and reactions did it invoke. Not all change is handled smoothly by students – even if they see the benefits, the cost may be perceived as too high. Other potential adopters of a practice should be informed of what happened so they might have appropriate expectation of what made a successful practice work. What good is it if students in a course show a 10% gain on test scores if they end up hating the subject? Effective instruction has an attitudinal as well as a cognitive component. Curricula that stresses critical thinking, problem solving and is learning-centered is often perceived as more difficult than traditional curricula. This change is risky for the students as well as the faculty. “We learned that our state university students ultimately found comfort in the dominant learning structure [teacher-centered] and would be at least initially resistant to moving toward a more flexible learner-based curriculum” (Inderbitzin & Storrs, 2008, p. 49). Instructors are often reluctant to try new teaching innovations because they are afraid of being rated poorly by students who would rather be taught and evaluated in traditional ways.

Finally, evaluation is important for the sustainability of innovation and change. It helps answer the questions is the change worth the effort, and what will be the maintenance cost of sustaining the change? Many of the “best practices” become short-lived because the resources needed to sustain operation dry up after the initial installation, and the expenses can’t compete with other departmental needs.

FUTURE TRENDS

Technology is becoming more ubiquitous, and powerful. This creates both opportunities and challenges for faculty. Future trends in faculty development include helping faculty develop and teach on-line and blended courses. There are even greater challenges here because of the need for integrating technology into teaching methods. On-line courses are often little more than text readings and discussion board postings. What “best practices” and faculty development opportunities are there for a new generation of on-line teachers? Furthermore, on-line teachers may be only part-time or adjunct instructors, often low paid, and not considered part of the main-stream faculty. This makes it even more important to think about how instructional excellence will be measured and rewarded in order to keep these programs alive and viable. The MORE model would seem equally as appropriate for considering the adoption and diffusion of on-line practices as it does for face-to-face instruction.

In the future, accreditation agencies and state governments will also have more to say about what happens in state run post-secondary institutions. Suskie (2006), notes, “…it seems doubtful that calls for accountability will soon disappear. … Higher Education is simply too large an enterprise, with too many stakeholders keenly interested in it… As long as higher education is viewed as a costly undertaking, there will be a strong interest in ensuring that it offers effective programs and services and operates in an efficient manner” (p.32). Faculty development centers will become more involved in the accountability issues and must be ready to work with faculty to help the institution meet accreditation standards.

CONCLUSION

There can be little doubt that there is general resistance to change, and this isn’t always a bad
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thing. If we jumped at changing everything we are doing every time someone came up with a new technology or instructional strategy, we would hardly develop competence in using it before we would be on to something else. However, when reflecting on how a new technology or strategy might be integrated into our current ways of teaching, we should see an opportunity to document the effects of that change on our students’ learning, and to determine if it was a change for the better, in effect, whether we found a “best practice”.

Strategic Planning

There is no doubt that the university is experiencing cultural change. With more diverse student populations, competition for scarce resources and increasing concerns about accreditation and accountability. Faculty development, the improvement of teaching and including research in teaching and learning (SoTL), demands some strategic planning, and rethinking faculty work (Gappa, Austin & Trice 2007). It isn’t uncommon in universities to have several different administrative structures that affect teaching and learning resources, with little coordination among the units. This creates an internal competition among units for resources that could be better used if there were common goals and coordinated efforts. Also, as previously discussed, there is often little serious evaluation of the effects of development efforts, and a lack of planning on diffusion of successful innovations. Too often the money is awarded to a faculty member or department and there is little or no follow-up to see if it made any difference, no less whether the innovation can be leveraged to another instructional applications.

The Faculty Developer as a Change Agent

Faculty developers are in a difficult position, they are positioned somewhere between administration and faculty. Typically, they are accountable to and report to administration. However, many hold faculty appointments in academic departments and teach one or more classes a year. While their primary mission is usually to help faculty increase instructional effectiveness they are also subject to ethical issues regarding pushing an administrative agenda like increasing efficiencies with larger classes, using technology for distance learning, or proving that students are meeting published learning outcomes. Administrators are under many external pressures such as competition for students, meeting accreditation requirements, getting students graduated in a reasonable period of time (making sure required classes are available and assessable), providing the needed space and technology to meet instructional needs. Administrators are looking for solutions to their problems, sometimes without consideration for the culture of the faculty.

In talking about some of the value dilemmas of change agents, Bennis, Benne and Chin (1984) state, “Value considerations present themselves intertwined with cognitive and technical considerations, and it is often difficult to sort out the value component of decisions and judgments from other components when it most needs to be confronted in its own right” (p. 447). For example, is it ethical to suggest faculty spend precious time changing their teaching at the expense of publishing discipline related research when clearly that is what they are rewarded for? The faculty development unit is responsible for assessing the impact of its program too. Assessing the impact of a workshop on subsequent instruction and student learning is a difficult task at best. So faculty development units will choose to work collaboratively with faculty where they have the best chance for change. Often this is with the innovators and early adopters as previously mentioned. However, perhaps the greatest potential is with the more numerous “early majority”. Faculty development units must see themselves as research and development units, and must begin to structure projects so that the results
can be measured and their impact assessed with regard to their mission and institutional needs.

SUMMARY AND IMPLICATIONS

In summary, the premise of this paper was that “best practices” in instructional innovations happen in an environment that pays attention to the principles of the MORE model. Faculty Motives, Opportunities, Resources and Evaluation must all be present for successful change. As we look at best practices at other organizations, like the use of podcasts in instruction at the University of Wisconsin, we must keep in mind the resources it took to make this happen. We must also look at how the technology affected learning or other desirable outcomes, and whether it should be supported as an adopted technology. Change comes with a cost to both the faculty and the faculty developers. Follow-through evaluation and recognition are necessary to highlight the efforts and effects of change and to provide the motivation for other faculty to follow in the leaders’ footsteps.

The notion of best practices and the MORE model has implications for faculty development centers. Below is a list of 10 propositions with a brief explanation for each.

1) Centers should have access to and control of a budget that can provide incentives, opportunities, and resources. It is not enough to have an enthusiastic staff of professionals. Faculty are not beating down our doors to attend workshops to become better teachers. However, it must be remembered that how a faculty spends time and effort must be valued by someone whom he or she respects. At the same time, faculty must perform well in areas of research and service to become well-rounded professionals.

2) Centers should be administered and staffed by persons who are respected by both the administration and the faculty. Many centers have their staff teach in academic departments, at least one course per year. This gives credibility to their suggestions, and also helps keep the staff grounded in reality. Many centers include university faculty on their staff. Purdue, for instance, has a Faculty Associate program where respected veteran faculty work part-time for the center on various projects or as instructional consultants.

3) Instructional improvement projects should be built around stated learning outcomes and time-lines for implementation. Effectiveness in achieving those outcomes should be documented by the faculty development center. Projects that have follow-up and reporting requirements are going to get more attention and buy-in from faculty because it communicates the message that someone values this effort enough to see that it is completed, and hopefully successfully.

4) There should be some way to publicize successful instructional improvement projects or activities. Rogers (1995) states that, “The easier it is for others to see the results of an innovation, the more likely they are to adopt it (p. 16).” Many of the programs I visited had printed newsletters. I believe printed and mailed newsletters communicate importance, and permanence, whereas e-mail communicates temporary, fast, and low importance. Another publicity method is web-site publication – websites require proactive users (they have to access them) and are possibly not as effective as printed documents. Many of the universities visited cited retreats where faculty could discuss what they find effective. A follow-up would be showcasing the innovation in action on campus.

5) Faculty development centers should build alliances with other faculty service centers (technology, library, service learning, international student services, computer center, etc.) so that efforts are supported and not
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duplicated. All faculty services are competing for resources, and limited resources go further if agencies work together. For example, the faculty development center at the University of Central Florida sponsors Service Learning Day. This provides visibility for both groups, and demonstrates that they are working together.

6) Faculty development center directors should be included in meetings of department heads and deans. It is important that faculty development center directors hear what the deans and department heads are saying with regard to faculty needs, program needs, and institutional needs. An effective faculty development center has to work at all levels.

7) A representative from the faculty development center should sit on the teaching awards committee. Teaching awards can turn into little more than a popularity contest. Has the instructor documented effective teaching? What is the impact of this instructor on institutional goals? What training, guidelines and resources are available to demonstrate effective teaching? These and other questions can be raised to support the instructors who exhibit effective instruction.

8) The faculty development director should report directly to the chief academic officer. In many institutions the faculty development officer is too far removed from persons who can make policy and financial decisions that directly affect center programs. They should also be involved with institutional effectiveness programs to help guide instructional improvement at the institution.

9) Faculty development programs should have the acknowledged support of administration with regard to alignment with institutional goals. This can include administrative testimonial support of the faculty development program. Effective programs support the university culture and higher-level institutional goals. In fact, the viability of the faculty center may depend upon how it can demonstrate that it is helping the university achieve its goals.

10) Faculty development programs must not forget to include staff development among its goals. Faculty development materials and presentations have to practice what they preach. The same MORE model variables apply to faculty development staff as well as faculty. Keeping up with rapid changes in technology and instructional practice is expensive and time consuming. Resources to encourage experimentation, research, and networking are important to staff competence and commitment.

REFERENCES


**KEY TERMS AND DEFINITIONS**

**Motivation**: A mental disposition affecting a choice of action

**Opportunity**: Circumstances that allow the time to pursue an activity

**Resources**: Space, technology, support and funds to enable an activity

**Evaluation**: The collection and processing of data to facilitate decision making

**Assessment**: Evaluation used to determine the degree to which learning outcomes are being met.

**Faculty Development**: Resources and activities to help faculty become effective at facilitating student learning

**Best Practices**: Strategies or instructional activities that improve student learning

**Learning Outcomes**: Statements of what the students are supposed to be able to do after taking a course.

**Instructional Technology**: Methods and means for designing and delivering instruction

**Learning Centered**: Curriculum built and assessed around stated learning outcomes.

**Blended Instruction**: A mix of face-to-face and on-line instruction.
Chapter 31
Object-Oriented Faculty Development: Training Teachers with Learning Objects

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ABSTRACT

The study outlined in this chapter simulated a faculty development program that utilized a demonstration/simulation -- a learning object that digitally demonstrates a task then asks the student to replicate it. In this learning environment, participants were given the chance to learn a skill from a teaching tool that they in turn could use in their classrooms. In addition, half the participants were asked to evaluate their learning styles by taking a Multiple Intelligence inventory before working with the demonstration/simulation. Overall, the participants felt that this study was an enlightening experience for them -- they became more aware of how they learn, which gave them insight on how their students learn. Faculty development designers, human performance training professionals, and instructional technology designers can use the results of this study to gain a greater understanding of object-oriented faculty development programs that improve human performance and appropriate ways to implement them.

INTRODUCTION

Distance education has taken many forms over the years. Beginning as a means for people to learn by corresponding through the mail, it now includes delivering education over the Internet through online courses -- offering education to students in an anywhere, anytime, easily-accessible package. This style of learning gives adults who do not have the time to attend face-to-face classes and/or who live in areas where training specific to their jobs is not available an opportunity to become involved in a learning community in a budget-friendly manner. It is this combination of convenience, accessibility, community oriented learning, and affordability that has motivated education professionals to integrate online coursework into their faculty development (Bush, 2005; Pittinsky, 2005) and human performance training programs.
Object-Oriented Faculty Development

Such programs are used by educational institutions of all levels to assist their instructors in improving their teaching practice (Pittinsky, 2005) and human performance development skills. Utilizing online coursework in such a way not only provides faculty with a chance to learn new skills, but it also provides them with a chance to become students -- thus giving them a new perspective on teaching methods and practices. Placing teachers in a student role gives them a chance to develop personally -- and, as Lipka and Brinthaupt (1998) point out, professional development and personal development:

...serve to complement each other. In fact, however, the major way that these two parts of a teacher’s identity complement each other is unidirectional -- few people would argue that training a teacher to become a competent technician is the best way to open up new avenues for personal and self-related exploration. (p. 2)

This becomes particularly important when a teacher is assisting students in understanding their own learning processes and building student confidence (Lipka and Brinthaupt, 1998). Thus, when offering teachers faculty development human performance training, it is wise to utilize a method that allows for self-reflection, personal growth, and that emphasizes the learner’s experience. Multiple Intelligence (MI) theory, when utilized in adult education, can provide such a learning environment (Shore, 2004).

Online teacher training programs often utilize learning objects -- digital, reusable, sharable chunks of learning information that offer flexibility in developing coursework. While this is a great opportunity for teachers and instructional designers to open up new windows for their students, it also brings up questions for them to answer, such as: How do I use learning objects to best accommodate my students’ learning preferences? How do my students process the information presented to them in a learning object? In order to answer these questions and to assist online coursework developers in understanding the value of learning objects in human performance and teacher training, the study presented in this chapter exposed a group of teachers to MI theory and documented their responses to a software demonstration/simulation. A software demonstration/simulation provides the student with a digital demonstration of a software task followed by an interactive simulation in which the student assesses what was learned. Teachers and instructional designers can use the data gathered from the participants in this study as a guideline for developing more effective demonstration/simulations in their faculty development and human performance training programs. In the following pages, when reference is made to an instructional designer developing a course, this information can also be applied to an instructor or any individual who utilizes instructional technology for faculty development and human performance improvement.

This study addressed the following objectives:

- Discover ways to assist teachers in understanding what learning processes take place when utilizing a demonstration/simulation.
- Understand how having teachers evaluate their MI strengths assists them in developing online coursework.
- Have teachers analyze their own responses to a learning object and record whether or not it gives them information that they can use to improve their teaching practice.
- Discover what best practices can be followed when utilizing learning objects.

BACKGROUND

...an environment that would balance structure and customization in which students and faculty could learn at their own rates and according to their own needs and not be limited to learning only from local resources. ...a system of interlocking
learning objects designed to share basic information and skills. The objects would be connected to create...guided pathways depicting a...project from beginning to end...[and] corporate pavilions where [the] latest technological innovations would be open for exploration and experimentation. (Chenail, 2004, p. 7)

Although the world Chenail describes may sound like some far-off, idealistic learning environment that would never be attainable, it is actually an accurate description of learning environments that are cropping up in the instructional technology field. Chenail’s “ideal” educational system is an example of an object-oriented learning environment -- a means of delivering chunks of information to students through the Internet that encourages them to share information and allows more than one student to use the chunks at any given time. These environments are generally online databases that include a collection of learning objects. Examples of learning objects include graphic images, animated demonstrations and simulations (demonstration/simulation), sound clips, Java applets, and web pages with learning content (Wiley, 2000). Students working in these environments can experience the open, universal type of learning that Chenail describes.

There are already a number of such educational Websites in existence. For example, Gaible (2004) discusses the Educational Object Economy (EOE), which began as a repository where students and teachers could access learning objects. This initiative, Gaible states, was started to develop an online learning community where information could be shared and disseminated among online communities. At the time this study was conducted, the organization’s Website stated that the EOE had 2,600 simulations for educators to share (Educational Object Economy, 2005). Clearly, object-oriented learning is on the rise.

This is good news for faculty development in that it fits in with the thrust of such programs. Faculty development programs allow teachers to grow as professionals and to improve their human performance. These programs often focus on how to reach as many employees as possible, both instructionally and geographically (Breda, Clement, and Waeytens, 2003; Bush, 2005). As an example of this on the instructional side, Breda et al. discuss the program at the University of Leuven in Belguim, which targeted new faculty members. This program was designed to utilize guided independent learning -- a style of teaching that the staff felt would best suit adult learners who were developing instructional ideals and beliefs. In such an environment, students are involved in their own knowledge development, and teachers guide the students through the learning process. This, the authors feel, encourages teachers to learn based on their own prior knowledge and beliefs rather than confining them to memorizing and regurgitating standard ideas and concepts -- an environment that would be easy to create with object-oriented learning.

On the geographic side, Bush (2005) talks about teacher training in the Mobile County Public School System in Alabama. Because the district has about 4,000 teachers dispersed throughout the county with varied schedules, the school system’s technology group began to offer online training. They felt this would provide quality instruction to all faculty, allow the participants to take courses at their own pace, and do coursework when and where it was convenient for them. All of these traits are ones that can be found in faculty development and human performance object-oriented learning environments.

Satisfying both the instructional and geographic needs of teacher training programs can be quite an undertaking, but it also opens up opportunities to begin to explore new means of instructional delivery. As Hatch, Bass, liyoshi, and Mace(2004, p. 43) state, this provides “an unprecedented opportunity to bring together emerging efforts to develop a more complex understanding of teaching and learning.” When used for teacher training, an object-oriented learning environment offers a convenient way for on-the-go, self-directed teach-
Object-Oriented Faculty Development

ers in various geographic locations to gain new skills and improve human performance. However, as ideal as this environment can be there is little direction (see Wiley, 2000) for course developers as to how to utilize it effectively, thus this study was conducted in order to discover methods to follow when developing human performance and faculty development programs online.

But why use an MI inventory? As Chenail (2004) states, the ideal object-oriented learning environment provides the student with a choice of learning objects that illustrate a concept in a variety of ways and a facilitator who can assist the student in making productive learning choices. Knowledge of MI theory will not only assist an object-oriented instructor in integrating learning objects into his/her coursework, it will also help students in the program choose which tools best suit them. This is one reason that MI was chosen as the learning preference inventory to administer in this study. A look at learning in the workplace will further explain the decision to use an MI inventory.

The idea that peoples’ different ways of learning and various perspectives should be respected has found its way into the workplace. In order to manage change effectively, Brockbank (2002) feels, organizations need to encourage learning among its employees. He suggests that the scaffolding of a business organization should encourage learning by allowing employees to be open with one another and support trust, intimacy, and affection. When learning occurs, it should be rewarded and the tone of the organization should encourage a group spirit of learning. Finally, Brockbank suggests that open relationships between employees in various levels within the organization should be fostered by creating a culture in which these types of relationships can flourish. Promoting openness can lead to greater productivity and harmony within a company or organization.

In this vein, many businesses have strived to be “learning organizations” (Brockbank, 2002). A learning organization is one that transforms easily and allows its members to continually learn and grow, both as individuals and as part of a group. To sustain a learning organization, Brockbank feels, companies must develop programs that allow their employees to transform as individuals, which in turn gives the organization the strength to transform according to the needs of its marketplace. Brockbank warns that managers who attempt to achieve a perfect learning organization will be discouraged, as there are many perspectives in a company, and to attempt to have every person see things in the same light is impossible. His suggestion to managers is to create a learning organization by allowing for diversity in points of view while keeping the organization whole. One way managers can accomplish this is by teaching their employees to respect the point of view of others and to find ways to integrate them into their own point of view, and, as Brockbank tells us:

Clearly, this links closely to learning. Developing a genuinely open mind, able to “read” the discourses of others and take their realities as if they make sense when they do not from one’s own perspective, is a learning skill. It is an essentially social skill, and dialoguing and questioning are its prime virtues. (p. 17)

When creating faculty development and human performance programs, object-oriented learning based on MI is a good place to start in that giving employees the freedom to choose their learning objects based on their strongest intelligences allows them to utilize tools that suit their learning preferences. This can be limited in that it forces the learner to continually make decisions about training without guidance. But if this type of training is offered in a learning organization -- an environment where various perspectives are respected and encouraged -- then administrators and managers will take into account their employees’ various intelligences when making training choices for their staff. Therefore, object-oriented learning based on MI theory offered in a learning organization is a productive use of learning objects, such as the demonstration/simulation tested in this
study. The results of this study will guide faculty development and human performance trainers in such an organization as to the best ways to utilize their learning objects.

METHOD OF THE STUDY

Participants

The participants were twenty adults who were working as teachers at the time of this study, both online and face-to-face, with varied levels of computer experience and that had an interest in utilizing technology in their classrooms. Teacher’s aides, assistants, and any education professionals who work with teachers in the classroom were considered eligible. Grade levels taught of the participants ranged from grade school to college. To solicit volunteers, a total of 26 emails were sent to teachers who were colleagues of the researcher or referred to the researcher by family and friends. Of these, nine joined and completed the study. The rest of the participants were obtained by posting a request to education and technology-oriented bulletin boards and listservs, which all together reached over 3,500 subscribers.

I chose to study teachers because of the need in faculty development programs for research on how teachers learn (see Hatch et al., 2004; Breda et al., 2003; Bush, 2005) and the most effective ways to present material to them in human performance training programs. I also wanted to encourage educational institutions to take an active role in developing their teachers’ instructional skills (see Hatch et al., 2004; Breda et al., 2003). It is my hope that studying teachers as students will encourage this practice.

Design and Nature of the Study

The design of this study was based on the utopian and deliberative standards in order to encourage growth in the education field and to assist education professionals in improving their practice. The combination of qualitative and quantitative data gathered led to information on how online curriculum can be better developed and utilized in teacher training. In order to answer the research questions discussed in the “Study Results” section below, this study followed a mixed methodology. This ensured that the data collected was valid by utilizing the results from the qualitative research to back up the results from the quantitative research. One limitation was that the population tested was restricted to teachers, which was done in order to support the theme of the study, but limits the results to one type of human performance training program. However, the information found in this study will be usable by other populations for their professional development and human performance improvement programs. It should also be noted that the participants in this study were non-paid volunteers rather than a random sample of participants.

Instrumentation and Validation

This study utilized instruments that were consistent and appropriate to the population in order to produce reliable and valid data (see Frankel and Wallen, 2000). The participants’ MIs were determined from an MI inventory (reproduced with permission from: http://surfaquarium.com/MI/inventory.htm) and a Likert survey was used to question the participants. As the results for the surveys came in, gaps in information gathered became clear based on the written feedback given by the participants and by reviewing the questions that resulted in neutral answers. The email discussion questions were developed to fill in these gaps. The five email questions asked participants to expand on their previous experience, as well as share any changes in their perspectives on teaching that occurred as a result of participating in the study.

Conducting a pilot study of 4 volunteers from the population gave me solid feedback and validated the feasibility of the study, the instruments
used, the methodology, and the demonstration/simulation. The feedback from the piloters was unique in that they saw the demonstration/simulation as a part of the entire study and were able to make comments on how it related to other parts of the study. This was not only useful in improving the demonstration/simulation, but it was also useful in improving the way the study was ultimately conducted. Additionally, two professionals in the field reviewed and assisted in the design of the demonstration/simulation. Their feedback led to, among other things, an improvement in the clarity of the directions used in the tool and the pacing of the tool.

Data Collection and Other Procedures

In order to collect data from the participants, they were broken into two groups of 10. One group began the study by taking the MI inventory and noting their results. Both groups then worked with a Microsoft PowerPoint tutorial in the form of a learning object -- a demonstration/simulation I created in Adobe Captivate -- then completed a Likert survey I created on the experience, and statistics from this survey were recorded. These findings represented the quantitative data in the study. From the findings of these results, I chose select participants from both groups to interview to collect qualitative data from them. I conducted the interviews through email correspondence and summarized them to determine patterns and relationships in the interview data collected. In order to sufficiently test the feasibility of conducting a faculty development program online, this study was conducted completely online. All volunteers were solicited through email, listservs, and online bulletin boards. Conducting the study in this manner allowed me to solicit volunteers from around the world, which resulted in gathering 19 volunteers from various parts of the United States and one volunteer from India. In the discussion of the results, participants that took the MI inventory are referred to as the “MI group” or “MI participants” and participants that did not are referred to as the “non-MI group” or “non-MI participants.”

STUDY RESULTS

Below I have outlined what I found from the results of the study as it relates to faculty development and human performance.

Research Question 1: How does one assist teachers in understanding what learning processes take place when utilizing a demonstration/simulation?

Based on information found in the literature review (see Pittinsky, 2005 and Lipka and Brinthaupt, 1998), it was decided that placing teachers in the role of student was a good way to assist teachers in understanding what learning processes take place when utilizing a demonstration/simulation, thus improving their teaching skills. All participants became students when they worked with the demonstration/simulation, and MI participants became students when the read about MI theory and took the inventory. The high rate of all participants who said they Strongly Agreed or Agreed with two questions on the Likert survey speaks to the usefulness of this method. Figure 1 shows the overall (MI and non-MI participants together) response to Question 6, “As a result of participating in this study, I more fully understand how a demonstration/simulation would motivate a student to learn.” Figure 2 shows the overall response to Question 8, “As a result of participating in this study, I have a better understanding of how to use multimedia learning tools to address the learning preferences of my students.” 75% of the respondents Strongly Agreed or Agreed with Question 6 and 65% with Question 8, giving a high endorsement to a learning environment that places teachers in the role of a student and assists them in understanding the learning processes that take place when utilizing a demonstration/simulation. This is information that can be useful
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in the field on two levels. First, it can encourage teachers to begin to utilize demonstration/simulations in their own classrooms as a learning object that addresses the learning preferences of their students. Second, it can encourage faculty development program designers to not only utilize demonstration/simulations to improve their faculty members’ human performance but it also outlines for them the impact that having teachers learn from a tool they can use in their classrooms has on their teaching methods.

Hearing from professionals in the field on this topic offers instructors insight on how to develop their online training programs. When asked in the email discussion question, “Discuss how, if at all, being involved in a faculty development program that utilizes tools similar to the ones used in this study would not only improve your technology skills but also influence your teaching methods,” participant 15, a 4th and 5th grade resource teacher who had no previous experience using a demonstration/simulation, replied that she

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**Figure 1. Likert survey question 6 overall response**

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<th>Number of Respondents</th>
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<td>12</td>
</tr>
<tr>
<td>Neutral</td>
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<td>3</td>
</tr>
<tr>
<td>Disagree</td>
<td>5.00%</td>
<td>1</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>5.00%</td>
<td>1</td>
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</table>

*Number of respondents: 20
Number of respondents who skipped this question: 0*

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**Figure 2. Likert survey question 8 overall response**

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<th>Number of Respondents</th>
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</tr>
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<td>Agree</td>
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<tr>
<td>Neutral</td>
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</tr>
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<td>5.00%</td>
<td>1</td>
</tr>
</tbody>
</table>

*Number of respondents: 20
Number of respondents who skipped this question: 0*
felt she would be able to more thoroughly teach a concept through a demonstration/simulation if she was comfortable using the tool herself. Participant 5, an instructional technology professor at the University of Pittsburgh at Johnstown, saw this type of program as a starting point, stating that involvement in such a program would improve his technology skills and:

...might encourage me to use similar technologies in my teaching, but only if I’m given the opportunity to (a) have ubiquitous online computer access for my students in and out of school and (b) ongoing training with other teachers so as to help me generate and implement ideas for integrating the technology effectively into teaching and learning.

Research Question 2: Does having teachers understand their MI strengths assist them in developing online coursework?

As an education professional, I was curious to see if asking instructors to examine their learning preferences in an object-oriented learning environment would influence the way they looked at how their own students learn. When presented with Question 6 on the Likert survey, “As a result of participating in this study, I more fully understand how a demonstration/simulation would motivate a student to learn,” 80% of the MI participants said they Strongly Agreed or Agreed, and 70% of the non-MI participants said they Strongly Agreed or Agreed. This shows a slightly higher margin of MI participants agreeing with this statement. Though not as much of a difference as expected, there is some evidence that it would be useful for faculty development programs to combine self-evaluation with learning. This can be seen from a response to the email discussion question, “Discuss how, if at all, being involved in a faculty development program that utilizes tools similar to the ones used in this study would not only improve your technology skills but also influence your teaching methods.” Participant 16, an avid user of technology in her college classroom and an MI participant, stated, “Having tools that provide assessment of one’s learning style would certainly provide more feedback for instructors and assist in adjusting teaching methods to students.” In response to the question “Discuss how, if at all, participating in this study changed your point of view on how to teach in your own classroom,” she further went on to say that she was recently involved in a course on learning preferences and teaching methods that was similar to the study, and she found this inspired her to try different approaches to teaching with her own classes. As a result, she incorporated technologies such as podcasts and presentations successfully into her curriculum.

Research Question 3: If teachers analyze their own responses to a learning object will it give them information that they can use to improve their teaching practice?

In order to shed light on ways show instructors how to utilize learning objects (see Wiley, 2000), I analyzed the data to find out what both groups of participants experienced when working with them. The majority of all the participants felt that working with a learning object would help a teacher understand how to utilize it in his/her own classroom. Figure 3 gives the overall results to Question 5 on the Likert survey, “As a result of participating in this study, I believe that training a teacher skills through a demonstration/simulation helps a teacher learn how to use this tool in his/her own classroom.” This question, like many others in the survey, was worded to specifically ask if the participant had changed his/her point of view “as a result of participating in this study.” The fact that 75% of the participants Strongly Agreed or Agreed with this statement is a strong indicator that the participants felt that studying a skill through a learning object gave them tools they can use in their own classrooms. This indicates that two levels of learning are going on in this type of training environment: the student is learning the skill the learning object is teaching as well as...
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processing information on how to use this type of instruction in his/her own classroom.

Given this, I expected that the MI participants would have had a higher agree rate in response to Question 5, as they were asked to reflect on their own learning processes before working with the demonstration/simulation, yet this was not the case. The Non-MI participants Strongly Agreed or Agreed with the question 10% more than MI-participants did. The big difference of opinion between the two groups appeared in their responses to Question 7 of the Likert survey, “As a result of participating in this study, I better understand my own learning processes.” Figure 4 shows that 60% of the MI participants Strongly Agreed or Agreed with this question, while Figure 5 shows that only 20% of the non-MI participants Strongly Agreed or Agreed with this question.

From this, I felt I did not have a clear answer as to the difference between the MI participants’ experience and the non-MI participants’ experience, so I turned to the email discussion responses. One of the MI participants, who teaches 11th grade English classes, touched on this in his response to the question, “Discuss how, if at all, being involved in a faculty development program that utilizes tools similar to the ones used in this study would not only improve your technology skills but also influence your teaching methods.” He replied, “Most importantly, however, is that I

Figure 3. Likert survey question 5 overall response

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<th>Number of Respondents</th>
</tr>
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<td>Disagree</td>
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</tr>
<tr>
<td>Strongly Disagree</td>
<td>0.00%</td>
<td>0</td>
</tr>
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</table>

Figure 4. Likert survey question 7 MI participant response

<table>
<thead>
<tr>
<th>Question 7 of 10</th>
<th>% of Respondents</th>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
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<td>Strongly Agree</td>
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</tr>
<tr>
<td>Agree</td>
<td>20.00%</td>
<td>2</td>
</tr>
<tr>
<td>Neutral</td>
<td>10.00%</td>
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<tr>
<td>Disagree</td>
<td>10.00%</td>
<td>1</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>0.00%</td>
<td>0</td>
</tr>
</tbody>
</table>

Number of respondents 20
Number of respondents who skipped this question 0

Number of respondents 10
Number of respondents who skipped this question 0
would be reminded of how I learn and how other teachers learn. Since people learn differently, it would remind me to continually vary my teaching methods to meet the needs of my students.” Participant 1, an MI participant and a high school chemistry teacher, summed up how participating in the study influenced him as a teacher, “Taking part in your study made me re-think my teaching style(s) and ask the question, how can I do this better?” Finally, participant 3, an MI participant and a faculty member with the University of Phoenix Austin campus, expressed a change in point of view on how to teach online. In response to the email discussion question, “Discuss how, if at all, participating in this study changed your point of view on how to teach in your own classroom,” participant 3 responded, “I think online teaching needs to have more visual simulations to be effective.” From these responses, we learn that not only do human performance students need to use learning objects to understand their use in the classroom, but that it is beneficial for them to reflect on their learning processes before using them.

Research Question 4: What best practices can be followed when utilizing learning objects?

The demonstration/simulation that was utilized in this study followed design standards according to the experience of experts in the field -- Tool Motivates the Student to Learn, Tool Avoids Cognitive Overload and Tool Offers Interactivity (see Jafari, 2003, Clark, 2003, Reigeluth, 1999, Nielsen, 2000, Lynch and Horton, 2001, and Dewald et al., 2000). This was done in order to test these practices and see if they offer a viable way to develop a learning object that improves human performance. The results of this study indicated that using these standards creates effective learning objects, offering the education community information that can be utilized in many object-oriented learning environments.

Overall, the participants felt that the demonstration/simulation was a useful learning tool. 80% of the participants agreed with Question 1 on the Likert survey, “As a result of participating in this study, I more fully understand the purpose of a demonstration/simulation as a learning tool,” and Figure 6 shows that 100% of the participants Strongly Agreed or Agreed with Question 2, “A demonstration/simulation is a viable way to teach computer concepts.” This reinforces that the demonstration/simulation was well received by the teachers in the study and was a tool that they could see a use for.

The overwhelming agreement with Question 2 is significant. The overall results of the Likert
survey were calculated to derive an average Consensus Score for the responses to each question from the 20 participants (see the “Method of Calculation” section later in this chapter for more information). The Consensus Scores are shown on the chart in Figure 7. As seen by the labels on the Y axis, the values 0, 50, and 100 represent Strongly Disagree, Neutral, and Strongly Agree (in the actual survey, additional values of 25 and 75 were assigned to Disagree and Agree). While there are many ways to score an average of 50, a score of 0 or 100 would have required all participants to Strongly Disagree or Strongly Agree with a question. This fact makes the score of 94 on Question 2, “A demonstration/simulation is a viable way to teach computer concepts,” very significant. It indicates an overwhelming amount of agreement with this statement from the participants after they worked with the demonstration/simulation. On average, all the scores fell between 50 and 100 showing that the participants had very little disagreement with the questions on the survey. Therefore, it is clear that a demonstration/simulation is an excellent way to present computer concepts to students in an object-oriented learning environment.

There were four more questions on the Likert survey that had high consensus scores, ranging...
from 69 - 76. These high scores speak for the effectiveness of the demonstration/simulation as a teaching tool that taught the teachers a new skill and showed them they can use it themselves in their classrooms, which, as mentioned above, was one of the major goals of this study. It is clear from this that an object-oriented faculty development program that utilizes demonstration/simulations as learning objects would be successful in training teachers on computer concepts as well as training them on how to utilize learning objects to improve human performance. Beyond the goals of this study, these results also indicate that the type of demonstration/simulation used in this study would make an effective teaching tool for anyone wanting to learn computer concepts -- an observation that perhaps could be shared with software development companies.

To understand whether or not the participants thought the demonstration/simulation was well designed, a revisit to Question 6 on the Likert survey and analysis of answers to the email discussion questions is necessary. 75% of the participants expressed agreement with Question 6 on the Likert survey (“As a result of participating in this study, I more fully understand how a demonstration/simulation would motivate a student to learn”), which speaks directly to the first standard used for the learning object, Tool Motivates the Student to Learn. These results indicate that the tool did indeed motivate the participants to learn and gave them an understanding of how it could motivate their students to learn – information that is very valuable to anyone developing an object-oriented learning environment to help improve human performance.

The email discussion answers showed reinforcement of the other two standards, Tool Avoids Cognitive Overload and Tool Offers Interactivity. One participant stated she was pleased with the ability to do tasks herself during the interactive section of the tutorial, “It was quite easy to learn how to do something new in this fashion by actually ‘doing,’ not watching someone else demonstrate or hearing someone else talk about it. Al [sic] of my learning senses were involved!” The tool was designed to offer students this type of interactivity, rather than just demonstrating to the student, to help avoid cognitive overload as it did with this participant. It also offered, as another participant pointed out, the ability for the participants to be involved in practice and feedback activities. Participant 18, an educational technology instructor at the University of Alabama in Huntsville who uses learning objects in his classroom regularly, felt that a demonstration of a skill, followed by practice and feedback, was a good way to teach and learn technology skills and one that he could see uses for:

*One thing that your study did illustrate that I have not been able to do previously with my [computer skills training] software is to design practice/feedback activities...This is interesting to me and I can see many applications: pre-assessments, practice exercises, self-checks.*

It is apparent that instructional designers could use all three of the standards presented in this study to create effective learning objects that would improve human performance.

**Method of Calculation**

The points on the chart in Figure 7 were calculated for each question by taking the number of responders to each category (Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree) of the question and multiplying each category response by the numeric value assigned to the category (100, 75, 50, 25, and 0, respectively). The category scores were then added together, divided by the number of responders (20 for the overall results), and rounded off. This procedure produced a range from 0 - 100 for the Average Scores on each question answered by the 20 participants. The differences between each numeric value for a response were chosen to be the same.
amount. Numerous texts discuss averages and their statistical properties, including standard deviation (STD) (see, for example, Crow, Davis, and Maxfield, 1960).

Fortunately, spreadsheets and many inexpensive scientific hand calculators give the standard deviation of a range of numbers. The standard deviations for each question of the survey were obtained using a TI-30X IIS hand calculator and confirmed with a Mathcad 7 utility. In a limited population, such as the one in this study, the quantity, STD/(n-1)\(^{1/2}\), gives the probable Range within which the average response to each question may lay. Table 1 summarizes the values of the averages and their average Ranges -- given as +/- STD/(n-1)\(^{1/2}\). The numbers are rounded to one decimal place since greater precision is unwarranted.

In this survey, the demonstration/simulation elicited strong positive responses to the questions despite the wide deviation in population personalities. In particular, the overall average and most of the scores are well within the agreement range (50 - 100). In addition, Question 2 stands out by its very high score and necessarily narrow Range since no score can be higher than 100.

**FUTURE AND EMERGING TRENDS**

Several trends and issues that designers using object-oriented learning environments for faculty development and human performance programs should keep in mind emerged from the data and from my experience working with the population (the support from the data and/or observation follows each recommendation):

While demonstration/simulations are a good way to train teachers on computer concepts (response to Question 2 on the Likert survey), keep in mind that not every learning style responds well to this type of tool (general feedback given from the participants and an overall study observation).

Any demonstration/simulation used in faculty development or human performance training should follow design guidelines and standards that ensure the object is sound (see section, “Research Question 4: What best practices can be followed when utilizing learning objects?”).

Exposing teachers to MI theory can have a positive effect on their learning experience and assist them in understanding how their students learn (see sections, “Research Question 2: Does having teachers understand their MI strengths assist them in developing online coursework?” and “Research Question 3: If teachers analyze their own responses to a learning object will it give them information that they can use to improve their teaching practice?”).

Ensure that the learning objects used in object-oriented faculty development and human performance programs present material that is relevant to the participants (feedback from participant 5).

Ask for feedback from and work with the students in such a program to tailor the program to their needs (feedback from piloters was used to improve the program in this study).

Utilize surveys and discussions to evaluate the effectiveness of the program and make continual improvements.

---

**Table 1. Averages and their ranges for each Likert survey question and for the overall survey. For each question n is 20, but overall, n is 200.**

<table>
<thead>
<tr>
<th>Question</th>
<th>Average With Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>76.3 +/- 6.3</td>
</tr>
<tr>
<td>2</td>
<td>93.8 +/- 2.5</td>
</tr>
<tr>
<td>3</td>
<td>50.0 +/- 7.7</td>
</tr>
<tr>
<td>4</td>
<td>73.8 +/- 6.3</td>
</tr>
<tr>
<td>5</td>
<td>73.8 +/- 5.4</td>
</tr>
<tr>
<td>6</td>
<td>68.8 +/- 5.6</td>
</tr>
<tr>
<td>7</td>
<td>53.8 +/- 5.7</td>
</tr>
<tr>
<td>8</td>
<td>62.5 +/- 5.4</td>
</tr>
<tr>
<td>9</td>
<td>65.0 +/- 4.7</td>
</tr>
<tr>
<td>10</td>
<td>61.3 +/- 5.1</td>
</tr>
<tr>
<td>OVERALL</td>
<td>67.9 +/- 1.9</td>
</tr>
</tbody>
</table>
changes as needed (I was given rich feedback from participants that could be used for future improvements to the tools used in the program).

Such a program needs to be flexible and a main focus should be the quality of the participants’ learning experience (observed while working with participants).

Avoid the tendency of online programs to isolate the students and incorporate ways to develop a community among them (observed, as participants in this program had no connection to one another).

Keep in constant contact with the participants to ensure they are able to complete assignments and work with the tools they have been given (I had to remain in contact with the participants to ensure they completed the study).

Keep in mind the experience level of the participants when setting deadlines (I found that those who were not as experienced needed more time to complete the coursework).

FURTHER RESEARCH

This study pooled together a variety of teachers from various educational levels and institutions to create its population. A recommendation for a researcher who wants to pool together volunteers in a similar manner is to ask permission to post a request with various listservs, as these garnered more responses than bulletin boards. The ones utilized in this study were: teachernet, EDTECH, and IFETS. Another option for a researcher wanting to do a similar study would be to utilize the faculty from one institution rather than pulling together faculty from various institutions. This may generate different results than the ones found in this study. A third option would be to pool together faculty from various educational levels and institutions, but to place them into an environment where they could interact and communicate with one another. I found that such a group may share similar ideals but have different perspectives on how to implement them, and having them brainstorm and discuss educational issues would surely lead to the development of very insightful and usable concepts and ideas.

Given more time and funding, this study could be conducted as an action research project. An educational institution wanting to develop such a program could begin by surveying and having discussions with its faculty to determine the needs of the program, develop preliminary learning objects, then survey and interview the participants at various checkpoints in the program. The results of each round of surveys and interviews would lead to improvements within the system that would be implemented before the next round. This would not only assist the institution in creating a very well-rounded faculty development program for its teachers, it would also offer the educational community priceless data on the process of implementing such a program.

CONCLUSION

Object-oriented learning is clearly an innovative way to present students with learning materials (Hatch et al., 2004; Bush, 2005). Teachers across the country and around the globe are taking advantage of this trend by developing their own learning objects or by utilizing existing ones in a variety of ways in their classrooms. A challenge of this type of education is how to best utilize it to the maximum benefit of the student (see Wiley, 2000). In order to fill in the gaps in the literature, this comparative study explored the use of learning objects in an object-oriented faculty development program that exposed teachers to MI theory and asked them to work with a software demonstration/simulation.

Although MI was not as much of a factor as expected, the results of the Likert survey and the email discussion spoke to the strength of the demonstration/simulation. This knowledge can influence professionals in the field to look at this
tool as a learning object that greatly promotes student learning. It also implicates to software developers that this type of learning object works well in teaching software concepts, as the demonstration/simulation used in this study taught a software concept. Finally, as seen from the information presented in this chapter, there are a number of ways to use learning objects successfully in faculty development and human performance improvement programs. My hope is that instructional designers and online coursework developers find the results of this study a useful tool in creating their own object-oriented learning environments.

REFERENCES


Chenail, R. J. (2004). When Disney meets the research park: metaphors and models for engineering an online learning community of tomorrow. The Internet and Higher Education, 7(2), 107–121. doi:10.1016/j.iheduc.2004.03.001


**KEY TERMS AND DEFINITIONS**

**Demonstration/Simulation:** This term is used to describe any digital representation of a real-life task used for teaching purposes that includes user interactivity. It also is used in this chapter as a catch-all phrase for any description of a demonstration or a simulation.

**Faculty Development Program:** A faculty training program offered by an educational institution that assists teachers in improving their performance.

**Learning Preference:** Refers to the process(es) through which a student prefers to learn, for example, some students prefer learning from reading text while others prefer hearing a lecture.

**Learning Object:** A digital, reusable, sharable chunk of learning information.

**Multiple Intelligence (MI) Theory:** Developed by Howard Gardner as a response to outdated IQ testing, this theory suggests that people possess many intelligences that assist them in learning about and perceiving the world around them (Armstrong, 2000). Understanding one’s own MIs can assist in character and professional development.

**Object-Oriented Learning Environment:** A database housed online that contains learning objects.

**Self-Directed Learner:** A student who feels comfortable exploring a learning environment at his/her own pace and who can utilize an instructor as a guide for, rather than the leader of, a course.
Chapter 32

Integrated Design of Web-Platform, Offline Supports, and Evaluation System for the Successful Implementation of University 2.0

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ABSTRACT

University 2.0 is a collaborative way of constructing and sharing knowledge, based on epistemological and social technologies to amplify the effect of interaction and participation at higher education settings. In this case study, Web 2.0 social technologies were implemented to improve teaching and learning performances by integrating user-centered interactive platform, offline support strategies, and evaluation systems. The interactive web-platform is the essence of University 2.0 and enables the various interested parties to practice the 2.0 spirits of openness, sharing, and participation. In order to make learning based on the web-platform more effective and efficient, offline supports such as learning cells, learning facilitators, and learning spaces should be supplemented. The CIPP model was employed to monitor all processes of the University 2.0 project, to guide developers to the next steps, to attract attention from faculty members and students, and to derive consensus among them.

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INTRODUCTION

When the term “Web 2.0” first emerged, it was not about technological abruptness. This generative concept was the result of empirical observation about the changes of doing economic activities and facilitating social interaction through web-platform in this knowledge-oriented global society. After “dot-com bubbles” burst, experts in Internet business started to realize that what made some Internet network companies successful was strongly related to increasing individual participation, amplifying the effects of knowledge sharing, and facilitating social interaction in more effective, efficient, and pleasant ways (O’Reilly, 2005). University 2.0 is an educational attempt to bring the successful 2.0 stories into our field of higher education.

This chapter introduces a case study as an example of implementing Web 2.0 social technologies to an institute of higher education under the name of University 2.0. The purpose of this implementation is to improve teaching and learning performances by employing user-centered interactive platforms, offline support functions, and evaluation systems in an integrated manner. A private university located in southeastern Seoul applied University 2.0 to its College of Bionano technology, which was newly established in 2007.

Bionano technology is a cutting-edge and highly interdisciplinary scientific field, encompassing a variety of science and engineering applications (Park, 2005). Bionano technology is a fusion technology that applies nanotechnology to biological systems (Borisova et al., 2007; Park, 2005). Combining biotechnology and nanotechnology has the potential to yield breakthrough advances in the area of science and engineering, such as the creation of new drugs, sensors, diagnostics, and fluidics tools (Park, 2005). Because bionano technology is multidisciplinary in nature and is changing rapidly, the traditional way of linear knowledge transmission from faculties to students was neither desirable nor valid. Therefore, students in this field need to improve self-regulated learning competencies to simultaneously understand all related information with collaborative activities. In order to improve students’ learning competencies in the field of bionano technology, University 2.0 learning strategies incorporate offline support, such as learning cells and learning facilitators, with an online platform consisting of open course ware, blog, user-generated contents (UGC), tagging, multimedia library, and podcasting services.

The purpose of this chapter is to share the experience of implementing Web 2.0 at a higher education setting and to explain each component of University 2.0 in the categories of web-platform, offline support, and evaluation system. The focus is on how to design these components as a unified learning intermediary. The 2.0 web-platform is required to construct the University 2.0 environment; offline support tools should be designed to fully assist learners in using a web-platform; evaluation system works as a navigator to lead all members involved in this project to strive for the same goal, which maximizes the effects of 2.0 learning activities. According to Vygotsky, human learning and growth can occur in environments created by humans through sociocultural intervention (Moll, 2000). University 2.0 can become another such human-created environment, integrating virtual space and physical learning space in a more dynamic and effective way.

BACKGROUND

The concept of Web 2.0 indicates epistemological and social changes about how we create, distribute, and share knowledge through dynamic social interaction on interactive web-platforms. Managing knowledge and information through Web 2.0 platforms would become a legitimate way of handling the speed of knowledge expan-
The necessity of 2.0 systems in handling information is becoming apparent. It was estimated that the total amount of human beings’ knowledge has doubled for 18 months from 2007 (Foray, 2006). This phenomenon implies that the life span of knowledge will be shortened and that uncertainty, along with knowledge in the knowledge-based economy, will be largely increased. The economic feasibility of knowledge will need to be evaluated, which will incur expenses, and additional expenses will be required to trade information. Currently, the difficulty of handling the enormous increase of knowledge is faced by the fields of global business and politics, and that difficulty is starting to appear in the field of education.

By facilitating the validation of knowledge through social legitimation and the distribution of information through social interaction, the Web 2.0 platform may increase their economic value dramatically. In detail, a web-platform is necessary to fulfill the Web 2.0 spirits of openness, participation, and sharing and to make possible the mutual engagement of activities such as tagging, blogging, UGC, and wiki (Barnes & Tynan, 2007; O’Reilly, 2005). With its implementation at universities, the Web 2.0 learning environment provides learners with great advantages in creating group knowledge and collective intelligence (Barlow, 2008; Barns & Tynans, 2007). In this project, a web-platform for the College of Bionano technology was developed as a collaborative cyberspace for interactive learning, and its primitive version was opened to the public in August 2008. Faculty members and students need time to become familiar with the new learning system with support from learning facilitators. Learning cell activities facilitate the dynamics of teamwork by increasing face to face interaction beyond cyberspace. Furthermore, the design and development of this web-platform reflects results from context evaluation, following the CIPP evaluation model.

Online intervention becomes more effective when it is combined with face-to-face offline interaction (Michinov & Michinov, 2008). The face-to-face meeting allows students to get to know each other, which helps in team building, and social relationships. As the study by Derntl and Motsching-Pitrik verified (2005), in online environment, students searched for information, gathered resources, and discussed through a web-platform. Then, they composed their ideas and prepared for presentations with face-to-face interaction (Derntl & Motsching-Pitrik, 2005; Michinov & Michinov, 2008). Furthermore, the University 2.0 environment demands learners’ active involvement in social dynamics, with the competencies related to media literacy to use functions in the 2.0 web-platform. In order to increase learners involvement, offline supports need to provide ways of facilitating individual involvement and social interaction. Offline learning strategies that are implemented include learning cell activities, learning facilitators, and learning spaces.

With Web 2.0, the educational environment has become more learner-centered and collaborative (McNeil et al., 2000). More and more faculties are using group projects in classes and group learning enables students to help each other to achieve their goals (Slavin, 1995; Yamarik, 2007). It develops learners’ critical thinking, problem solving, and collaborative learning (Gokhale, 1995). In the University 2.0 project, each learning cell is composed of a small team of students, who share similar interest within the field of bionano technology. As research verified (Butler & Coleman, 2003), small groups are more interactive than larger ones. Members voluntarily share information and create content together as an offline activity. Afterwards, members upload their work to the web-platform in order to show it to others.

In this project, the role of facilitators is different from that of teaching assistants. The role of facilitators is to make team learning and communication among individuals or group members
effective, so that team efficiency is maximized (Schwartz, 2002). Using facilitators can reduce initial inhibiting factors, such as the fear of poor evaluation, the free-rider, and production blocking and can make the group productive (Oxley et al., 1996). The core roles of facilitators are to create a supportive environment, to give timely quality feedback, (Yao et al., 2005) and to make on- and off-line group activities efficient (Schwartz, 2002). The facilitators also need to have a high level of media literacy to assist with online activities and must possess a strong background and skills in the field of bionano technology. Based on the results of need assessment, the qualifications of facilitator were identified. In total, 8 seniors and graduate students were trained before the web-platform was launched, and 20 more facilitators would be trained at a later time, to fully assist approximately 50 students and 16 faculty members at the College of Bionano technology.

This project employed the Context, Input, Process, Product (CIPP) Evaluation Model to design, develop, implement and evaluate the University 2.0 learning system in an integrated manner. The CIPP model, proposed by Daniel L. Stufflebeam in 1971, is widely used to successfully implement innovations and long term projects (Dick, 2002; Stufflebeam, 2003; Worthen et al., 1997). The more attractive aspect of this model is that it has been continuously revised and evolved by the developer, and the checklists and guidelines also have been open to other researchers (Stufflebeam, 2003).

The University 2.0 learning system underwent three context evaluations: needs assessment identified the needs of students and faculty, environment analysis checked possible barriers, and readiness diagnosis tested the level of media literacy of bionano technology college members. Based on the results of context evaluation, the guidance for designing web-platform, offline learning cell activities, and facilitator training program were provided, and the necessity of redesigning the curriculum and evaluation framework for the College of Bionano technology was proposed. Input evaluation was conducted to identify the learning competencies and characteristics of students and the teaching competence of faculty, and to check the possible resources that would be available for this project. With the CIPP Model, the evaluation process is on-going and iterative, and provides an integrated way of putting all Web 2.0 components together.

The integration of web-platform, offline supports, and evaluation system was intended to provide the best learning environment for the students and the faculty members at the College of Bionano technology, which is known to be one of the most knowledge-intensive fields in science. Indeed, the world-wide interdependence of the knowledge society is increasing with globalization through the power of social network technology. In this situation, individual authority of producing and delivering knowledge has passed onto the knowledgeable mass. Educational methodology is not much different. If something related to knowledge and education needs to be designed or made in this knowledge-oriented era, it has to go through the dynamic process of knowledge creation and delivery through social interaction. Under this circumstance, it would be very absurd for only one professor, department, or university to manage the process of knowledge transmission to the next generation. The function and system of the university in the new century, therefore, should be rebuilt not through linear updates, but through the 2.0 perspective of the world.

WEB-PLATFORM

The social interactive web-platform is the essence of web 2.0 implementation. Due to the interactive web-platform, University 2.0 is differentiated from other technology-based interventions, such as e-learning or u-learning. University 2.0 has to incorporate the open platform for higher education settings, which enables the various interested par-
ties to practice the 2.0 spirits of openness, sharing, and participation. By practicing the spirits of 2.0, the open platform would allow the smooth flow of large amounts of information into a university and the outflow of knowledge to the public. As a result, this virtual university, designed through the 2.0 methodology, is able to create collective intelligence and offers the necessary services needed for learning activities through educational interface open to the public.

**University 2.0 Platform**

For the College of Bionano technology at K University, a web-platform named Babel 5 was built as an educational platform with an open user interface, which maximizes the interaction between instructors and learners, according to the basis of Web 2.0 technologies.

The main functions of Babel 5 can be divided into “Courseware” and “Media Library.” Courseware is a collection of the materials related to classes offered by the College of Bionano technology, including open courseware from other universities and research institutions. However, Babel 5 is not limited to just presenting the materials in a passive way like the existing e-learning systems, online classes, or open courseware. The most different aspect of Babel 5 is that it is an interactive system that demands a high level of participation from users. Similar to open courseware, anyone can get access to course materials from Babel 5, but can also participate in group conversations, and even in classes. Furthermore, the learners are able to freely produce and enlarge the contents of learning with “WiKi solution.”

The characteristics of Babel 5 can be summarized as complete openness and amplified interactivity. Babel 5 is equipped with fully open courseware and interactive functions beyond the level of simply opening, and searching and recommending through the media library. While previous e-learning systems and open courseware offer video clips lasting 20 to 50 minutes and other materials, Babel 5 is designed for users to collect the materials based on their choice and to combine them together for further study. Above all, unlike existing e-learning systems and open courseware, which are limited to only offering contents, Babel 5 maximizes users’ participation by allowing users to reproduce and upload contents as well download and use them. Moreover, with Babel 5, learners can create the contents collaboratively through the WiKi solution. The WiKi system shows the characteristic of Web 2.0 in that users freely share

<table>
<thead>
<tr>
<th></th>
<th>Online Class</th>
<th>Open Courseware</th>
<th>University 2.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Openness of the material</td>
<td>Limited</td>
<td>Open</td>
<td>Opens Possibility of participation</td>
</tr>
<tr>
<td>Media library existence</td>
<td>None</td>
<td>None</td>
<td>Exists</td>
</tr>
<tr>
<td>Characteristic of the offered material</td>
<td>Course material/ Video clip (20–50min.)</td>
<td>Course material/ Video clip (20–50min.)</td>
<td>Composition of separate course materials by various topics (5–10min.)</td>
</tr>
<tr>
<td>How material is shared</td>
<td>Typical board</td>
<td>None</td>
<td>WiKi system</td>
</tr>
<tr>
<td>Download of the material</td>
<td>Possible but limited</td>
<td>Impossible</td>
<td>Possible for all users</td>
</tr>
<tr>
<td>Users’ upload approval</td>
<td>Only for instructor</td>
<td>Only for instructor and administrator</td>
<td>Instructor, learner, and other users</td>
</tr>
<tr>
<td>Other users’ participation</td>
<td>-</td>
<td>-</td>
<td>Reproducing, scraping, recommending</td>
</tr>
</tbody>
</table>

Table 1. Comparison of three major technological interventions
their opinions, and group knowledge is created from individual thoughts.

The Media Library enables all users to access a broader range of materials than coursewares, to reproduce and upload learning materials, and to present their own created contents. The learning materials are developed into the user participating library, which can be searched using tags, and get feedbacks on them including recommendations and replies.

The course materials are fully open, and all users, including the instructor and the learner, can upload multimedia materials in a variety of formats to the media library. In addition, the open material can be searched and downloaded without any special programs. Through the podcasting in

Table 2. Babel 5 functions

<table>
<thead>
<tr>
<th>Menu</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syllabus</td>
<td>Introduction of the course such as course description and class requirement will be included.</td>
</tr>
<tr>
<td>Course Matrix</td>
<td>· Easily structuralized series of the course in one lecture</td>
</tr>
<tr>
<td></td>
<td>· Arrange the various icons of course contents and directly access the information</td>
</tr>
<tr>
<td>Learning Cell</td>
<td>· Educational space operated by the team of students that take the course</td>
</tr>
<tr>
<td></td>
<td>· Course cell within the courseware is usually operated privately</td>
</tr>
<tr>
<td></td>
<td>· Interaction of the course cell is accompanied with on/off-line</td>
</tr>
<tr>
<td>Courseware WiKi</td>
<td>· WiKi during the course</td>
</tr>
<tr>
<td></td>
<td>· Assignment in the form of WiKi, Creation and operation of WiKi</td>
</tr>
<tr>
<td></td>
<td>· User creation and enlargement space of knowledge regardless of topic</td>
</tr>
<tr>
<td></td>
<td>· Making out one note by several users</td>
</tr>
<tr>
<td></td>
<td>· All materials related to the required lecture: Bibliography, Link, etc.</td>
</tr>
<tr>
<td>Communication</td>
<td>· Role of conveying news to the students that take the course</td>
</tr>
<tr>
<td></td>
<td>· Free board for Q&amp;A, suggestion, etc.</td>
</tr>
</tbody>
</table>
Integrated Design of Web-Platform, Offline Supports, and Evaluation System

Figure 2. Screenshot of interactive courseware in Babel 5

For Student

- to be a self-directed learner, and an independent problem-solver
- to be a knowledge creator
- to build interpersonal skills through collaborative learning

For Professor

- to be able to cooperate with other professors
- to attain abundant useful resources related to their courses and research
- to develop better teaching methods using plentiful materials

For University

- to offer an effective learning environment to learners, and instructors
- to be differentiated from other educational systems, and to be a leader in a new learning system
- to be a hub in the knowledge-based network in the bionanotechnology field

OFFLINE SUPPORT

The most difficult aspect of implementing University 2.0 project is that the 2.0 system demands user participation and dynamic social interaction.

the University 2.0 platform, the learners are able to study before and/or after class with an individual mobile device anywhere. For this purpose, the materials in the media library are encoded in a general format so that they can be downloaded and played on any device.

University 2.0 has changed the process of knowledge construction and educational activities. As a result, the university constituents, including the learners, instructors, and the university itself, can take advantage of University 2.0 systems as described below.

For Student

- to be a self-directed learner, and an independent problem-solver
- to be a knowledge creator
- to build interpersonal skills through collaborative learning

For Professor

- to be able to cooperate with other professors
- to attain abundant useful resources related to their courses and research
- to develop better teaching methods using plentiful materials

For University

- to offer an effective learning environment to learners, and instructors
- to be differentiated from other educational systems, and to be a leader in a new learning system
- to be a hub in the knowledge-based network in the bionanotechnology field

OFFLINE SUPPORT

The most difficult aspect of implementing University 2.0 project is that the 2.0 system demands user participation and dynamic social interaction.
Moreover, it should be voluntary and spontaneous. In previous technological learning environments, such as e-learning systems, learners’ motivation could be the key element of successful implementation; however, the 2.0 system cannot be sustained or even exist with a low level of participation and involvement. In order to increase learners’ participation and facilitate social interaction, offline support is necessary. Furthermore, to make learning based on this new platform more effective and efficient, offline support should be supplemented with learning cell activities, learning facilitators, and learning spaces.

Learning Cell

As Web 2.0 technology is applied to the field of education, the learning environment has changed dramatically (Ajjan & Hartshorne, 2008; Maloney, 2007). In a traditional classroom, teachers and instructors had the authority to deliver knowledge and skills as they chose. However, with the Web 2.0 environment, learners have access to more than enough Internet resources to gain knowledge and can learn by themselves (McNeil et al., 2000). Thus, the roles of instructors and learners have dynamically changed and sometimes, even reversed.

The Web 2.0 learning environment provides an interactive learning platform in an excellent way. However, at a certain point, students still need face-to-face interaction with faculty members and other students. Even in an online learning environment, group projects are frequently incorporated to facilitate collaborative learning activities. Students learn together by searching for resources, sharing ideas, and building collective knowledge (McNeil et al., 2000). As a result, University 2.0 enables collaborative learning as well as self-directed and self-organized learning.

In the College of Bionano technology University 2.0 project, the collaborative group activities are called as “learning cells.” A learning cell is a self-organizing, self-evolving, and collaborating organization, just like organic cells. To differentiate learning activities from typical group work, we call it “learning cell.” In practice, a learning cell is a small team that is composed of a group of students, instructor(s), and facilitator(s). Any class at the College of Bionano technology consists of several learning cells and learners are allowed to form learning cells depending on their interest. The members in a learning cell collect and share information, do group project together, and upload their own learning content (UGC) to the web-platform.

In particular, University 2.0 provides wiki solution for learning cell activities. A Wiki is a web page enabling users to upload learning contents and to share their ideas. It helps students’ online collaborative activities and facilitates asynchronous online discussion. Through Wiki, no matter when or where they are, learners can participate in discussions, work with other learning cell members, and share knowledge. Through learning cell activities, users produce collective intelligence and collective knowledge greater than the sum of individual knowledge. The learners also learn how to express their idea logically and how to understand others’ points of view. Their learning output is also shared to others through the web-platform and is beneficial to other students.

It is important to demonstrate and share the team’s goals, objectives, and action plans with all group members. In order to do that, the University 2.0 project offers a “learning cell statement,” which includes learning cell goals, objectives, roles, procedure and time plan, and ground rules. Using this learning cell statement, group members can be closely united and focus on their performance.

The University 2.0 system is a collaborative learning environment through which learners can search information together, share ideas, and build collective knowledge. However, to amplify the effect of collaborative learning on web-platforms, face-to-face social interaction is required, in particular, in higher education settings (Michinov & Michinov, 2008). The wiki
solution and the learning cell statement would be good tools for on- and off-line learning cell activities. In addition to learning cell activities, learning facilitators can help make collaborative learning more efficient.

Learning Facilitator

According to the definition from Wikipedia (2008), a facilitator can be defined as an individual who helps a group of people understand their tasks and achieve goals without taking a particular position in group activities. Facilitation makes learning faster, maximizes group synergy effects, and improves individual self-regulation (Schwartz, 2002; Weaver & Farrell, 2000). Therefore, a facilitator is not a decision-maker, but assists in group work. In practice, facilitators cast questions to learners, rather than giving them answers. They connect people into a team, link people to resources, and help team members draw a consensus.

In a computer-mediated learning environment, instructors use a method of collaborative group work, and it is considered a major part of course activities. However, as the interaction between students and students, students and teams, and instructors and students gets deeper (McNeil et al., 2000), the role of learning facilitators is necessary to encourage group learning and interaction among members.

Under this learning system, facilitators’ roles include guider, helper, and encourager (Hew & Cheung, 2008). Learning facilitators need to attract students’ participation by guiding students to participate in the class activities properly and keeping student’s learning process on track. In the University 2.0 environment, the role of the facilitator is more critical because they can help students overcome technical difficulties or observe how to use the learning platform and resources in the media library. The learning facilitator is also expected to create a desirable atmosphere for study, and to help learners get to their goals and produce learning output. The key to success of the University 2.0 project lies in the efficient combination between online learning and offline learning, and that depends on how properly the learning facilitators intervene in on- and off-line learning activities.

For this purpose, the University 2.0 project developed its own facilitator training program. The competencies and qualifications of facilitators were drawn from the investigation of other cases (e.g., Florida State University, 2008; Seitz, 2006; Zachary, 2000) and the results of needs assessment as a part of context evaluation. The necessary qualifications were identified, including communication skills, conflict solving skills, and team building skills. The facilitator training program is composed of 5 parts; (1) understanding adult learners, (2) facilitation skills, (3) team building and problem solving skills, (4) understanding themselves and others, and (5) efficient communication skills. This program was designed as an activity-based program, and each part of the program lasts 3 hours and includes several games and activities. The first facilitator training program was held in March 2008, and 8 student facilitators were selected. Before the training program, training participants discussed their roles and duties to better understand the student facilitator in the web-based environment. A professional instructor with more than 10 years experience in this field was invited to give a lecture and to share his knowledge and experiences as a professional facilitator.

Since the facilitators were involved in course activities after the training program, the professors understood the learners’ situations and the problems of each learning cell, and gave appropriate advice to them. With the learning facilitator’s active involvement, professors felt that they connected to students more closely and that their interaction was smooth and active. Students also reaped benefits—the learning facilitator created an academic atmosphere that motivated students and let them feel free to communicate with professors and other students.
These facilitation experiences were good for the learning facilitators themselves. They could fully focus on the course, and they were able to go one step further in preparing for the class and helping other students. Some student facilitators reported that they actually acquired a more active and positive attitude to self-directed learning. Trained facilitators can not only learn skills and knowledge, they are also able to change their attitude and behavior based on what they experience through these activities.

Learning Spaces

Through advances in the delivery system, learners can enjoy learning activities anytime and anywhere. However, that was in the 1.0 era. With the University 2.0 learning environment, learners need and want more. They do not want to just overcome the limitation of time and space, but they also want to be able to get together for face-to-face social interaction at the right place, at the right moment. Learners now perceive space as a change agent (Oblinger, 2006) in facilitating social interaction and learning activities.

For efficient classroom activities, a new interactive multimedia classroom was built at the College of Bionano technology in April 2008. This classroom is designed to support distributed learning, on- and off-line learning cell activities, and individual or group learning. The classroom is equipped with high-tech equipment, such as several beam projectors, two-side screens, and white-boards for teaching and group activities.

The classroom has enough space to move around freely and the room was ergonomically designed. In particular, students are able to move desks and chairs flexibly for their purpose, to facilitate discussions and collaborative learning. Also, the desk can be used alone for individual learning activities.

EVALUATION SYSTEM

As explained earlier, the University 2.0 learning systems include various tools and agents to fa-
cilitate social interaction and learning activities. However, it was very hard to make any progress in developing the University 2.0 system with so many gadgets and without a standard procedure that every developer must follow. Furthermore, with regard to this University 2.0 project, the developers were faced with new social network technology and issues that they were required to manage. The evaluation process naturally became the way of guiding developers to the next step, getting attention from faculty members and students, and deriving consensus among them.

The evaluation activity in itself affects the teaching and learning process as well as the learning outcome in any educational situation (Bachman & Palmer, 1996; Saif, 2006; Worthen et al., 1997). Researchers have verified that appraisals and rewards can influence knowledge creation and knowledge sharing (Lee & Cha, 2007). How we are evaluated affect our way of doing things and the standards we are apprised by influence the priorities of our tasks. Due to this reason, evaluation is the best way of ensuing and changing the direction of educational intervention (Davies, 1968; Hughes, 1989). Furthermore, evaluation can become a navigator to guide the procedure of designing, developing, and implementing educational intervention with the function of auditing or managing quality control in a given situation (Worthen et al., 1997). Indeed, constant evaluation compels developers to understand a given context with insight.

Unlike other evaluation models used to assess outcomes at the end of projects, the CIPP evaluation model is a process-oriented model, which can govern the actual procedures of designing and developing an educational intervention. The CIPP model helped educators realize that “evaluation is not something that we just need to do at the end of the project; rather, it is a process that should continue throughout the life of project” (Dick, 2002, p.148). CIPP stands for “Context” evaluation, “Input” evaluation, “Process” evaluation, and “Product” evaluation. These four phases lead evaluators through the entire process and outcome in a systematic way (Stufflebeam, 1971, 2003).

According to Stufflebeam’s explanation (2003), context evaluation assesses needs, problems, assets, and opportunities to help decision makers define goals and priorities. Input evaluation assesses alternative approaches, competing action plans, staffing plans, and budgets for their feasibility and potential cost-effectiveness to meet targeted needs and achieve goals. Process evaluation assesses the implementation of plans to help staffs carry out actual activities and to judge program performance and outcomes. Product evaluation identifies and assesses outcomes in various aspects to help staffs keep focused on achieving important outcomes and ultimately to meet targeted needs.

In this project, the CIPP model was employed to monitor the entire process of the University 2.0 project. Through the four phases, we expected to identify the needs of the faculty members and students, to encompass different perspectives and interests, to acquire consensus from the interested parties, and to improve the outcomes of projects consistently. Context evaluation and input evaluation were completed at the beginning of the project, but process evaluation and product evaluation was conducted during the project and will be continued for a while beyond the completion of the project.

As a context evaluation at the very beginning of this project, needs assessment was implemented to identify what faculty members and students expected to get from this project, to determine if they were ready to use the University 2.0 web-platform, and to find any environmental issues at the College of Bionano technology. After conducting needs assessment through a focus group interview and an open-questioned survey, the possible problems and issues were identified. The input evaluation provides information regarding students’ achievement, professors’ teaching competencies, coursewares, learning cell activities, facilitators, and classroom environment.
After identifying problems and issues by context and input evaluation, the information gained helped developers find the appropriate way to revise the web-platform, offline support strategies, and the evaluation process itself.

FEEDBACK TO THE WEB-PLATFORM AND REVISION

Readiness. Through the evaluation process, it was identified that professors and students were familiar in using web materials for learning and research, however, both parties were apathetic about producing and uploading contents on the Web, and participating in blog communities. This shows that both students and professors are still stuck in the Web 1.0 system in contrast to their positive perception toward the 2.0 spirits. In order to overcome this problem, the facilitators were advised to lead students and professors into actively participating in online 2.0 communities.

Motivation. Students’ motivation was pointed out as the biggest potential issue for the University 2.0 learning system, which is largely dependent on users’ participation. As students suggested during needs assessment, the issue of motivation for participation can be solved to some degree by systematically linking students’ evaluations with their level of participation.

Media literacy. Media literacy was identified as a fundamental ability that students and professors should possess to make use of the University 2.0 system. Only when able to freely interact socially on the Web can individuals function in the University 2.0 system. In order to fulfill the needs about media literacy, the College of Bionano technology redesigned the curriculum to include a course to allow learners to acquire a necessary level of media literacy.

Coursewares and learning materials. Based on the results of needs assessment for both faculty members and students, coursewares for the various levels of learners were collected within the field of bionano technology. Also, the Babel 5 platform provides many video clips visualizing the invisible micro phenomenon, which students in the field of nano technology need to understand. A video clip is only 10 to 15 minutes long, to better hold learners’ attention. Other requirements for course materials were compiled by experts in the field of bionano technology.

Intellectual property. From the professors’ perspective, the University 2.0 system, which advocates openness and making private contents public, can call for issues with copyright. Moreover considering the rapid change of technology in the bionano technology field, this can be a social and economic issue, not just an emotional one. Thus, even in the open University 2.0 system, consideration and support at a web-technology level is needed to protect the constituents’ research results.

Feedback to Offline Support Strategies and Revision

Administrative functions and school affairs. This case study of University 2.0 suggests that when applying artificially such a spontaneous system to an existent system of university, the establishment of an online web-platform is not enough. Actions need be taken offline as well to strengthen support systems, such as administration and school affairs. Above all, how conflicts can be solved among the new teaching and learning system, the existing administration and operation systems, and the existing school affairs and evaluations systems is the key to success of University 2.0.

Facilitators. Students expect facilitators to be competent in all aspects of media literacy and have expertise in the field of bionano technology. Professors expect facilitators to aid in connecting the professors to students, and to alleviate their burden in preparing for lectures. Both needs were reflected in the training program for facilitators.

Learning cell combined with learning spaces. To reflect the opinions of students during needs
### Table 3. University 2.0 evaluation system based on CIPP model

<table>
<thead>
<tr>
<th>Purpose of evaluation</th>
<th>Target of evaluation</th>
<th>Aspect of evaluation</th>
<th>Function</th>
<th>Purpose</th>
<th>Action Plan</th>
<th>Tool</th>
<th>Analysis Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Context Evaluation</strong></td>
<td>Learner, Instructor, Department, University, Project</td>
<td>Needs Analysis</td>
<td>To clearly understand the requirement of the interested parties</td>
<td>Learner’s requirement analysis: Focus group</td>
<td>Focus group questionnaire</td>
<td>Recording group conversation</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Instructor’s requirement analysis: Question</td>
<td>Questionnaire</td>
<td>Answering the questionnaire</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Readiness Analysis</td>
<td>To check readiness of members about the new educational methodology</td>
<td>Learner’s readiness: Question</td>
<td>Questionnaire</td>
<td>Answering the questionnaire</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Instructor’s readiness: Question</td>
<td>Questionnaire</td>
<td>Answering the questionnaire</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Context Analysis</td>
<td>To understand the suggested organizational, administrative, economic, and political conditions</td>
<td>Acquire information through official and unofficial methods like observation, examination of the document</td>
<td>People in charge of project’s observation, various rulebooks, unofficial conversation with related group member</td>
<td>Various</td>
<td></td>
</tr>
<tr>
<td><strong>Input Evaluation</strong></td>
<td></td>
<td>Educational Achievement Evaluation</td>
<td>To understand initial knowledge, attitude, motivation of learners and adjust them into the educational circumstance</td>
<td>Before the course starts, check the intellectual, cognitive, and emotional status of the course with a learner’s diagnosis</td>
<td>Diagnosis</td>
<td>Answering Diagnosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Teaching Course Evaluation</td>
<td>To understand the teaching circumstance and contents, and the suitability, appropriateness, and quality of courseware</td>
<td>Developing and using the checklist to understand the teaching circumstance and contents, and the suitability, appropriateness, and quality of courseware</td>
<td>Check list</td>
<td>Results of the checklist</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Support Strategy Evaluation</td>
<td>To understand facilitator’s function and power, to offer a guideline, and to carry out the training</td>
<td>Developing the diagnosis on the facilitator’s function and power</td>
<td>Diagnosis, Guideline</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Support Strategy Evaluation</td>
<td>To build learning cell’s guideline and strategy and to share it with the learner and instructor</td>
<td>Developing learning cell’s guideline</td>
<td>Learning cell’s guideline</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project Evaluation</td>
<td>Examining vision, strategy, and supporting system of the Department of Bionano technology and university</td>
<td>Self-evaluating committee</td>
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</tbody>
</table>

continued on following page
assessment, a classroom at the College of Bionano technology was redesigned to facilitate learning cell activities as well as individual learning.

Additional matters. The results of the evaluation suggest that students and professors have different views regarding the University 2.0 learning system. The professors believe that they are center of knowledge delivery and evaluation, and are rather conservative in a learner-centered paradigm. However, the students insist on the necessity of curriculum reorganization, show desire for a systematic change in school affairs and administration, decide what functions and contents should be provided by University 2.0 to aid with learning, and know how the evaluation system has to be changed for them to be active in

**Table 3. continued**

<table>
<thead>
<tr>
<th>Aspect of evaluation</th>
<th>Function</th>
<th>Purpose</th>
<th>Action Plan</th>
<th>Tool</th>
<th>Analysis Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project evaluation</td>
<td>Confirming and sharing vision, goal, strategy, and principle of the project</td>
<td>Self-evaluating committee</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process Evaluation</td>
<td>Educational Achievement Evaluation</td>
<td>To verify that learner’s course process is operated to increase educational achievement according to the principle of sharing, opening, and participating</td>
<td>Learner’s self-evaluation, peer-evaluation</td>
<td>Student-generated code</td>
<td>Open to student’s choice</td>
</tr>
<tr>
<td>Teaching Course Evaluation</td>
<td>To verify that instructor’s course process is operated to accomplish the course goal according to the principle of sharing, opening, and participating</td>
<td>On-line &amp; off-line monitoring</td>
<td>No structuralized format</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support strategy Evaluation</td>
<td>To recognize whether the role of facilitator is properly operated or not,</td>
<td>Attendance observation</td>
<td>Observation List</td>
<td>Contents of the observation list</td>
<td></td>
</tr>
<tr>
<td></td>
<td>To understand the function and effectiveness of the learning cell in the progress and to suggest improvements</td>
<td>Participation observation of the rate of participation in learner’s learning cell</td>
<td>Observation List</td>
<td>Contents of the observation list</td>
<td></td>
</tr>
<tr>
<td>Project Evaluation</td>
<td>To verify proper management of the strategy of the Department of Bionano technology and university</td>
<td>Self-evaluating committee</td>
<td></td>
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<tr>
<td></td>
<td>To verify proper management of the project’s goal and strategy</td>
<td>Self-evaluating committee</td>
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*continued on following page*
the new learning system. In such an environment, how to evaluate the learning capability of the students, and how to facilitate this in a real learning situation are more of the challenges University 2.0 has to offer for us.

**FUTURE TRENDS**

Online/offline learning systems are very common these days in higher education. More and more faculty members and learners are using Internet resources and Web technology (McNeil et al., 2000). Through University 2.0, a learner-centered interactive system, learners can participate in class more actively, and interaction between faculty members and students can be maximized, while offline supports are still vital factors in making learning efficient.

However, as Lanier (2006) criticized collectivism of Wikipedia as *Digital Maoism*, the collective knowledge is not always right and individual personality is obscured by the public (Lanier, 2006). Collectivism can be ignorant, because the multitude lacks authority and responsibility. Users, especially learners in University 2.0, may lose focus and direction due to the overwhelming amount of resources and constant changes (Tumlin et al., 2007). To overcome these problems of Web 2.0, users should have more accountability when dealing with resources. Also, people such as

<table>
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<tr>
<th>Aspect of evaluation</th>
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<th>Action Plan</th>
<th>Tool</th>
<th>Analysis Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Evaluation</td>
<td>Educational Achievement Evaluation</td>
<td>To understand learner’s satisfaction, confidence, course achievement</td>
<td>Understanding learner’s satisfaction, confidence, course achievement through questionnaire and diagnosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teaching Course Evaluation</td>
<td>To understand instructor, teaching contents, effectiveness of the courseware</td>
<td>Understanding teaching circumstance, teaching contents, utility and effectiveness of courseware from both learner’s and instructor’s viewpoints</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support Strategy Evaluation</td>
<td>To understand instructional effectiveness of facilitator, learning cell</td>
<td>Understanding the effect of facilitator and learning cell from both learner’s and instructor’s viewpoints</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Evaluation</td>
<td>To understand achievement of the project relating to the department and university</td>
<td>Self-evaluating committee (Confirming changes in the department and university level)</td>
<td>Comparison before and after the project activated</td>
<td>Comparative analysis on achievement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>To understand achievement related to the goal of the project itself</td>
<td>Self-evaluating committee / Achievement evaluation comparing to the goal</td>
<td>Achievement evaluation comparing to the goal</td>
<td>Comparative analysis on achievement</td>
<td></td>
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</tbody>
</table>
facilitators who can guide and monitor activities in web-platform are required.

In the research aspect, the University 2.0 system can be analyzed based on the characteristics of interpersonal relationship and information flow by employing social network analysis methods. Social network analysis enables the drawing of a map of connectivity that explains structure and characteristics of resource flows or personal relation ties (Wasserman & Faust, 1994). It is a quantitative analysis method to examine interdependent actors’ behaviors and flows of resources. By applying social network analysis to the University 2.0 project, we can figure out the pattern of interaction. In terms of centrality in network, this analysis explains which or whose resources are central in the field of bionano technology. Also, it makes it possible to analyze relational ties of learning cell members, such as who often forms groups with whom and who is in the center of a relationship.

CONCLUSION

At the current stage, the roles of social networks, dynamic relationships, and active participation are emphasized for the successful outcome of the University 2.0 project. Web 2.0 is a collection of social technologies that create a more participatory and dynamic network. In order to fulfill the needs of better learning with this socially interactive web technology, the integrated design requires a web-platform, offline support, and evaluation. Simply, University 2.0 can be explained as Web 2.0 applied to university settings. However, with the influx of more digitally literate students and the rapid change in academia, the traditional university system is in need of reform and University 2.0 learning environment can be an alternative option. University settings are designed to embrace collaborative digital media such as open courseware, multimedia courseware, wiki, podcasting and media library in order to adapt to Web 2.0 environments. Given the social characteristics of this Web 2.0 based platform, the chance of its successful implementation in teaching and learning is heavily dependent on how both faculty and students understand, recognize, and accept the user-centered technology and system in an integrated way.

This case study shows that the response level of society in general on Web 2.0 is not necessarily in conformity with that of constituents of a university. Web 2.0 is a spontaneous social community, a system where sharing one’s knowledge and productions is possible with one’s free will. At the same time, it is still raising many questions of social discussions whilst being applied to social bodies within universities. Universities are conservative systems, well-maintaining its original form since the middle ages. To what degree and how the university would adopt this user-focused 2.0 system advocating openness, sharing, and participation, depend on how much additional effort the university puts in. Just as with all efforts for innovation in human society, the possibility for creation of mass intelligence through the 2.0 system at universities, is also dependant on such social factors.

REFERENCES


Florida State University. (2008). *Small group facilitation skills and small group learning*. College in medicine, Florida State University. Retrieved December 11, 2007 from http://med.fsu.edu/education/FacultyDevelopment


Integrated Design of Web-Platform, Offline Supports, and Evaluation System


KEY TERMS AND DEFINITIONS

**Web 2.0:** Web 2.0 indicates epistemological and social changes about how we create, distribute, and share knowledge through dynamic user interaction on interactive web-based platforms. This connotes the second generation of web-based communities including blog, podcast, RSS, wiki that enable to encourage participating, sharing and collaborating of users

**University 2.0:** University 2.0 is an open learning platform amplifying learner interaction and facilitating knowledge-based learning activities. The open-platform enables various interested parties within higher education settings to practice the 2.0 spirits of openness, sharing, participation, and create collective intelligence

**Web-Platform:** Web-platform is a web-based system to support online activities such as tagging, blogging, UGC, wiki, and media library. A web-platform is necessary to fulfill the Web 2.0 spirit of openness, participation, and sharing, and to make possible the mutual engagement of activities among users

**Learning Facilitator:** A learning facilitator is an active and direct learning helper whose roles are to create an atmosphere for study, to help learners get to their goals, and to encourage social interaction among professors and students

**Learning Cell:** A learning cell is a small team composed of a group of students instructors, and facilitators. In the class, each learning cell consists of 3-4 students who have similar interests, and each learning cell members share their ideas and create learning materials together

**CIPP Evaluation Model:** The CIPP evaluation model is a process-oriented model, which can govern the actual procedure in designing and developing an educational intervention. The CIPP model consists of four phases: “Context” evaluation, “Input” evaluation, “Process” evaluation, and “Product” evaluation

**Needs Assessment:** Needs assessment is identifying what the interested parties expect to get from the process and outcome of an intervention.


Compilation of References


Compilation of References


Baquero, R. (2002). Del experimento escolar a la experiencia educativa. La “transmisión” educativa desde una perspectiva psicológica situacional [From the school experiment to the educative experience. The educative “transmission” from the situated psychological perspective]. *Perfiles Educativos, 24*(98), 57–75.


Brennan, R., McFadden, M., & Law, E. (2001). All that glitters is not gold: Online delivery of education and training. *Adelaide: NCVER*


Compilation of References


Cheryan, S., & Bodenhausen, G. V. (2000). When positive stereotypes threaten intellectual performance:


Clark, R. C. (September, 2002).


Compilation of References

(ESA) & National Telecommunications and Information Administration (NTIA).


Crawford, C. M. (2007). Developing multimedia architectural support within online learning environments: Reinventing modalities of meaning as society moves from the Information Age towards the Conceptual Age within the Knowledge Economy. *The International Journal of the Humanities*, (v. 5). Melbourne, Australia: Common Ground Publishing Party Ltd.


Florida State University. (2008). *Small group facilitation skills and small group learning*. College in medicine, Florida State University. Retrieved December 11, 2007 from http://med.fsu.edu/education/FacultyDevelopment


Agent Theories, Architectures, and Languages. Springer-Verlag.


Compilation of References


http://www.Webaim.org/articles/cognitive/


Kennedy, G., Krause, K., Gray, K., Judd, T., Bennett, S., Maton, K., et al. (2006), Questioning the net generation: A collaborative project in Australian higher education, ASCILITE Conference December 2006.


Monterrey Institute for Technology and Education. (2006). *The Online Course Evaluation Project (OCEP)*.
Compilation of References


Compilation of References


Schmidt, P. (2006). Black and Hispanic students are about as likely as their white and Asian American peers to enter college interested in majoring in the “STEM” fields. The Chronicle of Higher Education, 52(32), A39.


Compilation of References


Compilation of References


The Ohio State University Medical Center. (n.d.a). *College of Medicine Department of Internal Medicine*. Retrieved on December 30, 2008, from http://www.internalmedicine.osu.edu/


Compilation of References


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Gary Borich is a Cissy McDaniel Parker Endowed Fellow of Educational Psychology at the University of Texas at Austin. His books on effective teaching, assessment and evaluation include: Effective Teaching Methods, 7e; Observation Skills for Effective Teaching, 6e; Educational Testing and Measurement, 8e; Educational Psychology: A Contemporary Approach, 2e; Becoming a Teacher: An Inquiring Dialogue for the Beginning Teacher; and Clearly Outstanding: Making Each Day Count in Your Classroom.

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