Andrews University

School of Education

WEB-BASED COURSES IN HIGHER EDUCATION: CREATING ACTIVE LEARNING ENVIRONMENTS

A Dissertation

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by

Marilyn Ruth Eggers

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ABSTRACT

WEB-BASED COURSES IN HIGHER EDUCATION: CREATING ACTIVE LEARNING ENVIRONMENTS

by

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Chair: Shirley A. Freed

ABSTRACT OF GRADUATE STUDENT RESEARCH

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Problem

As more and more adults seek to continue their education, alternate methods of course delivery will be required to meet their needs. Web-based courses allow students to learn at times and places that are convenient for them. There is concern, however, about whether or not such courses can create effective, active learning experiences, and whether or not knowledge can be socially constructed in online interactions. In order for higher education to provide exemplary online courses, it is important to identify necessary elements and instructional strategies to create virtual learning environments. The goals of this study were to determine instructional practices in exemplary higher education Web-based courses and their perceived effectiveness and to determine implications of new delivery models for higher education.

Method

This qualitative study examined the 1998 Paul Allen Virtual Education Foundation's Outstanding Online Course Award winner and five of the six Honorable Mentions. Typical qualitative tools were used to gather data including a Web-based questionnaire, email correspondence, video recordings of conference presentations by four of the instructors, observations, interviews, course Web pages, plus articles and Web sites published by the instructors. Each course was a case study.

Results

Effective practices and design features of these exemplary online courses demonstrate multiple ways to facilitate active learning in Web-based instruction. The rich environments of these six courses included a variety of interactions between the instructor and students and among the students themselves. They model how innovative pedagogy guides the use of technology and that virtual learning communities can be created in any discipline. Faculty who have administrative support will be more likely to design, develop, and deliver effective Web-based instruction.

Conclusions

The study demonstrated ways online courses can be designed to meet the criteria of the American Psychological Association's Learner-Centered Psychological Principles. A number of implications for higher education emerged.

To my children, Tanya and Keith,
who encouraged and helped me in so many ways

To my husband, Gary,
who inspired me and supported me no matter what—
he always knew I could do it

To God,
who gave me courage, wisdom, and perseverance

TABLE OF CONTENTS

CHAPTER ONE

INTRODUCTION

Background

"Information available to humankind will double every seventy-three days," Rowley, Lujan, and Dolence (1998, p. 63) claim. Lifelong learning becomes a necessity as people seek to survive and flourish in a world changing at a dizzying rate (Dunlap, 1998). Amid the blizzard of information overload, distance learning has arrived and is quickly becoming a significant part of higher education (Lucas, 1998; Marchese, 1998). With distributed education, people can stay competitive at their jobs and remain well-informed throughout life.

Lifelong learning is now the norm, not the exception (William,1998; Duderstadt, 1999; Dunlap, 1998; Katz, 1999; Palattella, 1998). In some subject areas, degrees have a recognizable half-life; in addition, success often requires more than a degree or two—it means learning constantly. This demand for continuous knowledge acquisition includes the need for distance learning.

This need for learning and education requires different solutions because today people are living in "Internet time" (Masie, 1998). They are struggling to balance a plethora of demands on their time, including increased work demands, family responsibilities, community service, and more. Yet, in spite of their full lives, many people will need to add ongoing lifelong learning experiences to their already hectic

schedules. The convenience of online courses is likely to attract more and more people in the future.

Distributed education breaks the barriers of time and geography and opens doors for learners to learn any place and at any time. People can take classes from experts in their fields even if they are in different countries with diverse time zones. This option becomes even more viable with the use of the World Wide Web. Currently, Web-based courses are exploding at an exponential rate. Yet, for faculty "there is no solid research base to consult for guidance" (Brooks, 1997, p. 11), guidance that can help them know how to develop truly effective online courses.

Higher education has only recently begun to adopt new instructional strategies that better address learners' needs, such as active learning. Many are concerned that just when the face-to-face classrooms have begun to implement more effective instructional methods, the gains in learning will be lost in online courses. The fear is that the online courses—whether video-based or Web-based—will take instructors and students back to the days of the single instructional strategy: lecture.

Active learning, however, engages the learner instead of the learner just passively listening to a lecture or reading a book. Alavi (1994) describes three attributes of effective learning processes: active learning and construction of knowledge, cooperation and teamwork in learning, and learning through problem solving. Each of these requires skillful crafting of class interactions. But can these attributes be integrated into the instructional design and implementation of Web-based courses?

Educators tend to believe that "the quality of face-to-face discussions is higher than that of electronically conducted discussions" (Brooks, 1997, p. 12); but this is not

well supported by research. In fact, there is evidence to the contrary. “Online environments facilitate learning outcomes that are equal or superior to those generated in the face-to-face situation (Hiltz 1988a, 1994; Wells 1990)” (Harasim, Hiltz, Teles, & Turoff, 1995, p. 27).

There are a variety of strategies and methods that instructors can use to create an active, online learning environment and many of them involve various types of interactions. These could include: active learning (Bazillion & Braun, 1998), anchored instruction (Campbell, 1998; Grabowski, Koszalka, & McCarthy, 1998), contextual learning (Bazillion & Braun, 1998), cooperative learning (Bazillion & Braun, 1998; Bonk & Reynolds, 1997), generative learning, problem-based learning (Grabowski, 1995; Grabowski et al., 1998), collaborative learning (Grabowski et al., 1998), critical thinking (Bazillion & Braun, 1998), experiential learning (Campbell, 1998), individualization (Bazillion & Braun, 1998), lateral thinking (Campbell, 1998), learning to learn (Bazillion & Braun, 1998), mental models, inquisitory instruction (Grabowski et al., 1998), and situated learning (Campbell, 1998).

The technology to support these strategies is available through the use of email, listservs, chat rooms, bulletin boards, forums, and video conferencing. But are these strategies equally effective in online classes as they are in face-to-face classes? How can these strategies best be implemented with the currently available technology?

Higher education is at the crossroads because of the changing needs of adult learners (William, 1998; Blustain, Goldstein, & Lozier, 1999; Duderstadt, 1999; Farrington, 1999; Graves, 1999; Katz, 1999; Marchese, 1998; Palattella, 1998; Rowley et al., 1998; Trinkle, 1999). Colleges and universities are being challenged to reinvent the

design and delivery of instruction in order to overcome the barriers of time and distance. It is not enough to provide correspondence courses, even if they are electronic (William, 1998; Palattella, 1998). People have learned to value the unique interactive experience of the face-to-face classroom. They are no longer satisfied with performing meaningless practice exercises by themselves. Many adult learners function collaboratively at work and find solo learning experiences to be unsatisfactory. Adult learners desire the best of both worlds the personalization of face-to-face environments and electronic accessibility.

Statement of the Problem

While needs are increasing seemingly at warp speed, many in higher education are still involved in a pedagogy battle. Many know they need to overcome strong tendencies toward didactic instructional methods that exist in higher education. They are endeavoring to incorporate active learning principles into the instructional strategies. Yet, as these move their instruction to the Web, they frequently do so using lecture-type or electronic correspondence-type methods. Material is presented mainly in concrete sequential patterns. Next, students may interact with the content in exercises and assignments; and, finally, students are assessed and evaluated. All this often occurs with little meaningful interaction, during the entire process, between the student and teacher and even less between the students themselves.

Whether those in higher education are motivated by the myth of lucrative Web-based courses or by the genuine desire to provide lifelong learning to all people at all times, many are rushing to share their services online (Marchese, 1998). Simply stated the problem is, ‘How can online instruction be facilitated to incorporate currently

accepted learning principles?' It is imperative that new pedagogy—webagogy—be developed that will be active in nature, will address adult learner issues, and will take full advantage of the unique possibilities of the Internet. Ells asserts that

> Webagogy is the art, craft, and science of using networked technologies, including the World Wide Web and email, to support teaching and learning. Inherent in the idea of Webagogy is that carefully considered pedagogy is being implemented with technology—the pedagogy comes first!" (Ells, 1999, p. 1).

Dede (1996) agrees and further insists "The most significant influence on the evolution of distance education will be not the technical development of more powerful devices, but rather the professional development of wise designers, educators, and learners" (p. 34).

Purpose of the Study

Because higher education is interested in providing good-quality, satisfying online courses, it is important that the necessary elements of creating these virtual learning environments are identified. The purpose of this study is to determine instructional practices in exemplary higher-education Web-based courses and their perceived effectiveness. It will answer the following research questions:

Research Questions

1. How do faculty craft and deliver online courses to create effective learning environments?

2. What are the implications of new delivery models for higher education?

Benefits

Online courses and programs are here to stay, but many professors are not satisfied with merely converting their traditional courses to Web-based instruction

(WBI). Since colleges and universities are in the business of learning, they want to incorporate into their online courses those characteristics and components that would more likely promote a good learning experience for their students. Furthermore, there are new partnerships between higher education and corporate businesses that can provide resources to develop professional online experiences. Because all higher education will essentially be in competition in cyberspace—the geographical boundaries are eliminated—smaller colleges and universities, which do not have the full resources of these partnerships, will need to concentrate on the quality of the learning experience to draw students to their institution's virtual courses (Marchese, 1998).

The aim of this study is to identify the components and strategies of exemplary Web-based courses.

Overview of the Study

This is an exploratory study seeking to clarify ways exemplary Web-based courses utilize contemporary learning theories. The immediate challenge has been to find exemplary online courses. This is an almost impossible task considering the thousands of courses on the Web (Rowley et al., 1998). However, in 1998, the Paul Allen Virtual Education Foundation (PAVEF) conducted a contest to identify outstanding online courses. It used four principal criteria: "(1) creative use of technology; (2) sound instructional design: (3) integration of active learning; and (4) evidence of educational effectiveness" (Kearsley, 1998). I recognized these criteria as the same ones I was looking for in Web-based instruction. A total of 182 entries was received and judged by a panel of experts in educational technology. One winner and seven runners-up were

identified. The entries came from 148 institutions and represented almost every conceivable subject domain.

In order to answer the research questions of this study, all of the winners and honorable mentions are treated as a single case. Merriam (1988) notes that if one is studying a particular event, it can be considered as a single case study. My purposive sample is limited to the Paul Allen Virtual Education Foundation Outstanding Online Course Award winner and seven honorable mentions. Of the seven lead course designers/instructors, six agreed to be part of my study. I describe each of these courses as they were available to me on the Web and describe faculty perceptions, advice, and recommendations.

Definitions

The following terms are defined as used in this study.

Asynchronous: Electronic communication that is not done in real-time. Email and bulletin boards are asynchronous and allow people to communicate with others without being intrusive such as calling on the telephone.

Bulletin Board System: Bulletin boards are asynchronous communications often for subscribers only where members "can carry on discussions, upload and download files, and make announcements without the subscribers being connected to the computer at the same time "(Driscoll, 1998, p. 269). Simple ones post one message after another with no organization. Threaded bulletin board systems usually organize messages hierarchically by topic. This enables users to follow discussion themes utilizing this linear form of posting messages.

Computer-Mediated Instruction (CMI): CMI is using a computer to assist in communication for instruction. Computer Mediated Communication (CMC), Computer Conferencing, Computer-based instruction (CBI) are all similar terms.

Course authoring software: Special software to design, create, and post education or training courses on the World Wide Web. The software may have interactive features which allow students to interact with instructors, other students, or content.

Learning networks: Groups of people who are learning together via CMC networks. They can learn together whenever and wherever it is convenient for them.

Listserv: Special software that manages subscribed group email. Listservs are often used in online courses.

***M**ultiple user **O**bject **O**riented live chat system (MOO)*: A MOO is a synchronous or real-time method of communicating in text. It is a live chat that is object oriented. There are various commands which can be used to find out about other people in a live chat or other objects. Virtual objects can be people, rooms, and notes.

Streaming audio and video: Real-time audio and video "that is broad cast and received with very little time delay" (Palloff & Pratt, 1999, p. 191).

Synchronous: Electronic communication that occurs in real-time using text. Chats and MOOs are synchronous and are not as intrusive as a telephone. However, it constrains the users to be at their computers at the same time regardless of time zones.

URL (Uniform Resource Locator): A standard, global World Wide Web address. "The first part of the address—ftp or http—indicates the protocol to use" (Palloff & Pratt, 1999, p. 191) while the second part shows the Internet Protocol which is the server where the file is located.

Web-based Instruction (WBI): WBI includes email, File Transfer Protocol (FTP), and Internet Relay Chat (IRC)—anything using the Internet—in addition to Web pages for learning and also can include such technologies as streaming audio and video.

Summary

Many colleges and universities are rushing to put their courses and programs online. Some administrators hope that these additional instructional venues will be a new source of income that will help relieve challenged budgets. Some institutions are under such fiscal stress they have hastily moved toward what they believe may be a quick fix for budget and enrollment challenges. They have asked faculty to provide online courses quickly rather than go through the expensive process of research and development to find out what is the best way to deliver instruction from a distance. As a consequence, many professors are struggling to find ways to convert their existing courses to online versions. This process has provided challenges in figuring out how to do this technologically; further, the process often does not always address pedagogical issues such as active learning, adult learning characteristics, or sociocultural issues. This study describes exemplary online instruction through the lens of psychologically accepted learning principles.

CHAPTER TWO

THEORETICAL FRAMEWORK

Introduction

Learning theory has been around for a long time. Theory does not usually get up-front applause, but it is necessary nevertheless (Torraco, 1997):

> Few people, other than theorists, ever get excited about theories. Theories, like vegetables and televised golf tournaments, don't trigger provocative reactions from people. Most theories, except those that are truly revolutionary, such as the contributions of Newton, Einstein, and Darwin, just do their jobs quietly behind the scenes. They may increase our understanding of a real-world event or behavior or they may help us predict what will happen in a given situation. But they do so without a lot of fanfare. (p. 114)

Learning theories lay the foundation for instructional strategies and for setting up active learning environments. Those that emphasize active and sociocultural learning are particularly applicable for online learning, which can be a passive, isolating experience.

The growing need for lifelong learning ensures a bright future for online courses and training (Marchese, 1998). With this increased demand for learning and online courses comes an opportunity to reevaluate what we know about learning. How does it happen? Can the principles of effective face-to-face learning be translated into new online pedagogy? Are there now online instructional possibilities available that were not possible with face-to-face courses? Is there a new pedagogy developing? Harasim (1997) proposed the following support for developing new pedagogy for online courses:

> One of the basic requirements for education in the twenty-first century is to prepare learners for participation in a networked, knowledge-based economy in which knowledge will be the most critical resource for social and economic development. Students will need new and different knowledge resources, skills, roles, and opportunities. New communication technologies such as the Internet and the Web enable new approaches to and opportunities for teaching and learning. (p. 1)

New approaches are not only possible but necessary as instruction and learning move to the Web (Bonk & Reynolds, 1997; Meyen, Lian, & Tangen, 1997a; Moore & Kearsley, 1996; Palloff & Pratt, 1999). As this happens educators are asking themselves whether learning principles form the basis for this new pedagogy.

Much research has been done on how learning occurs. In 1995 the American Psychological Association (APA) published 14 learner-centered psychological principles (see Table 1 APA's Learner-Centered Principles).

While all 14 principles can be applied to any learning situation, I have chosen, with the guidance of Dr. Shirley Freed, to delimit my study to the 8 principles which can be discussed without having in-depth interactions with students. The six I am omitting are more directly connected to students and would require different research methods to evaluate them. Since this study is an exploratory study of effective online courses, I have chosen to describe the courses as I experienced them on the Web and through the interpretation of the course designers/instructors.

For the purpose of this study, I paid attention to the following learner-centered psychological principles:

1. Nature of the learning process
3. Construction of knowledge
6. Context of learning
8. Intrinsic motivation to learn

Table 1

Learner-Centered Psychological Principles

Cognitive and Metacognitive Factors	**Description**
1. Nature of the learning process	The learning of complex subject matter is most effective when it is an intentional process of constructing meaning from information and experience.
2. Goals of the learning process	The successful learner, over time and with support and instructional guidance, can create meaningful, coherent representations of knowledge.
3. Construction of knowledge	The successful learner can link new information with existing knowledge in meaningful ways.
4. Strategic thinking	The successful learner can create and use a repertoire of thinking and reasoning strategies to achieve complex learning goals.
5. Thinking about thinking	Higher order strategies for selecting and monitoring mental operations facilitate creative and critical thinking.
6. Context of learning	Learning is influenced by environmental factors, including culture, technology, and instructional practices.
Motivational and Affective Factors	**Description**
7. Motivational and emotional influences on learning	What and how much is learned is influenced by the learner's motivation. Motivation to learn, in turn, is influenced by the individual's emotional states, beliefs, interests, and goals, and habits of thinking.
8. Intrinsic motivation to learn	The learner's creativity, higher order thinking, and natural curiosity all contribute to motivation to learn. Intrinsic motivation is stimulated by tasks of optimal novelty and difficulty, relevant to personal interests, and providing for personal choice and control.

Table 1—*Continued.*

9. Effects of motivation on effort	Acquisition of complex knowledge and skills requires extended learner effort and guided practice. Without learners' motivation to learn, the willingness to exert this effort is unlikely without coercion.
Developmental and Social	**Description**
10. Developmental influences on learning	As individuals develop, there are different opportunities and constraints for learning. Learning is most effective when differential development within and across physical, intellectual, emotional, and social domains is taken into account.
11. Social influences on learning	Learning is influenced by social interactions, interpersonal relations, and communication with others.
Individual Differences	**Description**
12. Individual differences in learning	Learners have different strategies, approaches, and capabilities for learning that are a function of prior experience and heredity.
13. Learning and diversity	Learning is most effective when differences in learners' linguistic, cultural, and social backgrounds are taken into account.
14. Standards and assessment	Setting appropriately high and challenging standards and assessing the learner as well as the learning progress—including diagnostic, process, and outcome assessment—are integral parts of the learning process.

9. Effects of motivation on effort
10. Developmental influences on learning
11. Social influences on learning
14. Standards and assessments.

For discussion, I grouped #1 and #3 together and #8 and #9 together. For each section, I discuss the learning principle in general, and its application to WBI in particular.

Nature of the Learning Process and Construction of Knowledge

How humans learn has intrigued and troubled educators throughout history. Generally the learning schools promote is "the use of intentional processes that students can use to construct meaning from information, experiences and their own thoughts and beliefs" (APA, 1995 p. 6). "Successful learners," APA asserts "are active, goal-directed, self-regulating, and assume personal responsibility for contributing to their own learning" (p. 6). Gaining knowledge, then, is not just something that one person can give to another. APA (1995) adds "unless new knowledge becomes integrated with the learner's prior knowledge and understanding, this new knowledge remains isolated, cannot be used most effectively in new tasks, and does not transfer readily to new situations" (p. 7). This section will briefly explore these principles.

Constructivism and Active Learning

More learning occurs when students are active rather than passive in their learning process (Bonwell & Eison, 1991; Chickering & Ehrmann, 1997; Chickering & Gamson, 1987; Cross, 1998; Dunlap & Grabinger, 1996; Egan & Gibb, 1997; Harasim et al., 1995;

Harmin, 1994; Johnson, Johnson, & Smith, 1991; Sharan & Sharan, 1992; Vella, 1995). White (1998) maintains "Educational research has shown that students tend to comprehend complex concepts much better and to retain them as part of their body of knowledge much longer when they become actively involved in their learning process" (p. 1). Active learning is important in online courses as well as in face-to-face ones. Harasim elaborates "The network encourages, even requires, active rather than passive learning. Active participation is required because in a text-based environment it is necessary to make a comment in order to be seen as present" (Harasim et al., 1995, p. 275).

Many professors in higher education exclusively use the lecture mode for instruction. Although it is widely accepted as the traditional instructional mode, many educators are beginning to adopt a constructivist view of learning where the learner must construct her own knowledge. Some educators are now viewing learning theories from a constructivist perspective (Black & McClintock, 1996; Bonk & Cunningham, 1998; Brooks & Brooks, 1993; Dede, 1996; Dunlap & Grabinger, 1996; Jonassen, Peck, & Wilson, 1999; Kearsley, 1994; Knowles, Holton, & Swanson, 1998; Kubota, 1991; Lee, 1999; Lefrere, 1997; Lin et al., 1996; Savery & Duffy, 1996; Spector, 1996; Wilson, 1996). The following concepts and strategies are foundational to active learning courses:

1. Build instruction on the learners' past experiences and current context (Kearsley, 1994; Knowles et al., 1998).

2. Create instruction in a spiral organization so that the learner can easily understand (Houle, 1961).

3. Design instruction to encourage synthesis by the learner so learning goes beyond the given instruction (Harasim et al., 1995).

4. "Incorporate the sociocultural aspects of learning activities" and "provide for multiple perspectives and tolerance of uncertainty" (Kubota, 1991).

5. Build interactions and collaboration into the learning environment (Harasim, 1997).

Sociocultural Development

An interesting relationship exists between constructivism and sociocultural development theory. Vygotsky states that cognitive development is dependent on social interaction, and that cultural development has two levels: social and intrapersonal (Vygotsky, 1986). These two areas are significant because first the learner begins to grasp new knowledge during social interactions and then internalizes it. In order for students to learn well they need to have a rich social plane for mental activity and growth (Bonk & Reynolds, 1997). Gillani and Relan (1997) and Dodge (1998) support Vygotskian techniques for incorporating the use of support tools such as advance organizers, modeling, exploring, and generating in a well-designed Web-based learning environment. Instructors can provide scaffolding—like adding training wheels on a child's bike as long as needed—to assist the learners to grasp new knowledge and develop skills in the zone of proximal development. This zone is the range between what the student knows at the beginning of instruction as the lower limit and the student's potential of what she can accomplish as the upper limit.

According to Bandura's social learning theory, learning is achieved through observing and modeling desired behaviors (Kearsley, 1994; Knowles et al., 1998). We

learn by watching first and then doing. The practice begins symbolically and then moves to overt actions. Modeling generates three kinds of effects: (1) a modeling effect —learner acquires new kinds of response patterns, (2) inhibitory or disinhibitory effect—learner increases or decreases the frequency and quality of responses, (3) eliciting effect—learner accepts from model (i.e., instructor) cues for responses that are neither new nor inhibited.

Sociocultural development—"shared social construction of knowledge"—is an area that is missing in most traditional correspondence courses and is often missing in Web-based courses as well (William, 1998; Moore & Kearsley, 1996). In fact, many face-to-face courses do not address these issues. Interactions between the learner and the content, between the learner and the instructor, and between the learners themselves are necessary for learning (APA, 1995; Moore & Kearsley, 1996) and for the "shared social construction of knowledge" (William, 1998).

Summary

Learning theories today support the concept that learning is an individualized process whereby the learner constructs an understanding of concepts based on experience and information. This does not happen in a passive fashion but rather through the active engagement of the learner with others.

Context of Learning

"Context of Learning" is the sixth APA Learning-Centered Principle promoting the concept that "learning does not occur in a vacuum" (APA, 1995, p. 7). Instructors "play a major interactive role with both the learner and the learning environment" so it is

important that instructors implement this powerful principle. APA (1995) further sets the scene for this powerful learning principle:

> Technologies and instructional practices must be appropriate for learners' level of prior knowledge, cognitive abilities, and their learning and thinking strategies. The classroom environment, particularly the degree to which it is nurturing or not, can also have significant impacts on student learning. (p. 8)

One of the many possible applications of this APA LCP "Context of Learning" is creating a nurturing learning environment where communication is full and effective. Sherry and Wilson (1997) detailed a particular type of communication that is a stimulus to learning on the Web and that is transformational in nature. Transformative communication puts the teacher in a new role as a fellow learner both with her students and with work that focuses on authentic problems and projects. There are three points regarding the new process of learning and communication: (1) The instructor is a facilitator rather than an "in-charge" teacher; (2) students discover that the teacher does not have all the answers and that there are no simple answers; (3) students can now access resources outside of the classroom that include subject-matter experts, knowledge databases, and activities (Sherry & Wilson, 1997).

Dunlap (1998) describes a generative learning environment as one that involves "learners in a particular set of instructional strategies and tactics to have the desired cognitive effects on learning" (p. 5). She further defines this unique environment as seen in Table 2. Many of the strategies that she uses integrate other APA LCPs to create an effective learning environment.

Yuen (1998) describes supporting learning environments with Web-based Performance Support Systems (WBPSS) that are developed for the lifelong learner to

Table 2

Dunlap's Generative Learning Environment Strategies

Strategy	Definition
Learner responsibility	Using self-directed learning activities, learners are encouraged to be responsible for their own learning.
Dynamic, active learning	Learning is essentially an act of active construction on the part of the student (Resnick, 1989). By requiring learners to take on the roles of the profession and engage in self-directed learning, learners experience the knowledge construction process.
Authentic learning	Because learning is embedded in realistic contexts, learners acquire content and skills through the resolution of problems. Because the problems learners work on refer to concrete situations or events in the real world, knowledge gain is situated and, therefore, more easily retrieved when needed (Brown et al., 1989).
Collaboration	Through collaborative group work and the accessing of a variety of resources, learners experience and develop an appreciation for multiple perspectives.
Reflection	One of the key educational outcomes of generative learning environments is knowing how we know: the ability to (1) analyze personal knowledge construction processes and (2) articulate why and how a learning task was completed or a problem was solved (Honebein, 1996). This self-awareness of the knowledge construction process is encouraged during reflection activities embedded in the problem-solving process.

meet their learning needs just when they need them with the lowest possible learning curve.

Dunlap (1998) takes the concept further by proposing learners can design their own WBPSS with the help of special software to do so. Finding ways to individualize the learning environment for students is important (McManus, 1998).

There are two basic types of communication in online instruction that can support interactions in the transformative process: asynchronous and synchronous. Synchronous communication and learning is what happens most of the time in traditional education; it is real-time and most often face-to-face. Asynchronous learning is not real-time and so allows communication to take place without regard to time or location. This is particularly helpful for adults who have complex schedules. Harasim (1997) reports that "learners find that the flexibility of the asynchronous and place-independent CMC [Computer-Mediated Communication] access offers a bridge between learning and its application, between theory and practice, between the 'school' and the workplace" (p. 111).

In summary, the instructor is largely responsible for the learning environment by way of the decisions that are made for support and the kinds of communication she encourages. All other learner-centered principles directly affect the context-environment of the learning experience.

Motivation and Its Effects

Many educators wish their students had intrinsic motivation but do not know how to develop this LCP in them. APA proposes that "curiosity, flexible and insightful thinking and creativity are major indicators of the learners' intrinsic motivation to learn,

which is in large part a function of meeting basic needs to be competent and to exercise personal control" (1995, p. 8). While it is good to know what intrinsic motivation looks like in students, it is even more important to know how to develop this in them. "Educators can encourage and support learners' natural curiosity and motivation to learn," APA contends "by attending to individual differences in learners' perceptions of optimal novelty and difficulty, relevance, and personal choice and control" (1995, p. 8).

Learning complex and difficult material, however, takes hard work, diligent effort, and perseverance. Instructors, whether face-to-face or online, can facilitate "motivation by strategies that enhance learner effort and commitment to learning and to achieving high standards of comprehension and understanding" (APA, 1995, p. 8). These strategies include encouraging and supporting "learners' natural curiosity and motivation to learn by attending to individual differences in learners' perceptions of optimal novelty and difficulty, relevance, and personal choice and control" (p. 8).

Intrinsic Motivation

Teachers often complain that their students are not motivated and hence cannot or do not learn well (Driscoll, 1998; McGrath, 1998; Young, 1997). The motivation that instructors wish their students had is intrinsic motivation or motivation coming from within the individual student. "Motivation is important because it contributes to achievement, but it is also important as an outcome," states Ames (1990). She adds "Effective teachers are those who develop goals, beliefs, and attitudes in students that will sustain a long-term involvement and that will contribute to quality involvement in learning" (p. 413).

Intrinsic motivation is "learning for its own sake" (Breen & Lindsay, 1999, p. 79), not needing any extrinsic rewards or incentives. Students function from different motivations and this affects them in how they think and learn. Young's (1997) study suggests that

> motivation and cognition are reciprocally related over time. . . . The implications for this work include the notion that student motivation can be enhanced through instruction in cognitive strategy use as well as through alteration of classroom goal structures so that there is a stronger emphasis on tasks and learning rather than on grades or external recognition.

Although most instructors ideally would like their students to be intrinsically motivated, there are times when they promote extrinsic motivations. This is not without some problems, however.

> A student who works for extrinsic rewards such as grades is likely to engage in very different thought processes and behaviors compared with the student who wants to learn something new about the subject matter or improve a skill. Students' reasons for learning have important consequences for how they approach and engage in learning. (Ames, 1990, p. 413)

Harju and Eppler (1997) found that when compared with traditional higher education students "nontraditional students had a higher learning goal orientation and thus a strong, highly involved intrinsic motivation" (p. 153). Cramton (1999) also found that older students were more intrinsically motivated. Young (1997) cautions, however, that when instructors need to use them, extrinsic rewards should be individual rather than applied equally for all students in the class. She concludes that extrinsic motivation strategies "may detract from positive motivational and cognitive outcomes" (p. 254).

There are many ways to promote motivation. Garrison (1997) expounds that "to direct and sustain motivation students must become active learners" (p. 8). Task motivation is integrally connected to task control and self-management. Martin (1987)

offers another way to increase or sustain motivation by having instructors pay attention to the aesthetic appeal of the instruction. Belland (1991) studied a freshman biology course at Ohio State University and found some interesting things. First, that students who spent more time "…with materials scored highest on the tests and received the highest grades" Belland (1991), and further that students rarely took a p. 25 second course in biology. When analyzed carefully, the lab audio tutorial program ignored the learners' needs, and even though they learned enough to get through the course, they were not sufficiently motivated to take a second course. Some suggested strategies to overcome this type of problem would be to vary the instruction with opportunities for leadership, instructional games, role models, and cooperative activities (Driscoll, 1994).

Driscoll (1998) notes that "curiosity, in children and adults alike, is a strong motivator of learning" (p. 295). Curiosity can be generated by providing new, novel, complex, or incongruous approaches to the topic. A unique application of curiosity as a motivational strategy is the use of fantasy. Through fantasy instructors can provide students with "a meaningful context for learning that is easy to augment with their imaginations" (Driscoll, 1998, p. 296). An additional method of stimulating curiosity and thus learning is to set up a problem situation that the student can solve only by digging into the content of the course. Burns and Gentry (1998) claim that curiosity "is completely intrinsic because implicit in the sense-making idea that underpins curiosity is the notion that the resultant learning has value to the learner" (p. 139). Curiosity is an important part of motivation as is novelty (Egan & Gibb, 1997). Dede (1996) expands this concept from curiosity to creativity: "One good way to enhance creativity is to make the familiar strange and the strange, familiar" (p. 24).

Driscoll (1998) declares “Motivation appears to be enhanced when learners’ expectancies are satisfied, when they attribute their successes to their own efforts and effective learning strategies, and when the social climate fosters interaction and cooperation among students” (p. 312).

John M. Keller (1987), one of the leading experts on motivational design in instruction, developed the ARCS model:

A—Attention

R—Relevance

C—Confidence

S—Satisfaction

Instructors can increase motivation by using this model to analyze their students’ level of motivation before instruction as well as to incorporate motivation into the instructional design. The ARCS Model (Driscoll, 1998, p. 319) is shown in Table 3. Applying the ARCS Model, along with other instructional strategies, will increase the learning in courses. Ames (1990) attests that motivation is not something to be reserved for students who are not doing well or for isolated events or activities. She contends that “motivation as an outcome is important to all students in the classroom all the time” (p. 417).

Motivation is particularly important in online courses. Harasim et al. (1995) insist that “the most important characteristic for student success in this medium is motivation” (p. 27).

Table 3

Instructional Strategies for Stimulating Motivation as Suggested by the ARCS Model

Component of Motivation	Corresponding Strategies
Gaining and sustaining attention	Capture students' attention by using novel or unexpected approaches to instruction
	Stimulate lasting curiosity with problems that invoke mystery
	Maintain students' attention by varying the instructional presentation
Enhancing relevance	Increase the perception of utility by stating (or having learners determine) how instruction relates to personal goals
	Provide opportunities for matching learners' motives and values with occasions for self-study, leadership, and cooperation
	Increase familiarity by building on learners' previous experiences
Building confidence	Create a positive expectation for success by making clear instructional goals and objectives
	Provide opportunities for students to successfully attain challenging goals
	Provide learners with a reasonable degree of control over their own learning
Generating satisfaction	Create natural consequences by providing learners with opportunities to use newly acquired skills
	In the absence of natural consequences, use positive consequences, such as verbal praise, real or symbolic awards
	Ensure equity by maintaining consistent standards and matching outcomes to expectations

Effects of Motivation on Effort

Ultimately, the challenge for educators is to structure the learning environment in ways that will motivate learners to put forth the effort needed to understand and apply complex subject matter.

When faced with challenging and difficult learning tasks, some students will not put in the necessary effort to learn, whereas others will work diligently until they have success. Motivation may make the difference. Dweck and Leggett (1988) found that students learned better when they set their own goals. Further, when these goals were learning oriented as opposed to performance oriented, and when these goals were challenging proximal goals (those that can be achieved in a relatively short time and are "close at hand"), students learned better.

"The more familiar something is, the more likely it is to be perceived as relevant to the learner," explains Driscoll (1998, p. 316). In addition, another strategy to motivate students to work hard on learning goals is to make sure the instructor provides detailed and explicit feedback to students (Driscoll, 1998).

Summary

Motivation to learn is the basis for active, engaged learning. Intrinsic motivation is often found in non-traditional students and can be encouraged by providing choice, self-management, relevance, and aesthetic appeal. Capitalizing on natural curiosity stimulates the learner to find and create new knowledge.

Developmental Influences of Learning

Many may assume that developmental influences of learning as defined by the American Psychological Learner-Centered Principles refer strictly to childhood and youth; however, adults also have developmental stages of life. Further, they have specific learning needs. Because this study is focused on higher education, I will feature only adult learning theories in this section.

Adult Learning Theory

Higher education instructors are often content experts who do not necessarily concentrate their efforts on either effective pedagogy or learner needs. Since higher education is comprised of persons considered adults, however, it is reasonable to expect effective instructors to address adult learning theories. Butler (1998) asserts that "adult learners' stages of development, whether personal (cognitive, moral, ego, conceptual), chronological (early adulthood, mid-life, etc.) or professional (new or experienced teacher, etc.), profoundly affect their learning." Several adult learning theories are presented here.

Knowles—Andragogy

Andragogy—the art and science of teaching adults (Knowles et al., 1998)—has become an important study for both higher education and training. Adult learning theory is andragogy's underpinning. Early on, educators realized that the acts of learning and earning a living are not separate compartments in adults' lives (Knowles et al., 1998). In fact, learning is inhibited when the two areas are treated as distinctly separate. Conversely, learning is enhanced when the two areas overlay each other. Knowles (1998)

developed an andragogical model of six assumptions that help educators better meet adults' learning needs. First is the need to know. Adults do not mind learning if they know the reason for it. Second is the learners' self-concept. Adults resist when they feel they are being forced or pressured. Knowles (1998) explain why they need to be self-directing:

> Once they have arrived at the self-concept they develop a deep psychological need to be seen by others and treated by others as being capable of self-direction. They resent and resist situations in which they feel others are imposing their wills on them. (p. 65)

Third is the role of the learners' experiences. The experiences of a group of adults will be much different than with a group of children. Because groups of adults are more heterogeneous than groups of youths, individualizing instruction is important. Fourth is the readiness to learn. Adults are ready to learn when they need to learn in order to help them cope more effectively in life. Sometimes there are things that can be done to help adults be better prepared to learn, such as simulation exercises and career counseling. Fifth is orientation to learning. Children's and youths' learning focus is subject-centered, whereas adults are life-centered. Adults learn best around tasks and problems that relate to their lives. Further, they learn best when the instruction is presented in the context of application to their life situations. Sixth is motivation. Adults are better motivated by intrinsic pressures (increased job satisfaction, quality of life, etc.) than with external rewards (promotions, higher salaries, etc.).

Houle's Learner Types

It is important to understand that adults learn for different reasons. This knowledge can help instructors set up appropriate learning environments. Houle's (1961)

research led him to identify three types of learners (see Table 4). When an instructor realizes that her adult students come with different reasons to learn, it will help her know how to facilitate and challenge each one appropriately. No doubt every class has some goal-oriented, activity-oriented, and learning-oriented learners each with his or her own learning agenda in mind. While this may seem impossible to deal with, using a variety of innovative instructional strategies will not only help the instructor survive such challenging situations but will also help the adult students be successful learners.

Grow's Stages in Learning Autonomy

Houle looked at learner types whereas Grow (1991) addressed the issue of learning autonomy which is so critical in distributed learning. Students who are not able to direct their own learning will not be as successful as those who do. Those who are used to being told exactly what to do, who are used to the teacher being the authority and director of all learning in the classroom, will struggle and possibly fail in online courses. Without direction and constant feedback, their interest and motivation may dwindle. Therefore, the more we can learn about adults' learning autonomy and how to assist them in learning how to learn and how to manage their coursework, the more likely will be positive outcomes. Most adults have a long history of learning at Stage 1, the dependent stage. (See Table 5 for Grow's Stages in Learning Autonomy.) Some have had the experience of Stage 2 (Interested) and perhaps fewer at Stage 3 (Involved). Even fewer people function at Stage 4 (Self-directed). Many times instructors assume that their adult students should function in Stage 4 without any assistance and are frustrated and disappointed when students struggle, fail, or perhaps simply give up. Innovative online instructors will find ways to help their students learn how to function at Stages 3 and 4.

Table 4

Houle's Learner Types

Learner Type	Description
Goal-oriented	Use education for accomplishing fairly clear-cut objectives
Activity-oriented	Take part because they find in the circumstances of the learning a meaning which has no necessary connection—and often no connection at all—with the content or the announced purpose of the activity
Learning-oriented	Seek knowledge for its own sake

Table 5

Grow's Stages in Learning Autonomy

Stage	Student	Teacher	Examples
Stage 1	Dependent	Authority, coach	Coaching with immediate feedback, drill. Informational lecture. Overcoming deficiencies and resistance.
Stage 2	Interested	Motivator, guide	Inspiring lecture plus guided discussion. Goal-setting and learning strategies.
Stage 3	Involved	Facilitator	Discussion facilitated by teacher who participates as equal. Seminar. Group projects.
Stage 4	Self-directed	Consultant, delegator	Internship, dissertation, individual work or self-directed study group.

Levinson's Adult Developmental Periods

Levinson (1986) had an approach to adult development that differs from either Houle's or Grow's. He observed that there were nine developmental periods in adult lives, as shown in Table 6. In describing his research Levinson remarks that his initial finding was surprising because it was

> not an a priori hypothesis. It was as surprising to me as to others that the life structure should show such regularity in its adult development, given the absence of similar regularity in ego development, moral development, career development, and other specific aspects of the life. (p. 7)

Are there certain times in life where it is too stressful or difficult for adults to handle new learning opportunities or periods in adult life that enhance an openness to learn and to take risks? I used Levinson's Adult Developmental Periods in my study to see if outstanding instructors were in certain periods of life. The findings are surprising.

Summary

This section, while not exhaustive, explored a variety of learning theories. Often adults are portrayed in developmental periods, stages or types. This brings understanding about the needs and expectations of the learner as they journey towards autonomy. However, regardless of stage, adults will function with intrinsic motivation in environments where the learning is authentic, reasonable, and connected to the prior knowledge.

Social Influences on Learning

Traditional instruction tends to be didactic. The instructor gives content information to the students, and students are then supposed to learn the content. However,

Table 6

Levinson's Adult Developmental Period

Developmental Period	Ages	Description
1. Early Adult Transition	17-22	The time for building and maintaining an initial mode of adult living
2. Entry Life Structure for Early Adulthood	22-28	The time for building and maintaining an initial mode of adult living
3. Age 30 Transition	28-30	An opportunity to reappraise and modify the entry structure and to create the basis for the next life structure
4. Culminating Life Structure for Early Adulthood	33-40	The vehicle for completing this era and realizing our youthful aspirations
5. Midlife Transition	40-45	Another of the great cross-era shifts, terminating early adulthood and initiating middle adulthood
6. Entry Life Structure for Middle Adulthood	45-50	Provides an initial basis for life in a new era
7. Age 50 Transition	50-55	Offers a mid-era opportunity for modifying and perhaps improving the entry life structure
8. Culminating Life Structure for Middle Adulthood	55-60	The framework in which we conclude this era
9. Late Adult Transition	60-65	A boundary period between middle and late adulthood, separating and linking the two eras

students and instructors are social creatures and learn best in more social situations (APA, 1995) where they can work together, sharing what they know. Sherry and Wilson (1997) define transformative communication:

> In the transformative view, the communication between teacher and taught is generative: Instructors learn along with their students. As a result, instructors and students alike are transformed as learners by the process of communication. Through such collaborative discourse within the learning community, a two-way dynamic system comes into being. The active learning that occurs then begins to push the frontiers of knowledge. (p. 67)

But how does this relate to distance education? Dede (1996) proposes "Distance educators need the virtual communities that information infrastructures make possible" (p. 21). He then explains why virtual communities are necessary: "Learning is social as well as intellectual. Individual, isolated attempts to make sense of complex data can easily fail unless the learner is encouraged by some larger group that in constructing shared knowledge" (p. 21). Communication and collaboration are key factors in the learning process (APA, 1995). Although this can occur in face-to-face courses, Web-based courses enhance transformative communication possibilities. Using technology, however, does not automatically mean that there will be better learning. Sherry and Wilson (1997) emphasize that "if the technology is implemented without a concurrent change in pedagogy, the use of the Web will not guarantee learning any more than a campus library guarantees learning" (p. 68).

Communities and Environments

Recently the learning environment has increasingly become a part of the higher education landscape. Developing a community requires collaboration, and collaboration requires effective communication. The adult-learning, transactional process "is a

democratic and collaborative endeavor whereby facilitators and learners are engaged in a mutual act of challenge, critical reflection, sharing, support, and risk taking. The essence of the transactional experience is collaboration" (Galbraith, 1991, p. 2). In fact, collaboration is the key to this kind of learning that is based on adult learning theory. Galbraith also notes that "a collaborative and critically reflective learning experience must be a combination of contemplation and action" (p. 4).

One of the difficulties that educators and students see with Web-based learning is the perceived isolation of the learners. Some view this type of learning as solo experiences of self-paced learning. While there is a place for this kind of instruction, online courses do not have to be done alone. There are ways for the instructor to facilitate online-course learning communities. In fact, some believe that online courses are even better forums to develop learning communities than face-to-face classes (Dwyer, Barbieri, & Doerr, 1995; Knox, 1997). But is a Web-based class a true community? Does it matter if it is not a true community?

According to Peck (1988), a true community has certain distinguishing characteristics. The one that best relates to online learning is the feeling of safety. Billson (1994) explains that "when people feel psychologically safe in a group, their participation levels will increase" (p. 25). Vella (1995) expands these concepts:

> People need both challenge and safety. When the learning environment does not appear safe to adult learners, they will disappear, or resist the program dramatically to protect themselves. The effort to provide a safe environment involves respect, calling adults by name, asking for their expectations of a learning program, asking for regular feedback on the process, affirming their contributions. (p. 188)

This safe environment is not sterile, however, and does not squelch vigorous dialog. On the contrary, the online environment fosters active dialog when all members

feel safe to share their divergent views. Bonwell and Eison (1991) state that "instructors must create an intellectual and emotional climate that encourages students' taking risks" (p. 22). Community members agree that it is okay to disagree. In fact, a true community is a safe place to "fight gracefully" (Peck, 1988). Members accept one another and a variety of points of view. A true community has the ability to contemplate and reflect. When things start to get rough, they are able to be introspective and reflective. According to Jensen (1998), such a safe learning environment is necessary in order for students to learn.

Once a safe sense of community is established, a learning environment still needs to be created. Wilson (1995) believes that instructors' concepts of knowledge will affect their thoughts on instruction and consequently how they would perceive online learning environments should be, as shown in Table 7. He further proposes a definition for a constructivist learning environment: "a place where learners may work together and support each other as they use a variety of tools and information resources in their pursuit of learning goals and problem-solving activities."

Billington (1988, 1998) conducted a 4-year study to find out more about ideal learning environments for adults both in higher education and in the work place. She connected growth with learning because "significant learning and personal growth are inseparable; growth is learning"(1998).

The study found that adult students grew in midlife but only in one environment—the one with the seven characteristics (see Table 8). Her findings support adult learning theories and the APA LCPs being featured in this study.

Table 7

How Different Assumptions About Knowledge Can Influence Our Views of Instruction.

If you think of knowledge as…	Then you may tend to think of instruction as…
—a quantity or packet of content waiting to be transmitted	—a product to be delivered by a vehicle.
—a cognitive state as reflected in a person's schemas and procedural skills	—a set of instructional strategies aimed at changing an individual's schemas.
—a person's meaning constructed by interaction with one's environment	—a learner drawing on tools and resources within a rich environment.
—enculturation or adoption of a group's ways of seeing and acting	—participation in a community's everyday activities.

Interactions

Wagner (1997) states that interactions are key to effective online courses. She adds that it is the act of interactivity that is cited as the big loss when moving from a face-to-face classroom to a Web-based course. There are two purposes for interactions: "They must change learners, and they must move learners toward an action state of goal attainment" (Wagner, 1997, p. 21). Wagner (1997) advanced several types of interactions that affect learning (see Table 9). Moore and Kearsely (1996), on the other hand, propose three basic types of interactions that will be referred to throughout this study: learner to content, learner to learner, and learner to instructor.

Theory translates best into learning when the learner is actively involved with content, the instructor, and other students. Socio-cognitive theory supports the

importance of interactions (Mo-Yee & Greene, 1999), and interactions are a strong component of effective online instruction (Dynes, Cooper, Trudel, & Guglietti, 1998; Harasim, 1993, 1997; Harasim et al., 1995; Hiltz & Turoff, 1993; Katz, 1999; Knox, 1997; Meyen et al., 1997a; Moore & Kearsley, 1996; Parker & Rossner-Merrill, 1998; Repman & Logan, 1996; Sherry, 1996).

The bases of communication are interactions between two or more people; and these interactions are a psychological principle of learning (APA, 1995). This is a principle not usually found in correspondence courses or in some Web-based courses. By applying this learning principle to online courses, students are more likely to be engaged than with correspondence-style courses that do not require interactions with peers. Harasim (1993) reveals an important advantage of online interactions is "that conferencing ensures that dominance by a few does not exclude the ability of others to have their say" (p. 124).

Bruner encouraged student-to-student interaction rather than emphasizing the traditional student-teacher interaction because the "inquiry teacher is interested in students developing their own criteria or standards for judging the quality, precision, and relevance of ideas" (Knowles et al., 1998, p. 99). It is through the process of reflection and evaluation that students learn, thus making student-to-student interactions a necessary component of any learning environment, including Web-based courses.

Effective interaction does not just happen, it takes "careful planning, thoughtful implementation, and a supportive classroom environment, and requires an instructor's knowledge of techniques of questioning and strategies and styles for involving discussion" (Bonwell & Eison, 1991, p. 21).

Table 8

Seven Characteristics of Highly Effective Adult Learning Programs

Characteristic	Definition
Safety and respect	An environment where students feel safe and supported, where individual needs and uniqueness are honored, where abilities and life achievements are acknowledged and respected.
Freedom and experimentation	An environment that fosters intellectual freedom and encourages experimentation and creativity.
Faculty accept and respect students	An environment where faculty treat adult students as peers—accepted and respected as intelligent experienced adults whose opinions are listened to, honored, appreciated. Such faculty members often comment that they learn as much from their students as the students learn from them.
Self-directed learning	Self-directed learning, where students take responsibility for their own learning. They work with faculty to design individual learning programs which address what each person needs and wants to learn in order to function optimally in their profession.
Pacing or intellectual challenge	Optimal pacing is challenging people just beyond their present level of ability. If challenged too far beyond, people give up. If challenged too little, they become bored and learn little. Those adults who reported experiencing high levels of intellectual stimulation—to the point of feeling discomfort—grew more.
Active involvement	Active involvement in learning, as opposed to passively listening to lectures. Where students and instructors interact and dialogue, where students try out new ideas in the workplace, where exercises and experiences are used to bolster facts and theory, adults grow more.
Regular feedback	Regular feedback mechanisms for students to tell faculty what works best for them and what they want and need to learn—and faculty who hear and make changes based on student inputs.

Note: Adapted from "The Adult Learner in Higher Education and the Workplace: Seven Characteristics of Highly Effective Adult Learning Programs," in *New Horizon's for Learning* (pp. 1, 2), by D. D. Billington, 1998, on-line. Available: http://www.newhorizons.org/article-billington1.html

Interactions are needed for many reasons. Johnson and his colleagues (1991) have developed a list of learning benefits that occur when learning peers interact. Johnson et al.'s list includes the following selections:

> 1. In their interaction with peers, individuals directly learn attitudes, values, skills.
> 2. Interaction with peers provides support, opportunities, and models for prosocial behavior.
> 3. Peers provide models of, expectations of, directions for; and reinforcements of learning to control impulses.
> 4. Students learn to view situations and problems from perspectives other than their own through their interaction with peers.
> 5. Relationships with peers are powerful influences on the development of the values and the social sensitivity required for autonomy.
> 6. Students need close and intimate relationships with peers with whom they can share their thoughts and feelings, aspirations and hopes, dreams and fantasies, and joys and pains.
> 7. It is through peer relationships that a frame of reference for perceiving oneself is developed.
> 8. In both educational and work settings, peers have a strong influence on productivity.
> 9. Student educational aspirations may be more influenced by peers than by any other social influence. (pp. 2:21-2:23)

Constructed knowledge is the basis of social constructivism (Harapnuik, 1998), and it takes interactions between learners and instructors and among the learners themselves to co-construct knowledge. Cooperative learning enables students to "work together to maximize their own and each other's learning" (Johnson, Johnson, & Holubec, 1994, p. 4).

Many professors are now implementing cooperative learning and are finding good results (Betz, 1996-1997; Johnson et al., 1991).

When educators talk about distance education and WBI, they are usually referring to physical distance; however, Wolcott (1996) notes that psychological distance is also present in addition to physical distance. She states that "psychological distance

Table 9

Types of Interactions

Interaction	Description
1. Interaction to increase participation	It is active, volitional, and internally mediated, representing a process of discovering and constructing meaning from information and experience.
2. Interaction to increase engagement	This type of interaction provides learners with a means of engagement.
3. Interaction to develop communication	It includes clearly articulating expectations, providing opportunities for personal expression, offering the ability to exchange information without fear of being judged or punished, persuading individuals to subscribe to a particular point of view or to recognize the value of making a change.
4. Interaction to receive feedback	Learners need to obtain information from a variety of sources (from instructions, from other learners, from their own observations, from information resources) to judge the quality of their own performance.
5. Interaction to enhance elaboration and retention	The extra cognitive "practice" that results from generating alternative interpretations makes it easier for learners to integrate new information into their existing cognitive framework for enhanced long-term retention and recall.
6. Interaction to support learner control/self-regulation	This interaction is particularly important within the context of preparing individuals to be lifelong learners, since it deals with the ability of a learner to stay on task, to mediate the need for additional information to complete one's understanding, and to recognize when the learning task has been completed.

Note.
Number 2 had a typographical error in the original publication: number 1 and 2 interaction names were listed the same but each had different definitions. Number 2 is corrected in this table as per directions of the author, Ellen Wagner, personal communication, July 15, 1999.

also refers to mental dimension of separateness or dissimilarity between people" (p. 23). When physical and psychological distance are combined, the results are magnified for both kinds of distance. Rapport, however, is the bridge that helps break down the distance problems, and "building a rapport means that we are creating a relationship between persons that is characterized by harmonious, mutually-accepting interaction" (Wolcott, 1996, p. 24). There are three ways that Wolcott notes we can improve how we relate to our students and how we can develop rapport with them: (1) achieve a certain level of comfort in engaging in a learning discourse; (2) exhibit mutual respect; and (3) identify with the goals and expectations for the learning experience.

Building group experiences where interactions flourish does not often occur accidentally. Based on observations of 25 'superb' professors in the classroom, Bonwell and Eison (1991) have developed a list of behaviors that:

> Promote interpersonal rapport by projecting warmth, openness, predictability, and a focus on student-centered teaching. The list includes:
> • Being strongly interested in students as individuals who are highly sensitive to 'subtle messages from them about the way they feel about the material or its presentation';
> • Acknowledging "students' feelings about . . .class assignments or policy and encouraging them to express [those] feelings";
> • Communicating 'both openly and subtly that each student's understanding of the material is important to him or her';
> • Encouraging 'students to be creative and independent in dealing with the material [and] to formulate their own views' (Lowman, 1984, p. 17). (p. 22)

Rapport "is crucial for developing a sense of community among learners" (Wolcott, 1996, p. 24), and this is done through interactions. If rapport is not present, it contributes to our isolation and sense of alienation or even disenfranchisement. So how can we minimize psychological distance in online courses? Adopt a learner-centered approach where interactivity can actually be used to develop an online course that may be

as good or better than the regular classroom (Harasim et al., 1995; Kearsley, Lynch, & Wizer, 1995; Simonson, 1997). Some interesting new media can support new online instructional experiences (Dede, 1997): (1) Multimedia and hypermedia, (2) Computer-supported collaborative learning, and (3) Interactive knowledge webs.

In addition, attitudes play a part in psychological distance. Wolcott explains "An attitude persists among many that distance education is second-best—that there is no equal for face-to-face classroom learning" (Wolcott, 1996, p. 25). If instructors believe this, students are more likely to feel they are in a second-rate learning environment and rapport will be blocked. Instructors must question themselves to determine if their attitudes, actions, policies, or interactions might be contributing to building psychological distance between them and their students and thus might be preventing learning.

Wolcott developed a system of instructional practices that will increase rapport in distance courses. Called Strategies for Learner-Centered Distance Teaching, the strategies include building rapport, decreasing isolation, and enhancing interaction. Each of these is in a matrix for pre-active, interactive, and post-active stages. Although the strategies were originally developed for one-way video, two-way audio distance learning, they work effectively for WBI as well.

The bottom line, however, is people interacting with people. Johnson et al. argue (1991) "Learning is a social process that occurs through interpersonal interaction within a cooperative context" (p. 1:11), They elaborate the concept further:

> Long-term, persistent efforts to achieve come from the heart, not the head, and the heart is reached through relationships with peers and faculty. Love of learning and love of each other are what inspire students to commit more and more of their energy to their studies. The more difficult and complex the learning, the more important are caring relationships to provide the needed social support. (p. 1:11)

When students work together, they are better able to think divergently and creatively, and to develop conceptual frameworks (Johnson et al., 1991). Harold K. Sperlich, President, Chrysler Corporation, explained how this connects in the business world: “Everyone has to work together; if we can’t get everybody working toward common goals, nothing is going to happen” (Johnson et al., 1991, p. 1:23). Yet these kinds of productive interactions will not automatically happen on their own. “A learning community does not evolve naturally over the course of a semester; instructors and students must be actively involved in community building” warn Repman and Logan (1996, p. 37). Instructors must actively create online learning communities where meaningful collaboration occurs. Trinkle (1999) claims that “distance education, in short, can be more stimulating, and encourage more critical reasoning, than the traditional large lecture class, because it allows the kind of interaction that takes place most fully in small-group settings” (p. A60).

In summary, the topic of social influence on learning presents a huge challenge to online instruction. This is partially a result of the reticence of higher educators generally to embrace more interactive teaching methods even in face-to-face situations. As Harasim et al. (1995) note “Collaborative learning changes the whole nature of the teaching-learning process and the teacher-student relationship” (p. 31).

Standards and Assessment

The American Psychological Association’s Learner-Centered Principles include “setting appropriately high and challenging standards and assessing the learner as well as the learning progress—including diagnostic, process, and outcome assessment—[which] are integral parts of the learning process” (1995, p. 10). Students need to know how they

are doing during a course. Having this knowledge can help students know how to study. Further, instructors need to assess students at the end of the course to learn how well the students met overall course objectives.

As more instructors are using active learning and constructivist instructional strategies, new ways of assessment also need to be used. Lin et al. (1996) explain that "by designing activities that make students' thinking visible to others, and by creating performance goals that are clear and motivating, students need to have frequent opportunities to 'debug' their thoughts, assumptions, and arguments" (p. 215). When evaluation is used for feedback to enable mastery learning, feedback needs to be fairly detailed. Rather than read their score and a few sparse comments from the instructor and then throw it away, students will carefully study the instructor's detailed comments, so they can revise their assignment and learn from their mistakes. One student in Archer and Scevak's study (1998) expressed frustration on the typical method of taking a test when receiving only the score back with no feedback at all:

> I hate it when you do an exam, and you hand it in, you get a mark back, and they don't even give you your exam. They say it was fair enough, but it's confidential. But you don't know which questions you got right and which questions you got wrong, so you can't improve upon them. You just keep making the same mistakes over and over again. This way, when you get the feedback, at least you know what you're doing wrong. So you can pick up your act a little bit. (p. 215)

A common concern for higher education is that online courses and learning experiences will not be as academically rigorous as their face-to-face counterparts (Bork & Britton, 1998; Noble, 1998a, 1998b). Hudspeth (1997) explains,

> Because Web-based instruction typically provides a great deal of participant and system interaction, expectations and priorities concerning learning methods and course outcomes are different from those in a traditional course, in which the printed text book and library resources represent a stable base of knowledge. New sources of knowledge may shift the objectives of a course. (p. 353)

Trinkle (1999) further warns that "the on-line course can be as abused as the traditional survey class" (p. A60). There are ways, however, to ensure the quality of online learning. "One way to communicate high expectations, the sixth principle, is through the use of a rubric (a.k.a., primary trait assessment). A rubric is an explicit statement of the criteria and standards to be used to evaluate student performance," state Chizmar, Walbert, and Hurd (Chizmar, Walbert, & Hurd, 1999) in regard to Chickering and Gamson's (1997; Chickering & Gamson, 1987) seven principles for good teaching practice. Some instructors provide practice tests with "the correct answer set" (Hudspeth, 1997, p. 354) and also provide a feedback form for students to let them know what they think about the test. Other innovations in assessment are documented later in this study.

In summary, the ways in which high standards are set and assessment of progress is facilitated will determine the kinds of learning that take place. Once again, educators in universities and colleges will be challenged to find useful forms of assessment for online courses.

Summary

When designing instruction for face-to-face classes or for online courses, educators who implement instructional strategies congruent with currently accepted learning theories will ensure successful experiences. This chapter explored a theoretical framework that can be used for Web-based instruction. The framework was based on the APA LCPs that can be applied to face-to-face instruction and to online courses.

CHAPTER THREE

METHODOLOGY

Introduction

The methods used for any inquiry must be determined by the research questions. This study seeks to answer two broad questions: How do faculty craft and deliver online courses to create effective learning environments, and what are the implications of new delivery models for higher education? Patton (1990) advocates "a paradigm of choices" in order to find the most appropriate methodological approach for the best quality research.

This study was an exploratory inquiry to find answers rather than to prove expectations, so an inductive data analysis that is typically used in qualitative research (Fraenkel & Wallen, 1993; Hoepfl, 1997) was most appropriate. Eisner (1991) notes:

> For statistical procedures to be used, data have to be created. The form data take to be statistically treated is numerical. When this transformation occurs the uniqueness of particular features is lost. What emerges is a description of relationships, almost disconnected from the particulars from which the data were originally secured. (p. 38)

If numbers were primarily used to interpret the exemplary practices in the courses being studied, I fear some unexpected discoveries would be lost that could be found only through the qualitative process. This is another reason why the research problem and question being studied in this investigation have determined the type of methodology to be used.

Case Study Methods

Examining particulars is a distinct feature of qualitative research according to Eisner (1991), and he contends that "particulars exemplify more than they describe directly. In the particular is located a general theme" (p. 39). Case studies investigate particulars in order to find themes. Merriam (1988) states that "a case study is an examination of a specific phenomenon such as a program, an event, a person, a process, an institution, or a social group" (p. 9). Miles and Huberman (1994) further define "a *case* as a phenomenon of some sort occurring in a bounded context" (p. 25). Therefore, I chose to study a special information-rich event—a bounded system—a case study of exemplary WBI courses.

Merriam (1988) explains:

> Investigators use a case study design in order to gain an in-depth understanding of the situation and its meaning for those involved. The interest is in the process rather than outcomes, in context rather than a specific variable, in discovery rather than a confirmation. (p. xii)

In some cases a case is more than one. Miles and Huberman report that, as "Yin (1984) points out, cases may have subcases 'embedded' within them" (p. 26). This study is a bounded case study. It is bounded to the Paul Allen Virtual Education Foundation Outstanding Online Course Award winner and participating honorable mentions. Within this case of one competition event there were six subcases of individual courses. Therefore, each course is a subcase in itself, but all the subcase studies were analyzed together as a bounded case. A complete description and background of the competition and why it was selected are presented later in this chapter.

Self as Instrument

Qualitative methods use the "self as an instrument" (Eisner, 1991, p. 33). Ultimately, there are always biases present no matter which research method is used (Eisner, 1991). In fact, "the questions we ask, the categories we employ, the theories we use to guide our inquiry; indeed, what we come to know about the world is influenced by the tools we have available" (p. 28). I will endeavor to let the course instructors speak for themselves in the case-study chapters (Strauss & Corbin, 1990). However, it is important to understand my background with distance learning and my personal goals in this study.

My first experience with distance learning was when I took a correspondence course I needed for a teaching certificate. Once finished, I determined I would never take another correspondence course again. I did not enjoy the isolation of learning alone. My points of view were limited, the responses of the instructor arrived long after I had moved on to other topics and had lost interest, and there was no cooperation, collaboration, or divergent thinking. The traditional correspondence course was a self-study course and as such was tolerable. Yet the experiences I valued in face-to-face courses were missing. Never again, I determined.

Several years later I took a distance learning course that included one-way video and two-way audio. The instructor was at San Jose State University with one group of students, and there were four distance sites at regional community colleges. Even though I was at a distance, I was part of a lively experience that included cooperative learning, collaboration, and divergent thinking. I interacted with students at my site in carefully crafted learning experiences. There was a definite learning community that stimulated my

thinking. The experience was much more satisfying than the isolating paper-and-pencil correspondence course had been.

Soon after completing the distance education course, a different need arose. This time I needed to find ways to help teachers learn new skills in educational technology. It was clear that regular self-study correspondence courses would not be suitable for learning how to use and integrate technology into the curriculum. Regular distance learning with one-way video and two-way audio, while effective and often desirable, was not possible since the goal of my organization was to reach isolated teachers across the country and often located in small rural schools. Often these teachers did not have access to local colleges and universities. This challenge was intriguing. If we could reach these small, rural, school teachers then we could reach other teachers as well. I saw fascinating possibilities for educators everywhere.

As we studied the various delivery options for distance workshops, inservices, and courses for teachers in remote locations, it did not take long to realize that equipment and online access were key considerations. Because the Internet is now more readily available even in remote areas than it used to be, the Internet became the delivery mode of choice. With instructional Web pages and email, we determined a decent course could be delivered.

Developing average courses, however, was not our goal. We wanted the teachers we served to be motivated to learn and to have enjoyable and satisfying online experiences. We wanted them to be engaged and energized in unique learning environments. Another constraint we put on ourselves was making sure the instruction was user-friendly and did not use so much new technology that novice users could not get

past the technical hurdles. But we did not know how to do all these things. So we analyzed the components of good face-to-face courses and tried to find ways to implement these on the Internet through a combination of Web pages and a class listserv—both were common and easily usable technologies.

Of course, we also explored the Web for online courses and programs. While we found many, most did not create the kind of active learning environments that we believed were not only possible but necessary for the best learning experiences. It was apparent that we were not the only ones stumbling along searching for a better way of effective online instruction.

What were others doing? How were they translating effective learning and instructional principles to produce active learning into Web-based classes?

Purposive Sample

As I began this study I needed to determine how to identify exemplary Web-based courses for my sample. First, I had to identify the probable characteristics, and second, I had to find some way of determining my sample by applying these criteria to courses. There are thousands of courses on the Web, so it was not possible to analyze them all for the necessary desirable characteristics. A randomly selected sample of the courses would show only the variety of courses that are currently available online, but they would not necessarily be exemplary courses. Patton (1990) notes that purposeful sampling allows for information-rich cases to be studied in depth.

While searching for exemplary courses I discovered the 1998 Paul Allen Virtual Education Foundation's Outstanding Online Course Award competition (http://www.paulallen.com/foundations/_private/virtual_awards.asp). One hundred

eighty-two courses were submitted "from 148 institutions in the USA and abroad" (Paul Allen Virtual Education Foundation, 1998). Four criteria were used in judging these courses, and they closely matched the criteria I was developing to identify effective courses. The Virtual Education Foundation's goal was to find the "best course based on four principal criteria: (1) creative use of technology; (2) sound instructional design; (3) integration of active learning; and (4) evidence of educational effectiveness" (Kearsley, 1998).

As I explored the literature (see chapter 2), some of these same themes emerged: however, I was unable to verify the description of each of the criterion. In addition, there were four objective experts who reviewed and judged the entries: Drs. Jon Dorbolo, Greg Kearsley, Christopher Dede, and Roberto Bamberger (Paul Allen Virtual Education Foundation, 1998). One course was selected as the winner, plus there were six Honorable Mentions. Since experts created my sample by having already evaluated and selected the most outstanding WBI course and six Honorable Mentions, I was able to: (1) examine exemplary courses for effective instructional strategies, and (2) survey the instructors to determine their perceptions concerning their learning and instructional experiences. This plan set my course of research.

Data Collection

Qualitative research "tends to be *field focused*" (Eisner, 1991, p. 32). My study is field focused even though I did not physically walk into any classroom to observe a class in session. Technology, however, enabled me to visit and explore virtually anywhere in the world.

I emailed all of the seven courses' lead instructors, explaining my study and requesting their participation on October 8, 1998. Five instructors quickly emailed back that they would participate if the questionnaire was not so long as they were very busy. The sixth professor agreed to participate in late May 1999. The seventh professor never responded even though I invited him a number of times.

Dr. Ed Meyen, Curriculum Development course designer/instructor from University of Kansas, Lawrence, invited me to attend a conference he was sponsoring where four of the seven courses would be featured. Attending the "Creating Effective Online Instruction" Conference May 26-27, 1999, allowed me to meet whole teams and to talk to the instructors personally. Each course team or solo designer/instructor gave a presentation on the course. Then later each course was featured in a hands-on lab while the instructor guided conference participants through their course and answered questions. This was a wonderful and unexpected opportunity that I had not known would be possible at the beginning of the study.

Data were also collected by downloading substantive parts of the courses and by collecting articles published by the instructors on their courses as well as other articles concerning online instruction. Miles and Huberman (1994) state that a major feature of qualitative data is "that they focus on *naturally occurring, ordinary events in natural settings*, so that we have a strong handle on what 'real life' is like" (p. 10). I endeavored to discover the natural settings and real life of these courses. Miles and Huberman explain further,

> The emphasis is on a specific case, a focused and bounded phenomenon embedded in its context. The influences of the local context are not stripped away, but are taken into account. The possibility for understanding latent, underlying, or nonobvious issues is strong. (p. 10)

My goal was to immerse myself in each course, capture what it might be like to be an enrolled student, and then describe the particulars of each course so that readers can imagine the learning experience.

Questionnaire

In order to learn more about the learning environment and interactions, instructional strategies, and techniques that were used in the best online courses, several things needed to be done. First, I posted a Web-based questionnaire for the instructors of the courses. I wanted to find out from the instructors how and why they put their courses together the way they did, and how they perceived the effectiveness of what they did. Equally important, what would they do differently and why?

In particular, I examined the potential for interactions within the courses, because I believe that it is in the social interactions where knowledge is constructed (Black & McClintock, 1996; Bonk & Cunningham, 1998; Brooks & Brooks, 1993; Denning, 1999; Dunlap & Grabinger, 1996; Herring, 1997; Hsu, Boysen, Yarger, & Chen, 1998; Jonassen et al., 1999; Kubota, 1991; Lin et al., 1996; Mo-Yee & Greene, 1999; Savery & Duffy, 1996; Spector, 1996). Since I did not have access to all communications involved in all the courses, I relied only on that which was available and the perceptions of the participants themselves.

Because I did not have direct server access that would allow me to automatically block access to the questionnaire to all those without approved usernames and passwords, I had to devise an alternative method to ensure the validity of the data. The questionnaire used CGI scripts to send the responses back to me, but in doing so they eliminated the user's email address which meant that I could not validate the user by email address.

Therefore, when I sent out the announcement of the Web site, I included a unique username and password for each faculty. Even though I could not block unauthorized access, at least I was able to have each entry come in with two unique identifiers and thus could sift out any drop-in users. By this method I was able to validate the contents of each response. In the end, however, only authorized participants actually filled in the questionnaire; there were no drop-in users.

Instructor Interviews

After analyzing the surveys from the instructors, I interviewed four of six of the instructors. All the them, however, were understandably reluctant about having to spend any more time than was absolutely necessary due to their busy schedules and heavy responsibilities. Although they initially agreed to a telephone interview sometime after the surveys and course analyses, many preferred for me to draw from their papers and Web site the information that I needed. Indeed, I was able to find answers to my questions this way and probably found more thorough responses than quick answers to hurried interviews. When I was able to interview a professor, however, I used "An interview guide or 'schedule'," which Hoepfl describes as "a list of questions or general topics that the interviewer wants to explore during each interview" (Hoepfl, 1997, p. 6). She adds "The interviewer is free to probe and explore within these predetermined inquiry areas" (p.6). Fortunately, design flexibility is a key of qualitative research to accommodate developing circumstances and discoveries (Patton, 1990).

The Data Files

For each of the six courses I compiled a data notebook where I kept my field notes, interview notes, questionnaire data, course documents, related articles by the instructors, and email correspondences. I organized the data notebooks into five or more parts:

1. Questionnaire data
2. Presentation materials on the course—this mainly applies to the four courses that were featured at the "Creating Effective Online Courses" Conference at the University of Kansas, Lawrence
3. Documents, home pages, and other background information on the instructor(s)
4. Course documents
5. Transcript of the CEOI Conference presentation (when applicable) and field notes
6. Other documents related to the course as posted on the Web.

Because each course was unique and the types of documents were often also unique, each data notebook is organized similarly yet differently. I numbered the pages so I could cite them in each notebook wherever appropriate (Vol. _, p. _). In addition to the main sections listed above, I made a detailed index of all the key pages for each notebook so as I studied and wrote I could easily and quickly access just about any page I needed.

Finally, I also made a seventh data notebook for the main documents of the cross-case analysis. I compiled all the instructors' questionnaire data by question for easy evaluation. The notebook has several sections:

1. Coded Web-based questionnaire
2. Compiled data by question from each of the faculty
3. Transcripts of the CEOI Conference presentations
4. Original questionnaire contents submitted by each of the faculty.

The seventh data notebook was not the exclusive source of data studied for the cross-case analysis, however, but having the key documents in one notebook facilitated the analysis process.

One of the remarkable surprises of the study was being able to attend the "Creating Effective Online Courses Conference" (CEOI) at the University of Kansas, Lawrence, where four of my six case studies were featured. Dr. Ed Meyen, coordinator of the conference and one of the professors in my study, invited me to the conference. There I met both formally and informally the professors and/or teams.

Each course was featured in a major presentation where the team or individual professor explained the course, what the goals and problems were, how problems were solved, and what was learned in addition to many other topics. Afterwards each course had a hands-on lab session where the team or sole instructor walked the conference participants through their course. Each participant was at an Internet-connected computer. The instructors also answered questions and explained things more in depth than they had previously done in the earlier presentation.

This rich opportunity gave me a more in-depth picture of the four courses and the instructors than I could ever have gotten from the questionnaires or telephone conversations alone. I was able to purchase a set of videotapes of all the formal presentations at the CEOI Conference and had them transcribed. This extended far beyond my original study design.

I also had the opportunity of experiencing BioMOO first hand; this is the MOO used in the international BioComputing course based in Germany while the MOO itself is based in Jerusalem, Israel. I had a casual interview with Georg Fuellen in BioMOO, but because I was fairly new to MOO etiquette and commands, I was a little clumsy. Having a personal experience in BioMOO helped me to better understand the BioComputing course, faculty, and students' experiences. Therefore, it was an exciting experience for me to chat live with Fuellen in the "halls" where his innovative course had been housed. Because MOO conversations can be recorded, I have a transcript of our conversation.

There was another unexpected surprise with BioMOO. It had been used for the planning sessions of the international group of scientists who collaborated to develop the BioComputing course, and all the meetings were either recorded and the full transcript posted on the Web or the minutes were posted. Further, the study group sessions were also conducted in BioMOO and were recorded and posted at the BioComputing Web site. I read these transcripts and felt that I was right there in the group as a silent observer. The planning session meetings illuminated my understanding of online collaboration methods and techniques while the study groups' transcripts gave me insights into online group dynamics.

Data Analysis

I analyzed the courses according to principles of active learning theory, adult learning theories, and instructional strategies. As I looked for themes, connections to the theoretical framework established in chapter 2 gradually emerged. The theoretical framework is a sound basis for learning regardless of the time or location. However, as I share the cross-case-analysis data I interweave current literature, which provides a connection to the existing body of knowledge in this field.

A wide range of characteristics typify enriched learning environments, though not all characteristics need to be present to ensure successful learning. How many were present in this set of courses was variable. As I examined each course, I tried to determine which exemplary characteristics were present, to what extent, and how they were implemented. This analysis indicated that the courses shared some common best practices, and it further identified some characteristics of effectiveness not originally anticipated (Eisner, 1991; Merriam, 1988; Miles & Huberman, 1994).

Many of the survey and interview questions were open-ended in order for the participants to fully share their experiences and perceptions. The data were "open coded" as similarities and themes developed (Eisner, 1991). Hoepfl (1997) explains the process:

> Discrete categories identified in open coding are compared and combined in new ways as the researcher begins to assemble the 'big picture.' The purpose of coding is to not only describe but, more importantly, to acquire new understanding of a phenomenon of interest. (p. 8)

"Qualitative researchers pay attention to the idiosyncratic as well as the pervasive, seeking the uniqueness of each case," Hoepfl contends (1997, p. 3). As the picture developed, I translated "the conceptual model into the story line that will be read by others. Ideally, the research report will be a rich, tightly woven account that 'closely

approximates the reality it represents'" (Strauss & Corbin, 1990, p. 57). Eisner (1991) makes a strong case for writing in this nontraditional manner:

> We seek not a mirror but a tale, a revelation, or a portrayal of what we think is important to say about what we have come to know. This narrative should be supported by evidence, structurally corroborated and coherent, but it cannot be a disembodied listing of what somebody did or saw. It needs both a cast and a plot; it needs to have a point. The thematic structures derived inductively from the material researchers have put together and from the observations they have made can provide the conceptual hubs around which the story can be told. (pp. 190-191)

Merriam concurs that "using common language, as opposed to scientific or educational jargon, allows the results of a study to be communicated more easily to nonresearchers" (1988, p. 31). I have sought to write in a meaningful way that is helpful to those who are interested in learning more about effective WBI. The cases portray the creative use of pedagogy supported by technology.

Trustworthiness of Research

The next concern was to answer the inevitable questions of trustworthiness. How can a qualitative study be determined as successful or not? Eisner discloses that "qualitative research becomes believable because of its *coherence, insight,* and *instrumental utility*" (Eisner, 1991, p. 39). He further expands these qualitative features:

> *Coherence*: Does the story make sense? How have the conclusions been supported? To what extent have multiple data sources been used to give credence to the interpretation that has been made? (p. 53)
>
> *Consensus*: The condition in which the readers of a work concur that the findings and/or interpretations reported by the investigator are consistent with their own experience or with the evidence presented. (p. 56)
>
> *Instrumental Utility*: The most important test of any qualitative study is its usefulness. . . . A good qualitative study can help us understand a situation that would otherwise be enigmatic or confusing. (p. 58)

I endeavored to follow Eisner's guiding principles first by providing coherence. I tried to support all these cases with vivid examples and direct quotes, letting the instructors speak for themselves wherever possible. Consensus was addressed by sending out the chapters to each of the designers and feedback was solicited. In a number of cases small changes were made in the chapters as they indicated. Several educational technologists have asked to share this study with others, indicating the study's usefulness.

Eisner emphasizes that "qualitative studies typically employ multiple forms of evidence and they persuade by reason" (Eisner, 1991, p. 39). "Qualitative inquiry, like conventional quantitative approaches to research," he adds "is ultimately a matter of persuasion, of seeing things in a way that satisfies, or is useful for the purposes we embrace" (Eisner, 1991, p. 39). The value of this study will be how it contributes "to the knowledge base of the field" (Merriam, 1988, p. 61). Such value will be discovered within the context of the review of the literature that is integrated into the cross-case analysis and based on chapter 2's theoretical framework.

Patton (1990) notes that credibility in qualitative research depends less on sample size than on the richness of the information collected and on the analytical abilities of the researcher. Eisner (1991) adds that "structural corroboration, like the process of triangulation, is a means through which multiple types of data are related to each other to support or contradict the interpretation and evaluation of a state of affairs" (p. 110). The types of data that I collected were: (1) faculty surveys, (2) faculty interviews, (3) course documents, (4) presentation transcripts, (5) Web sites, (6) papers by faculty, and (7) articles on courses or faculty.

One of the possible weaknesses of qualitative research is that researchers are vulnerable to accidental or intentional neglect to collect or admit data that go against the researcher's values or expectations. Eisner advises that "*it is especially important not only to use multiple types of data, but also to consider disconfirming evidence and contradictory interpretations or appraisals* when one presents one's own conclusions" (p. 111). To ensure structural corroboration, I was careful to admit the disconfirming evidence and contradictory interpretations when they occurred. For example, there was wide disagreement among the instructors on the ideal amount of students there should be in an online course. Occasionally, I came across instances where only one course had a particular remarkable feature, so I included these as I did not want to miss meaningful discoveries. Unless stated otherwise, all findings occurred in at least a majority of the cases (three courses).

There are few strict guidelines for qualitative researchers on when to stop collecting data. The questionnaire data were finite because I promised the course instructors they would not be required to fill out tediously long or multiple questionnaires. It was difficult to determine, however, when I had done enough data collection and analysis with the courses. I tried to remember that "exhaustiveness is not always salutary" (Eisner, 1991, p. 117). Equally important, I made sure that there were enough quality data sources for triangulation (Hoepfl, 1997) to help ensure that the study had structural corroboration (Eisner, 1991). I tried to show objectivity at all times both as I collected data and assembled notebooks for each course (as detailed in "The Data Files" section previously) and as I analyzed the case studies.

Summary

This study was a qualitative exploratory case study. The six cases studied were the winner and five honorable mentions from the Paul Allen Virtual Education Foundation's 1998 Outstanding Online Course Award competition. Questionnaires for faculty, interviews, and documents were the types of data collected. The data were analyzed for themes and other discoveries useful in determining what works in WBI.

CHAPTER FOUR

MURDER ON THE INTERNET

Overview

"Murder on the Internet" ("Murder") is a unique approach to foreign language instruction that capitalizes on using email and World Wide Web resources. This intermediate-level course is a simulation-game where students take roles of characters in a murder mystery based in a specific town in target country. They work collaboratively, functioning as specific characters, to solve a murder mystery. All of this is accomplished through four two-week rounds of email where students write in the language to be learned. Between rounds there is instruction on grammar, vocabulary, speech, and other language essentials. The focus of the course, however, is for the student to become functional in the language within an authentic context. There are French and Spanish versions of the course "Un Meurtre à Cinet" (Vol. 1, p. 25) and "Misterio en Toluca" and (Vol. 1, p. 157), developed by Terri J. Nelson and Walter Oliver respectively. Both instructors are at California State University, San Bernardino.

"Murder" is taught during the third quarter of the first year of French/Spanish. This means that students come to the course with some knowledge of the target language and have beginning writing and speech skills. Based on this foundation, the course takes students through a game situation that propels them into using the language in ways that go beyond most textbook and classroom approaches.

In “Murder” students learn the target language through task-based, collaborative activities and use critical thinking to accomplish the tasks. The final project requires students to solve the murder mystery by creatively and coherently putting all the clues together, and presenting their solution in creative ways to the class.

Course Design

The course simulation is based on a soap opera or murder mystery movie metaphor, which is something with which most people identify and find intriguing and motivating. Nelson and Oliver weave instructional elements of the course throughout the murder metaphor. Even grammar lessons are designed to enable students to communicate more effectively in the simulation.

Instructional Design

The instructional goal of the course is the key to its success: “The Murder course is designed to give students practice at reading and writing the target language in a contextualized environment” (Vol. 1, p. 8). This simulation forces students to read and write much more than in more traditional language courses. “Writing in the foreign language classroom is rarely for communication: the student generally writes so that the instructor can assign a grade,” Nelson and Oliver point out (Vol. 1, p. 224). Whereas in “Murder”, “The students are writing for communication: they care about the answers to their questions because they want the information in the responses. They are motivated by content and not by concern for an instructor’s evaluation of their work,” (Vol. 1, 226). Email was chosen for the students to communicate with for specific reasons.

Nelson and Oliver (in press) elaborate,

> we wanted students to write for communication (and not for the instructor's grade). To that end, e-mail provides numerous advantages: e-mail keeps the students in the target language, access is convenient (especially with a listserver), and the students stay focused on writing rather than using whispered translations, facial gestures, and other devious signaling devices. Also, this technology is easy to learn, easy to use, and gets the job done. (Vol. 1, p. 229)

Nelson states unlike many language courses whose emphasis is grammar "Grammar was subservient to everything else" in "Murder" (Vol. 1, p. 194). Reading for the gist of things is typically a difficult skill to develop in the more traditional and limited method of doing word-for-word translations. This authentic-context instructional strategy helps to build good reading strategies which means that the instructors do not have to "dumb down" lesson materials (Vol. 1, p. 196).

Each student is given a character role to play during the game. Characters are part of a complicated story line that is revealed to them only a small portion at a time. There are many smaller mysteries that need to be figured out before they try to solve the ultimate mystery of whodunit. Students have email discussions on a listserv to probe and prod each other in trying to find more clues. They also use evidence and clues that are embedded in authentic documents on the World Wide Web. At the beginning of each round, the instructor sends each student a personal email message that includes "secret information" the student *must* be willing to reveal during the round. When the discussion begins, students question each other to discover clues. According to Nelson, this is not a teacher-centered course.

> "…this class allowed students to communicate with each other in the target language. The instructor was able to provide one-on-one tutoring according to the needs of each student. In this way, students had maximized time working in the target language. (Vol. 1, p. 3)

Oliver suggests that, similarly, other contexts beside "Murder" could get people to go further and deeper in learning the language. One key to the success of "Murder" is *redundancy*, going over and over things in different ways but always in ways that keep students motivated. Many different kinds of resources, scenarios, and such are needed to keep the curriculum both motivating and reinforcing. This simulation approximates what it is like to learn a language in the target country, therefore, the potential for authentic learning is increased. According to Nelson a valuable aspect of the course relates to its flexibility in accommodating students' learning preferences.

> The students were actively participating at a time and place convenient to them... and all of their work was in the target language. Students made significant progress, but everyone wasn't expected to be learning the same things within a time frame constructed by the instructor. (Vol. 1, p. 2)

"Murder" is truly an active learning course where students are completely involved in the simulation:

> the students **do** something rather than having the teacher tell them about it. They spent 90% of their time practicing the target language in a meaningful way, rather than learning about it (i.e. grammar, vocabulary). The grammar portion of the course was designed such that students appreciated how it helped them participate better in the e-mail exchanges. (Nelson, Vol. 3, p. 2)

Whether in a face-to-face classroom or in an online course, the teacher is the most important factor because everything in the course is determined by the instructor's philosophy and understanding of pedagogy. "Murder" instructors had unique, nontraditional roles that helped students progress in their learning adventure:

> The instructor worked individually with students on the grammar portion of the course: coaching and tutoring. The instructor also intervened (most often off-list) when student messages were unclear. The instructor also played the role of the chief detective in the murder case and would occasionally be called upon publicly (via the listserv) to answer questions concerning the murder investigation. (Nelson, Vol. 3, p. 3)

Lydia[1], one of Nelson's students, corroborated and expanded on Nelson's explanation of the instructor's role in "Murder":

> The instructor was a character also. If she saw that we were having problems in certain grammatical areas she would send us an e-mail with suggestions on other words we could use or ask us questions (in character) about something we wrote. She would make sure all the characters were giving each other correct information. Because the only rule was that characters could not lie. She would give us hints and suggest that we might look at a piece of information more closely. (Vol. 1, p. 213)

This course is learner-centered and encourages "students to communicate with each other in the target language" (Vol. 1, p. 3). The instructors provided "one-on-one tutoring according to the needs of each student. In this way, students had maximized time working in the target language." (Nelson, Vol. 3, p. 3).

Interactions

Interactions are the critical substance of this course, and the art of asking good questions is most important for the students. Nelson observes,

> Probably the most useful thing that you can learn as a foreign language learner is how to ask a good question. That's the hardest thing to teach students how to do. We do it in real artificial ways, and we try to tell them you have to ask questions about [it] . . . they don't really care what the answer is . . . here they do care. They're really concerned about asking the question well and especially about what that answer is, so there's real communication going on, whereas in a normal classroom it's pretty artificial. (Vol. 1, p. 243)

But the interactions are much more than just asking questions. Students ask questions while in character. Further, they must be very careful about what they say and what they do not say. Nelson comments on the way email is used,

> By using e-mail and role play in a murder mystery, students were careful about what they said & how they said it (so they wouldn't look guilty!). But, they were also interested in what the other students said. E-mail is the perfect vehicle for this type

[1] Not her real name

> of communication because the students stay in the target language and they don't use any other forms of communication (with the exception, perhaps, of e-mail icons like smiley faces, etc.). (Nelson, Vol. 3, p. 2)

Maria[1], a student, adds that "The relationship among the characters was well defined. All the characters interacted or were related among one another. It was the feeling of a small community within the program" (Vol. 1, p. 218).

The murder mystery theme and the belief that communication should be authentic drive the types of interactions that the instructors use in this course. These kinds of interactions worked for Maria who said "Murder" "helped me interact with other fellow French students" (Vol. 1, p. 217)

Nelson explained that there are a required number of messages students must post within each of the four two-week rounds. The instructors do not leave round participation up to students' choice and motivation alone; even though the murder theme is motivating, students are busy and may still need some "encouragement" to keep up. Oliver explains,

> All of the messages (with the exception of feedback and information sheets) is sent to the listserve [sic]. A group of 10 students sends, on the average, a total of 150 messages in Round 1 up to a peak of 280 messages (average) in Round 3. They are only required, however, to send 10 messages per round. (Oliver, Vol. 3, p. 33)

Each course scenario requires a minimum of seven and a maximum of twelve or thirteen students. Limiting the number of students per scenario is for the protection of students; otherwise, they would get too many e-mail messages. In fact, one round— with only 10 students in it—had an average of 280 messages (Vol. 1, p. 33). Answering this many messages is demanding. To address this problem instructors limit the number of students per scenario to keep each round's total from getting too large. For

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[1] Not her real name.

example, a class of 14 would be broken into two groups of 7. During some quarters, two or three scenario groups could be going on in one class at one time. By limiting the scenario size, students are more involved and are less likely to be overwhelmed by email. Although this approach is more demanding on the instructor, it is effective for students.

Discussion Rules

There are basic rules for this instructional game. Students have to craft questions based on their characters, and they must *always* tell the truth when asked for information. It is not necessary to tell everything known about the character; however, the student must be honest. If asked, "Did you have an affair with Stépahnie?" or a similar question, a "Yes" or "No" answer is required. However, the student does not have to say how long the affair lasted, or where, or when, or any other details unless someone specifically asks. More language-proficient students are given less fleshed-out characters because they are able to develop the characters as they desire. Oliver describes,

> We normally assign the lesser fleshed out roles to more advanced students because they can improvise and because we allow students to create their role within the confines of what we tell them. For example, the married couple . . . if it's played by two people they generally end up getting divorced half way through the course . . . and that's okay. (Vol. 1, p. 246)

Even though they are encouraged to flesh out the characters, students cannot change anything that is given to them initially by the instructors in the original character description—all of this information must stay the same. Students can, however, go above and beyond the original descriptions to make the characters more interesting. Instructors give more well-developed character roles to students with less-developed language skills. This helps ensure that students are not overly stressed while trying to learn a language

and to creatively participate in the simulation, all simultaneously. This strategy works well for Nelson's and Oliver's students.

Accuracy

Emphasis in the course is on content not form, on meaning rather than on accuracy. Nelson and Oliver do not intervene directly when there are mistakes in "Round" messages. Instead, they deal with mistakes outside of the mystery environment. Oliver shared a message that one of his weaker students had sent out on his course listserv. It was not grammatically correct.

> Pregunta a Alberto beltrán:
> ¿Por que estaba tú con Dolores el sábado por la noche de su muerte? y ¿Qué estaba tú hecho allá?
> Question for Alberto beltran:
> Why was you with Dolores on Saturday on the night of her death? And what was you done there? (Vol. 1, p. 34)

Oliver explained the philosophy behind how they handle such mistakes:

> This is a sample message from one of the "weaker" students. Although her message is not grammatically "accurate," she is able to communicate meaning. That is our focus; as long as the messages communicate, we allow students to proceed uninterrupted. We've found, though, that students do self-correct and peer-correct without teacher intervention. And, as their messages become more complex, they begin integrating more difficult grammar concepts without teacher prompting. (Vol. 1, p. 34)

Oliver further asserted that this student would have been functional in Mexico or Spain, even though it would have been easy for people there to realize she was struggling with the language. In addition, her accent would have given her away as a novice Spanish speaker. Nevertheless, she would have been functional and would have communicated. Nelson noted that many times students end up doing peer correction. One student, Lydia, reported "It was okay if we made mistakes. It wasn't about being perfect, it was about

learning and learning from our mistakes" (Vol. 1, p. 212). Frequently the student who made the original error notices the correct version, picks it up, and starts using it correctly. Peer correction is powerful. Lydia further expands this thought:

> We had to try and communicate our questions as clearly as possible so the others students would know what we were asking. If a student didn't understand they'd send an e-mail back saying they needed more information or give a suggestion on how to write the sentence in a way it could be better understood. Students would help each other with grammar and sentence structure. (Vol. 1, p. 213)

Teacher intervention also works, but this only occurs outside of the mystery environment. Nelson reports,

> It's real easy for me to check by their messages that they're having difficulty and to just write them a little note and say, 'I noticed that you're having some trouble remembering or that you're confusing the two of them, why don't you go back and look at these two pages in the textbook and do a couple of exercises and see if that helps.' It really allows you to individualize the instruction to the needs of those particular individuals. (Vol. 1, p. 248)

In this way the student knows what is incorrect and also knows where to go for review on troublesome concepts. The instructor may also provide additional personal help.

Assessment and Evaluation

"Murder" includes interrogations—tests—where students speak the language within context. Typically students are required to come in for face-to-face oral interrogations. Nelson explains "Students also completed 'oral interrogations' once each Round (where they met face-to-face and asked each other questions). Students remained 'in character' while interrogating" (Vol. 1, p. 3). Nelson further describes the unusual process of assessing with these oral interrogations "Besides the in-class, student-to-student interrogations, the final exam was a one-on-one interrogation with the instructor

where students were expected to explain 'their' whereabouts at the time of the murder and also possible theories for whodunit" (Vol. 1, p. 256).

Most professors look forward to final projects to see how their students have applied what they have learned in the course. Students in the French and Spanish "Murder" courses created innovative projects, considering that they were first-year students. Nelson and Oliver explained,

> We've elected NOT to solve the murder for the students. Instead students are asked to submit a project in which they determine who committed the murder and why. Submissions have included: a legal brief indicting one of the characters, a hidden diary of the victim, letters, essays, and a videotaped confession. (Vol. 1, p. 9)

All of these final projects were written and/or spoken by the students in the target language. The students' task was to solve the mystery and present their reports to the class. Each student solved the mystery in his or her own way, and then found a creative way to share with the class his/her solution to the murder mystery. One girl watched French news shows for hours and then developed her own 15-minute news program complete with advertisements that all had relevance to solving the mystery. Other students prepared videotaped confessions and enactments of their version of the solved mystery. One of Oliver's students, a music major, wrote a song with lyrics that explained who had done it. The student then sang the song for the class.

Students can choose their project format and can ask to work in teams, if their rationale is worthy of this. One team created an eight, full-page newsletter with many articles, right-on-the-topic reports, and advertisements where each item was in the target language and each contributed to solving the mystery. When the team handed the newsletter out in the class, other students appeared surprised and delighted. Because of

the intense efforts put into these final projects, instructors and students look forward to the presentations as a highlight of the course.

Authentic Context Benefits and Limitations

Within the context of "Murder," students excelled in grammar and accuracy "even though this was not an intended or expected goal for the class" (Vol. 1, p. 256). "The understanding of grammar and the ability to use it in a spoken word which is the most difficult part for students," Nelson asserts that the students "as long as they stayed within the 'Murder' context, they in fact learned more and better than students in a more traditional classroom" (Vol.1, p. 241). For instance, verb conjugations, past tense, and related grammar issues are typically challenging, especially for first-year students.

When speaking or writing French or Spanish, past tenses can be challenging even for second-year students; yet within the "Murder" context, students perform remarkably well. Once students are taken out of the murder mystery context, however, they return to more average performance. Oliver expands,

> Significantly, however, when they left the context with a similar exercise . . . say a cloze exercise where they're to put in the appropriate form of something or another at the appropriate time, they dropped back to the level we would expect for people who have only had 30 weeks of instruction. . . . So long as they stayed within the context of a mystery, having to do with a murder . . . and it could be totally different from the story they were working with, their accuracy went way up. I guess our secret is if we can find enough simulated contexts for students to study over a 30-week period they might become fluent. (Vol. 1, p. 241)

Oliver believes this phenomenon indicates a significant need for further study. Instructors may need to provide other authentic environments that will strengthen student performance within different contexts. Both Nelson and Oliver would like to explore the possibilities of applying this method of instruction to additional learning contexts.

Students who are accustomed to a "vocabulary lists and word-for-word" instructional approach generally find that neither the vocabulary nor the level is authentic, interesting, or useful. Consequently, students who learned in the traditional method may not be able to function well in the language as quickly as did "Murder" students. Nelson and Oliver believe that their students are functional. Because they use a variety of authentic documents like train schedules, newspapers, and other information from the actual cities where the "Murder" scenarios are located, students get accustomed to using more advanced vocabulary and grammar.

Web Design

There are two kinds of branches or portals in this course. One portal takes you to the inside information and the other portal takes you outside to authentic places in Spain, Mexico, or France depending on the course. These authentic sites are places where students try to gather useful information and clues. Nelson and Oliver compare the "Murder" course students with those from the typical first-year of language study. They explain that "Murder" students have a much greater likelihood of being able to succeed as communicators and to functionally survive in the target country after just 1 year of the "Murder" version of this language course (Vol. 1, p. 198).

Both French and Spanish versions have stylized maps of the towns where the crime was committed. These maps are clickable. When students want to find out more about the hospital, they simply click on the hospital icon. The link takes them to a photo of a real hospital in the target French or Mexican town. The site possibly provides some additional information for solving the mystery there. Other links and resources may also be included.

At the end of the clue page for each of the four Rounds there are different subjects of related resources and links to the Web. These flexible resources directly relate to that particular clue page. This course feature provides extended learning opportunities, as well as basic support needed to solve the mystery.

There is a plethora of information and resources in the course, including over 1,500 pictures. Nelson explains that there are pictures in typical language texts but usually not very many and certainly not enough to satisfy students' needs and interests (Vol. 1, p. 198). Students need to see an abundance of detail and real-life connections. It is helpful for them to have many photos from the target countries to help create a more authentic learning environment. For textbook publishers, including many color pictures in printed texts is cost prohibitive and takes up valuable space. On the Web, however, as many pictures can be posted as are needed. The pictures in "Murder" look professional and have drop shadows on two sides. Nelson and Oliver traveled to France and Mexico respectively to take all the pictures.

Navigation

Every site needs a good navigation system to ensure the users will not get lost and will be able to function efficiently within the site. Navigation sidebar icons help students know how to get around within the "Murder" course Web site. The "Murder Logo"—eyes peeking out from behind flames—is a visual clue that they are in the course Web site. This button takes students back to the course index page.

To help students access information they need at the "Murder" Web site, several icons serve to make navigation clear. Whenever students see a particular icon, they know what to expect. The toolkit icon is for "Helper Software." This section includes all

information and links about how to download any necessary software that students will need to function in the course. The icon of stapled pages is for "Internet Activity," where the activities are "based on images and text" (Vol. 1, p. 130). A headphones icon is for "Internet Activity" which has text and graphics but also adds audio information. A pen and scroll icon indicates a "Writing Activity" whose only help is a picture. The clipboard icon signals a printable worksheet to use to complete the assignment.

Instructors and Instructor Issues

There are two instructor/course developers for "Murder on the Internet." Nelson and Oliver worked together to develop the concepts, and then separately Nelson built the French version and Oliver created the Spanish version. Although Dr. Walter Oliver did not fill out a questionnaire, I heard Oliver's and Nelson's joint presentation and had dinner with both of them. This gave me a unique opportunity to get to know both of them better and to learn more about their course.

Terri J. Nelson, Ph.D.

Terri J. Nelson had a vision for students learning a foreign language. She said "I wanted students to use a foreign language in the written form in order to communicate ideas . . . rather than to write for an instructor's grade" (Vol. 1, p. 2). This conviction is at the heart of the "Murder" course, so she truly found a way to achieve her goal. Nelson developed the concept of an email simulation or game that not only required students to write in ways that clearly communicated ideas but that also highly motivated them.

Nelson is passionate when she speaks about her students and her subject. The most satisfying thing about this course, Nelson disclosed, was "seeing not only the

students' progress but also their enthusiasm and creativity. Whenever I see any of the students who have 'done' the murder mystery, there is a special bond" (Vol. 1, p. 4). This innovative instructor found a way to address the typical challenge of more traditional instructional methods. It is clear that she has a love for the French language and wants to share this with her students. She strongly believes in authentic learning because she believes it motivates learners and that when they are motivated they learn better. The course concept was Nelson's. It shows her creativity and willingness to experiment and take risks. She is not locked into traditional methods but wants to develop effective strategies and innovative curriculum. On the other hand, she does not appear to be a radical trying to dump all the old strategies and methods just to make everything new. She believes in starting out small, testing frequently along the way, and letting things grow naturally.

Technology has been a big part of Nelson's professional life since 1991, yet she believes that it should be used only when something cannot be done better another way. She is dedicated, hard working, yet flexible when working with students. Course development of this magnitude requires persevering effort on the part of the developer.

Nelson is planning to develop the second year of the French "Murder" course. Also, she is working on several other major projects including "a second-year course (full-year). It will be highly centered on task-based cultural activities that expect students to explore culture rather than merely read about it. There is an element of 'mystery' interwoven throughout the project, but no murder!" (Vol. 1, p. 256).

Walter Oliver, Ph.D.

Walter Oliver has a long history of integrating technology into higher education courses to enhance learning. Part of this history includes that he

> has been a campus and system-wide (the 23 campuses of the CSU) leader in the use of the computer in instruction since 1972 when he first attended an NEH seminar. . . .He has introduced different aspects of computerized technology to a wide variety of foreign language and general education classes at CSUSB. (Vol. 1, p. 256)

When discussing the online course, Oliver objected to the term *distance education* and said that it should not be used. He prefers the term "technology mediated instruction" whenever technology is integrated into the curriculum either close to you or far away—one term fits all (Vol. 1, p. 201).

Oliver is currently "a CSU system-wide coordinator for the Strategic Languages Initiative, is built upon the idea of fostering inter-campus collaborative activities to bring a wider range of language instruction to students throughout California" (Vol. 1, p. 256).

Teamwork

Nelson had the original idea for the "Murder" course, but she explains, this course was a true team project; "although the initial vision was mine, it has been a completely shared one . . . something that has been fostered and grown through our mutual dedication to the project" (Vol. 1, p. 256). Together Nelson and Oliver developed the "characters, plot, [and] messages to individual characters," and then each one developed the French and Spanish materials respectively (Vol. 1, p. 4).

Nelson and Oliver made a great team for many reasons, including their shared vision, interest and skills in using technology for learning, and perseverance in getting the work done. Nelson describes the unique teamwork relationship:

> It is important to note, too, that as a senior faculty member, he (Oliver, Herrington, & Omari) was much more familiar with the campus/institutional climate and resources and better able to publicize the project to the right "powers that be," encourage administrative support, etc., than I (as a first-year faculty member when we first began to work on this). (Vol. 1, p. 256)

Most of the time university courses are developed by solo professors working in isolation. After attending the "Creating Effective Online Instruction" Conference at University of Kansas, Lawrence, Nelson comments,

> One of the most revelatory things about the Kansas conference that I found was the number of projects that were team projects. Universities tend not to create environments that encourage collaboration: we're expected to go out an write our journal articles (sitting alone in our library carrels (sp?) or offices). Even the grant applications we filled out only had room for one person's name! Yet, it is by sharing our ideas, by having a good sounding board, by having someone in the office next door that can help you problem-solve (or even to go to lunch with when you're working on Sundays!) that brings joy, enthusiasm and success to such huge projects. Without Walter, this project would have never gone beyond the "experimental" stage. So, collaboration has been a key to success—and collaboration means, too, collaborating with students to build something together. (Vol. 1, p. 256)

It took years for Nelson and Oliver to develop their courses to the current level. Slowly they have been growing, learning, and experimenting. Both say that it is important to start small and grow rather than try to develop a full-featured course with all the latest technologies. They indicate this is basic when wanting to succeed with online instruction.

Considerations

A concern of both Nelson and Oliver was how a student from a conservative religious background would function in the "Murder" simulation. Oliver noted one particular experience where a student from a very conservative religious background was able to function within this type of fantasy and had no trouble at all. Oliver described the student as definitely into the game experience. So far, this issue has not been a problem

because students seem to recognize that the simulation is not morally serious but instead is a means to an end and an enjoyable way to learn a language (Vol. 1, p. 201).

Flexibility

The "Murder on the Internet" course continually evolves. In four Rounds students develop their characters, ask questions, and solve the mystery, all while using the target language. One of the course features that evolved developed during Round 2. At the beginning of Round 1 students focused on a newspaper article as a review of some of the previous clues and scenarios. It refreshed their minds with available details and clarified the current scene with short articles and advertisements. Everything in the newspaper article was relevant to the Round. The students enjoyed this feature so much when they came to Round 2 and discovered that there was no newspaper article, they immediately asked for one. Now there is a newspaper with short articles at the beginning of each Round. Students' feedback helped change the course and actually made it better. If the instructors had been rigid or had believed that there was something sacred about their design and content, they would have ignored students' suggestions and would have missed a unique course-improvement opportunity. "Pedagogy should determine the technology; users' should be given a voice in the process," Nelson and Oliver (in press) attests. This is important, they add, because "if students are self-motivated to learn (i.e. they aren't there only to fulfill the language requirement), they will" (Vol. 1, p. 237).

When course authors first created various characters, some were "better" than others in that they did not have many skeletons in their closets while others had more dark secrets. Some of the students who got one of the benign characters asked to be given some dark secrets because they did not like having bland characters. They also wanted

the challenge of trying to hide something. Both Nelson and Oliver are open to student feedback and to making adjustments that they believe will be helpful. Now all characters have at least a few dark secrets.

The problem with starting out with a fully developed course, Nelson and Oliver believe, is that when instructors and/or designers receive criticism or suggestions, they will not be as open to making changes as if they had started incrementally, piece by piece, testing it, making revisions, testing it, moving to the next piece, and so on. They advise not to start with courses that are too big or too complete and counsel developers to be sure to stay flexible.

Nelson and Oliver practiced what they preach by starting out with only typed directions before moving to email and photocopies. They did not move to the Web until the photocopies got too expensive. Oliver wanted to work with the Web about that time anyway, so the move was natural. In this phase, also, they started out small and just put up a few resources on the Web to enhance the class. Students asked for more pictures at the Web site; so Nelson and Oliver put up more pictures. Once, due to students' requests, Oliver scanned in 30 pictures the following weekend and posted them at the course Web site. Nelson and Oliver made midstream course changes as well as end-of-course changes. Because the instructors took student suggestions and requests seriously, students felt empowered to be co-producers of curriculum in a safe learning community.

Another evidence of Nelson and Oliver's flexibility occurred when they sold this course to a publisher, Heinle & Heinle (Vol. 1, p. 199). They note "We decided to adopt an open architecture in the Instructor's CDs published by Heinle & Heinle" (Vol. 1, p. 230). Because institutions who use "Murder" can customize the Web sites, they believe

an open architecture course will be better for both instructors and students. Hopefully, there will be more of these kinds of courses in the future.

Distance Instruction

In the course Nelson and Oliver work one-on-one with students. They believe this strengthens student learning. Email facilitates this process. On the other hand, working one-on-one with students precludes the scalability of the course. “Murder” instruction is dynamic with just-in-time grammar. They spot error trends in e-mail messages and in the class dialog and then create appropriate lessons to help address the problems (Vol. 1, p. 194). Because the course design was not “set-in-cement,” the instructors adapted often to the needs of each unique group of students. This contributed to meaningfulness of the material students were able to use.

“The computer may or may not be better than teaching on a blackboard: it all depends on what you want students to learn and how you plan to teach,” observes Nelson and Oliver (Vol. 1, p. 223). But if there is a vision of learning, they believe that most everything can be done online with current technology (Vol. 1, p. 202). Most face-to-face courses can translate well to online instruction, but it takes much time and energy to do it well.

Problems

Nelson and Oliver do not think students are ready for the type of distance instruction murder involves (Vol. 1, p. 202). Further, they believe there is an overrating of the claims that students are demanding distance courses. Nelson’s and Oliver’s beliefs may stem from being in an urban area where students do not feel the need for these types

of courses. However, even in urban areas some students occasionally have personal circumstances that increase the need for Internet options.

According to Nelson and Oliver, in most situations at California State University, San Bernardino (CSUSB), there is a low level of interest and need for full distance courses. At times the university has advertised online courses, but no one showed up to take them. In those circumstances the university reassigned the instructors to a face-to-face course. Once when this happened, Nelson told the group who showed up to the orientation meeting how the course was going to be delivered (with technology and the Internet); five people then got up and walked out because they preferred a traditional course.

Even when students overcame their fears or prejudice toward online learning, they sometimes had difficulty because of the new type of learning environment. Maria complained that the difficult part of this kind of course is "that it tends to be too exhausting to stay in front of the computer for too long" (Vol. 1, p. 220).

Once Nelson taught the "Murder" course when high-school students were enrolled along with university students. She had required all students to attend one face-to-face meeting at the beginning of the year. All further instruction and communication were done via email, phone, and online contacts. The secondary education students worked on the French course in their own high-school lab. The main problems with this group were discipline, staying on task, and motivation.

Designing and developing an online course is fraught with challenges. One such challenge was dealing with the initial disappointment of low student interest in online

courses and nontraditional learning. Lydia explained her reactions and growth in this area:

> The biggest challenge that I overcame in the course was moving away from the traditional style of learning. I didn't understand how the internet would help me understand French any better. I was used to book learning with traditional homework assignments (which we also received). After taking the class I realized that there is so much more information that I couldn't read about in books. Online I visited actual French countries. I read authentic French advertisements, newspapers, listened to French radio stations. I had access to a French pen pal if I wanted. (Vol. 1 ,p. 214)

In addition, Maria, a woman in her early 20s, expressed her attitudes and challenges with online learning "I came with an open mind into this course. Overall [the] outlook is satisfying. Yet I am the type of student which needs classroom feedback, and face to face interaction with the teacher." She added "I need constant supervision" (Vol. 1, p. 219).

Professional Development

Online course development is an intensive process that many instructors will not be willing to participate in if it is not considered as research activities. Faculty need to get technical training to develop the courses. Nelson and Oliver (in press) explains their situation:

> Our retention, promotion and tenure system recognizes this work as part of our professional development: learning to use appropriate technologies "counts." However, as advanced users of technology, we have little to no access to technical support and training. Efforts at faculty development in technology at our institution unfortunately target the low-end user (e.g. using e-mail, PowerPoint, and Word); advanced users are expected to teach colleagues these basic skills and to troubleshoot on an individual basis but are given no opportunities to further their own skills. Any training we have received has been paid for out of our own pockets (e.g. conferences and workshops) or generously provided by our publisher (Heinle & Heinle paid for Authorware training used in the creation of another project). (Vol. 1, pp. 230-231)

Nelson found it "extremely difficult to find the time to develop courseware" (Vol. 1, p. 4).

She added that CSUSB faculty "have a teaching load of 9 quarter classes per year" (Vol. 1, p. 4). This leaves little time for developing innovative online courses. Nelson, however, is fortunate that her work "has been recognized in terms of 'professional development' (i.e. research) for reasons of retention, promotion & (hopefully) tenure" (Vol. 1, p. 4). CSUSB allows the faculty "to 'buy out' one course release" in order to gain more course development time. This is usually done by securing a grant to develop the course. "The grants are local but extremely competitive," Nelson reported (Vol. 1, p. 4).

Unexpected Discoveries

Whenever an innovative new course is developed and given, surprises are common. This course was no exception. There were five noteworthy, unexpected surprises.

1. The course targeted written skills, yet the students made unexpectedly good progress with speech skills as well. Nelson explained,

> Although I don't have quantifiable data, it seemed that students were able to master the past tenses in French with less hesitation and more accuracy in the murder class, as opposed to classes in the more traditional format. Once the conversation switched to another context, however, they reverted to more typical speech. This has important implications for foreign language instruction, however, since it proposes that, given a variety of contexts, even students without a study abroad experience can master these tenses (it's generally assumed that most students will need a year abroad in order to speak with 50%+ accuracy in the past tenses). (Vol. 1, p. 4)

2. Students need to be self-disciplined in order to be successful when working alone. Many students attended the optional face-to-face class session in order to have

direct contact with others. Of those who chose to "work asynchronously, about half completed the work well; the others needed to be prodded" (Vol. 1, p. 4).

3. The Web was the latest addition to the course with only a few pictures in the beginning. The students enjoyed them so much, however, that hundreds more were added.

4. Engaged students doing meaningful activities will work long hours: "They'll complain about the work, but they won't **not** do it!" (Nelson, Vol. 3, p. 4).

5. In general, students are not ready for non-traditional classes. Nelson pointed out "It takes a while to get students to understand the benefits of non-traditional classes. A number of students walked out on the first day without even attempting the course" (Nelson, Vol. 3, p. 4).

Changes in Course

Nelson is satisfied with the course; she has used the "Murder" mystery in five classes with good success. She noted "It has evolved from an ancillary activity to the primary course activity" (Vol. 1, p. 4). One thing she would like to experiment with, however, is a threaded discussion list to determine if this would make it easier for the students and her to keep up with the high volume of email (Vol. 1, p. 4). Seeing the messages visually arranged would likely make it easier to keep track of the dialog. Lydia, one of the "Murder" students, had some additional suggestions for course changes:

> I would suggest audio components be added because I know for myself and many others this is one of the most problem areas. So along with the internet I would suggest some sort of system where students could listen to actual French conversations or watch French news and entertainment shows, award ceremonies since they report on American goings-on, also it won't seem so foreign to students. (Vol. 1, p. 214)

Although Maria had a good experience in "Murder," she also would like to see some changes, such as "more group discussions, and an actual designed murder. It is not satisfying to know that it was all made up" (Vol. 1, p. 219). However, by using a fictional murder scenario as the theme, students can be more creative without changing history.

Nelson is planning to do a second-year version of "Murder." She disclosed that "this change is not motivated by the students' abilities: we have a great first year book, now, and our second year class format has changed such that it will fit very well with the murder" (Vol. 1, p. 4).

Face-to-Face Versus Virtual Considerations

When I asked Nelson and Oliver if they thought that their course could be completely delivered online without having face-to-face interrogations, Nelson responded:

> You have to keep in mind that this course is just one course in many courses, and it is not supposed to teach you everything about the language. So what they do not get in the pronunciations, they will probably get either before this course or after this course. (Vol. 1, p. 203)

Therefore, in the big picture puzzle of learning a language, this course is only one piece. All the courses together should provide a well-rounded learning experience.

Oliver remarked that there are ways to do everything online. This is particularly true in a case such as a class in Wyoming, for example. Where the need to help students is driven by constraints created because of remoteness of location. A phone bridge conference could be set up for the interrogations and also for a session at the beginning to get started. Oliver said you could also do videoconferencing. However, when there are more than two people involved, it still is unreliable and complicated. For this reason this

might not be the best way to do this right now. Certainly in the future it will become easier to videoconference in courses.

Would it be possible, I asked, to make creative video projects and share them with an all-online class? Both instructors responded "No problem!" (Vol. 1, p. 204). Students could send them their videos; then Oliver and Nelson would digitize them and post them on the Web for everyone to see. They believe that there are all kinds of things that can be done to promote creativity and sharing in a vibrant learning community.

Reflections and Advice

Nelson and Oliver encourage educators to remember that there are still so many things that can be done with paper and pencil or with chalk and chalkboards. Only use computers or technology when something cannot be done another way. They emphasized that this is the only way to use technology successfully. In fact, this reasoning is what led them to use email. They could have used regular postal mail, but it would have been too slow. Email was a unique way to meet the need of students sharing information with each other quickly and inexpensively (if they already had access to Internet service). Oliver also advised to keep the technology simple because the more bells and whistles there are, the more hassles and troubles the students will surely have.

Oliver believes "scalability is stupid and should be avoided" (Vol. 1, p. 205). Scalability, however, is usually the vision of administrators, provosts, and politicians who hope online education will be a cheaper way to do things in mass—industrial-age style. They hope they can teach more students and classes with less faculty and thus reduce course expenses and university budgets. In contrast, Nelson and Oliver believe such beliefs are out of touch with the ways of doing effective online instruction.

Nelson and Oliver state that online teaching is a 24 hours, 7 days a week job: They are never off. When they travel, they virtually take the course and students with them wherever they go. This is both wonderful and horrible. Although it is convenient to be able to travel and keep a class going, they can never take a break from it.

"Usability testing is key," Nelson declared. "You must be open to suggestions from students! They can give you wonderful ideas" (Vol. 1, p. 4). She added a caution to new online instructors to avoid doing everything at once but rather to "start small and build a course" (Vol. 1, p. 4). For example, begin with posting "some class notes online," and later "add some interactive activities." "If you build it piece by piece," she concludes, "with usability testing at each step of the process, you'll be pleased with the results" (Vol. 1, p. 4).

Summary

"Murder on the Internet" created a rich soap opera simulation in which students practiced the target language (either French or Spanish) in an email dialogue. Students were motivated to work hard as they tried to solve the whodunit mystery all while in character. They learned to read authentic documents posted on the Web, learned about the culture, and were able to find meaningful information used for clues. Their ability to write the language was remarkable. Surprisingly, their ability to speak the language increased remarkably as well, even though this was not the goal of this particular course.

CHAPTER FIVE

CALCULUSQUEST™ DIFFERENTIAL CALCULUS

Overview

CalculusQuest™ (CQ) is an online, level-one differential calculus course based on a mountain-climbing metaphor. Active learning is foundational to the course, and access for every student—even those with only basic Internet connections—is another paramount feature. The course captures an intriguing balance between skills, conceptual development, reflection, and a community learning environment.

The original course authors, Robby Robson and William Bogley, along with later team member and instructor, Richard Schori, are all faculty at Oregon State University (OSU).

Course Design

CalculusQuest™ is centered on a mountain-climbing metaphor that provides the theme for the course. This metaphor was chosen because both calculus and mountain-climbing "are challenging, require the use of fundamental skills as well as 'right brain' creativity, and offer great rewards to those who take the challenge" (Vol. 2, p. 56). The instructors are the guides. This is in keeping with both the mountaineering metaphor and with the chosen pedagogy. This course offers many unique, interactive features that will be covered in a latter section.

Initially CQ was designed as a Web course to be delivered completely online. Later, however, it was modified to be an enhanced Web course with limited face-to-face sessions with students and instructor. The course authors were adamant that technology should *only* be used to support pedagogy. Robson asserts,

> But there's really one theme that we want to stress, and the first theme is to use the technology to support the pedagogy. The second theme is to use the technology to support the pedagogy. The third theme is to use the technology to support the pedagogy. And finally, we really wanted to use the technology to support the pedagogy. (Vol. 2, p. 237)

After the initial course was developed by Robson and Bogley, Schori modified the class into a web-enhanced version by "supplementing the Web course with one lecture and one recitation per week" (Vol. 2, p. 2). All course content, exercises, activities, and messages are posted at the CQ Web site. In the modified version of the course, students may now choose to attend the weekly, 2-hour lecture and recitation sessions with the professor and the TA. Distance students miss no new concepts by being absent from Schori's face-to-face lectures, because he provides only a summary of what will be studied for that week. Lectures are on Mondays. Schori explains that he "also introduced structured recitations" each week and then his TA would take over. He adds that "students worked in groups of three or four on problem sets" (Vol. 2, p. 43). Local students love to come to the lectures and recitations even though they do not need to do so.

Active learning is promoted in all aspects of this course. Students work with an enhanced, interactive textbook and with the many interactive activities. Both the interactive textbook and the activities are designed to build a balance of skills and concept development. There are four critical course components: CQ Web site,

QuestWriter™, Instructor, and, of course, the students. Each of these components is explored more later.

Instructional Design

Nationwide only 50% of calculus students pass with a C or higher. This fact forced the team to look at things differently as they sought to find ways to help more students be successful. They wanted to build a uniquely , interactive, supportive course that would create a better learning environment.

The instructional team's first major decision was not to use a text. Initially they did not realize the magnitude of this decision. They simply wanted to take advantage of the unique possibilities of the Web for interactivity and were intrigued with the potential for learning. They believed that only using a printed text would limit those possibilities. It took 6-9 months to write a hyperactive text, however, but this forced them to rethink the pedagogy from the ground up. Bogley declares his feelings about the decision not to use a text:

> I didn't realize it at the time but this was a pretty major decision, to not rely on the available printed text meant that we had to build one of our own. So the ensuing six to nine months of designing a course, trying to implement the interactivity and figure out what the students are going to do when they sit down in front of their computer was overlaying with this effort to essentially crank out a text book in a six month period. I don't think it was the wrong decision in the sense that we were forced to rethink the pedagogy from the ground up, but it certainly meant that we had to spend a lot of time cranking out text as opposed to devising Java Script routines or other innovations. (Vol. 2, p. 239)

The enhanced interactive textbook was developed to help students learn actively. It allows students to work in a dynamic environment and to interact with the content as they read—unlike static printed textbooks.

A key theme that drove this team was their belief that the focus should be on pedagogy rather than on technology. Technology was used only to support the pedagogy and not done just to utilize of the "latest and coolest" technology.

One of the unique features of this hypertext course is glossary links that pop up in separate windows when the student clicks on the word. The authors made the decision to use these links because they wanted to keep the Web pages as short as possible. At this point in time an exact ideal length for a Web page is not defined, but Schori maintains that it is not very long. Therefore, this team strikes for brevity and to eliminate confusion by creating the pop-up boxes (windows) with lots of white space around them. The pages are set up ease if reading. The pop-up boxes contain "short definitions of terms from CalculusQuest™, differentiation and trigonometric formulas, a few historical tidbits, and other information which can be presented in a concise format. . . . Glossary items will appear in separate windows which can be kept on-screen for reference" (Vol. 2, p. 67). Getting back to the original page where the link was first clicked is easy because there is a button that automatically closes the box and takes the student back to the original page. This is an attractive design feature.

The course has 10 stages, each with a mountain-climbing title. Some examples are: "Stage 1: Gearing Up," "Stage 3: Testing Our Limits," "Stage 7: Exploring the Landscape," and "Stage 9: View from the Top." CalculusQuest™ also has different areas for specific activities within each Stage: "a Lesson, a Practice area, and an Onward & Upward area" (Vol. 2, p. 78).

Stage Design

Each Stage has its own cover page which acts as a guide to that Stage. An introduction ties the mountain-climbing metaphor to the week's goals and objectives. These objectives are clearly labeled in the second section. The third section contains buttons for the Lesson, Practice, and Onward & Upward areas. Students are guided by a short description of "What To Do." The cover page sets the learning procedures for students and helps them to navigate throughout that Stage.

Lesson

The "Lesson" area is a place where actual mathematics is explained. It is the first place most of the students will begin each Stage on their ascent up CalculusQuest™. There are no online lectures, as such, but instead there are readings that lay a foundation for the week's concepts. It is important to realize that " many Lesson pages are interactive, but nothing from a Lesson is recorded as part of your grade" (Vol. 2, p. 78).

Another feature of the Lesson area is the "hub which helps you navigate and focus on learning objectives" (Vol. 2, p. 78). The navigation Lesson Hub states the purpose of the lesson and includes other sections such as: "What's Here," "What To Do," "Expected Study Time," and "Objectives." "What's Here" organizes the Lesson's internal links so students can easily access just the section that they need when they need it. "What To Do" gives a sentence or two overview of the lesson's activities. Another helpful feature is the "Expected Study Time" area that provides a range of anticipated time required to do all of the activities and problems one time. Of course, actual student times will vary, but this feature helps them know how to plan their study time. The "Objectives" are listed again on this Hub almost the same way as they were on the Stage cover page.

The practice area

The practice area is like an electronic sandbox where the students can "play" with functions and concepts without any of their explorations contributing toward their grades. There are activities and problems that help students to check and solidify their understanding. This area takes the place of traditional homework and laboratories. All the problems in this area have links to problems. Students are strongly advised, however, to resist going to the answers until they first have given their best efforts to solve the problems on their own. Like the Lesson area, each Practice Area has a navigation hub to help students "focus on learning objectives" (Vol. 2, p. 78). The Practice Hub contains all of the features mentioned in the Lesson Hub description above.

Onward & Upward

Onward & Upward is the graded portion of the course. The only actual requirements that are recorded for the class are all kept in this area. The Onward & Upward Hub features are somewhat different from those of the Lesson and Practice Hubs. There is a new feature called "Activities" that includes a "Sign-In" link. Each week the instructor has a few quick questions for the students to answer. After answering the questions, the "Sign-In" link takes the students to the "What's Next Page" (described in the Other Features section) and from there they can get to the Recorded Activity for that particular Stage. Also posted here is information on when the Recorded Quiz is due. Both the date and the time are given. Another section on the Onward & Upward Hub covers any special activities such as Communication Activities (CA). There are two CAs for the course. The last section contains quizzes and tests for that Stage.

Other Learning Support Design Features

CalculusQuest™ incorporates several features to assist the student in the learning process. All of Stage 1 is set up to help students learn how to navigate in CQ, to understand the course structure, and to get help with some technical matters. The Lesson Hub includes two objectives for Stage: for students to be able to use proficiently the CQ Web site and to "demonstrate familiarity with the Field Guide to Functions and its content" (Vol. 2, p. 82). A quick reference called "Important Pages" is available for those who need to refresh their memories on the purpose of the different sections of the course and where to go to do various things.

Sample tests are also provided. The Sample Final Exam includes a link at the end of each problem that says: "Mail solution to the class." When students study for the test, they are to send the solution to the class for group discussion and input to compare, contrast, defend, and amend their solutions. The Sample Final Exam directions clearly establish that "a **solution** is an explanation of an **answer**" (Vol. 2, p. 145). Students are encouraged to write out the solutions in detail and to discuss them with their classmates on the class listserv. The instructor notes that well-written solution reveals understanding. Just knowing the correct answer is not enough in this course.

CalculusQuest™ Help is a section designed to help students find solutions for any problems encountered throughout the course. Contact information is given for the support team, which is led by the instructor. Furthermore, various on-line and written resources are linked as well as on-campus and Math Department resources. Even more help is provided to ensure student success. Each week Schori posts Tips that review activity deadlines, review sessions, and similar benefits.

On the whole, CQ course designers have attempted to incorporate all possible support for students in an online learning environment.

Interactions and Learning Community

Schori recounted that reading Parker Palmer (1998), a well-known authority on teaching, inspired him to develop a learning community both in his face-to-face classes and in the Web-enhanced classes. He comments:

> The learning of mathematics requires much more in the way of social interaction than has been traditionally understood. The solitaire student sitting in a corner studying mathematics has been a prototypical image for too long and it has hurt the public image of learning studying mathematics. (Vol. 2, p. 31)

One of Palmer's points is that the subject should be at the center of attention rather than the teacher or the students, as is often the case. Schori declares,

> Making the subject the center of attention is precisely what we do in CalculusQuest™, and in particular with the Communication Activities. These structured activities, the focus of this paper, represent a teaching centered class activity that fosters creativity in the process of building community. (Vol. 2, p. 31)

The course now has threaded discussions that facilitate creating an online learning community. "Writing on a topic forces the student to really come to grip with the topic and helps them integrate into their way of knowing," Schori proposes (p.31). He further states that

> at the International Conference on Technology in Collegiate Mathematics, November 1997, in Chicago, a speaker claimed that students who go to big name universities are more interested in having their famous professors hear what they have to say than the students are interested in what the professors have to say. (Vol. 2, p. 31)

In face-to-face courses, Schori contends "at most 20% of the students will respond to our questions and pleas for discussion and the evidence is that the other 80% resist speaking for fear of embarrassing themselves in front of their peers" (Vol. 2, p. 31).

Palmer, a well-known authority on teaching, notes "Behind their fearful silence, our students want to find their voices, speak their voices, have their voices heard" (Palmer, 1998, p. 46). He further emphasizes the importance of students talking to learn: "Learning does not happen when students are unable to express their ideas, emotions, confusions, ignorance, and prejudices. In fact, only when people can speak their own minds does education have a chance to happen" (Palmer, p. 75). These thoughts and others led Schori to create online chat groups where students can talk about the things that they are learning and also about the practical applications of calculus to their lives and future careers. Schori further reports that "students are much more willing to write their opinions, even to the world, than they are to speak them in a classroom" (Vol. 2, p. 34). He adds that this is a potential research topic. "Students pay attention to what other students say and are often willing to speak very clearly in either supporting the others' points of view or criticizing them," Schori discovered.

Bogley added some specific ways that interactions and discussions could be used for learning: "We want to encourage collaboration and communication among the students. From my perspective it's all the better if the students talk about a given problem and come to a common understanding" (Vol. 2, p. 241). He expands on the idea and the benefits that he saw when students discussed calculus well. He said that the students

> don't so much as do math as talk about math the way the pros do it. 'How do you do a problem like this?' The student responds by saying, 'Well, here's a solution strategy . . .' not carrying out the solution but describing the solution. To me this reflects a level of understanding that is not revealed in standard test taking formats or problem solving formats. It's been influential to me to watch the students participate in these communication activities because it often turns out that the students who are very adept at taking tests, taking exams, doing problems, have difficulty with these communication activities and conversely there are students who absolutely flourish and sound like pros when they discuss things in a communication activity who really struggle with standard test taking formats. It was an enlightenment to me to see that

> there are these different learning styles and abilities and strengths and the communications activity is one way that we give the students an opportunity to demonstrate the understanding in a way that I wasn't getting access to previously. (Vol. 2, p. 241)

Communication Activities

Students learn best when they thoroughly think through the process of what they are doing and of how they are applying the principles they are studying. They also have to learn how to properly evaluate or critique someone else's process. There are two Communication Activities (CA) per course. Schori describes the CA procedure:

> We used two Communication Activities which consist of all students solving or writing a mathematical problem (step 1), the computer pairing the students and showing the other person in the pair step 1 of their partner. Step 2 consists of evaluating or critiquing your partner's step 1. Step 3 is to rewrite your Step 1 based on comments made by your partner's step 2 comments. Step 4 is usually just an acknowledgement that the exercise was complete. (Vol. 2, p. 3)

Chat Groups

The Chat Groups gave the students an asynchronous way to discuss various questions that helped relate calculus to their lives or helped them reflect on how they learn best. There were four chat topics during the course, and participation in the Chat Groups was required. The instructor set up eight academic chat areas, but the students divided themselves into discussion groups based on their major, future career, or interests. They did not have to stay with the same group for each of the four topics.

The first Chat Group activity was "Get Acquainted." At this time students shared information about themselves just as they would do if they were meeting face-to-face. They dialogued on things such as what year they were in college or high school, prospective major, and interesting things about themselves.

The second chat group activity was "Getting Real." Here students discussed the question: "Where and how does mathematics fit into your future career? (Vol. 2, p. 157). Rosa answered:

> Hello All~ Here I am again, answering questions about my future. What do I want to do and what on earth does math have to do with all that? It is really rather simple, I promise. I want to work in genetic research and I want to go to med. school. (Although, all of this is ALWAYS subject to change.) Math plays a key role is all aspects of life. "Even farmers use it!" my HS math teacher used to say. Within the field of medicine, chemistry and physics are prominent. Both of these sciences require math. In fact, one must take calculus prior to physics. If I understand correctly, Calculus was written to make physics work. Any type of research requires math. In fact, math is necessary for almost anything!!! What does everyone else think of all this "math stuff." I personally enjoy it, but it sometimes makes me crazy!!!

Tanya, another student, searched for ways that math could possibly impact her career as a dentist:

> Math, hmmmm. What will it do for me? Well I want to become a dentist so as the curriculum states I must take 2 calculus courses. I suppose I'll be needing math in order to be able to prescribe drugs, ensure dosage amounts, and to count teeth. I guess the tooth counting part is not really calculus. I'm sure I'll be needing calculus for my major or else they wouldn't be making me take it, right? Ok, now that I think about it I will be needing Calculus in the future. I am sure that it will be more Chemistry than math, but then again those two sure seem to go hand in hand at times. All in all, math will be important to me and my future (I hope) as a dentist. Anyone care to respond to this? I'll be keeping my eyes peeled.
> as always,
> [Tanya], warrior princess and math goddess in training

Keith responded to Tanya's musings:

> Math goddess? Double Hmm.
> I think they are aiming at making you round. Or, is that well rounded? Chemistry does seem like the most practicle connection. I'm wondering if you will need to calculate the tension or torque on braces that you might be applying to your your patients teeth.
> Happy Holidays, Mike

José, a high school-student, was not so positive or hopeful about how calculus would ever be used in his life:

> I'm not exactly sure what I'm going to do as a profession, but it will most likely be in the business world. In business I will use math for stuff like accounting and financing, however calculus will serve no real purpose in life, and it is extremely worthless unless I become a calculus teacher.

The third chat group activity, "The Proof," dealt with the man who proved Fermat's last theorem. Professor Wiles worked 7 years on the theorem that "had been the most celebrated mathematical problem for the past 350 years" (Vol. 2, p. 170). The solution had no practical application, so the students were to discuss whether or not such a solution was beneficial or worthwhile.

Kip had an metaphorical perspective on the topic:

> If an artist worked on a sculpture for 7 years, and produced an inspiring, beautiful, work, we would call him a genius. So shouldn't the same apply to a man that creates a work of...um.. math? I think this may stem from society outcasting those who make math their life. Stereotypical, catagorization, of social misfits who may not be able to tie their shoes, but can perform complex math calculations with ease, is quite comparable to artists who never leave their houses or are schitzofrenic public rejects. Some of the best works come from these peole. So, no matter how wierd they are, they too, have a place in our society, even if we don't understand it.

Hillevi was able to see the importance of the journey to find the solution:

> I'm not certain that the proof of the therom has any real significance to my life. Not with respect to the Mathmatical aspect of it. However, there is significance in the process that generations of Mathmatician have gone through in an attempt to solve it, and ultimatly doing so. The process of having passion about something, wanting to know the answers, hoping to find the purpose behide some several hundred year old therom. Its a tool, maybe not one used directly but indirectly. Whats that old saying about the journey being as important as the final destination? In my life I may not use Calculus, but the journey that it will have taken me on to my final destination is an important one.

Tanya, however, had an opposite reaction to the previous student's position:

> After looking at the proof and what it stated, I came to the conclusion that Dr. Wiles wasted seven years of his life. I cannot think of one good purpose for the definition of the proof. IT hasn't helped me or anyone else that I know since Wiles has proved it. Bottom line: What good is it doing for mankind and/or will it make math easier on us? I believe that Dr. Wiles researched this proof for the sheer notariaty of it all. Much in the way a person sits on a pole for several years just to get in the Guinness

> Book of World Records. Bottom line, once again: What's the point of this proof and what can it do for us now?

Keith tried to help Tanya see a more positive perspective on Dr. Fermat's 7 years of effort:

> In response to your harsh words about Dr. Wiles proving Fermat's last theorm: Lighten-up! It is only your opinion that he wasted his life. To him, he accomplished a life-long ambition. I wonder if those who are quick to criticize have even thought of tackling an equally difficult problem.
> The beauty of this whole thing is that Wiles had the necessary tools that others before him lacked. For some reason I am now thinking of what we all hear from time to time: "We can put a wo/man on the moon, but we can't..." Again and again we are able to remove the "can't" as time moves forward. Who knows, maybe 350 years down the road Fermat's proof may prove handy.

At this point I will assume an affective stance and provide a personal reaction to these student reflections. Reading through the chat logs made me feel that I was "there" and could "feel" the tensions and "hear" the aha's as students connected calculus to their lives in unexpected ways. By creating small groups based on academic interests, the instructor set the stage for dynamic and meaningful discussion. This discussion allowed student emotion to be expressed. While many professors implement this strategy in face-to-face classes, others question the feasibility of using this method online. CalculusQuest™ is a good example of meaningful, small group discussions.

Assessment and Evaluation

A unique feature of CalculusQuest™ is the grade-free quizzes that allow students to see how well they understand the lesson concepts and skills before taking a graded and recorded quiz. Students can take these quizzes without any penalty and can get immediate feedback. The practice quizzes are where

> the student is able through this Java Script in-line quiz to check their comprehension and make sure they've really got it. If they need some advice about why the answer

> to this in-line quiz is what it is, an explanatory pop-up page is provided. (Vol. 2, p. 240)

This is an excellent instructional strategy. Students can test their knowledge and learn from their mistakes *before* any quiz is recorded.

QuestWriter™ allows students to do three things with quizzes: submit for grading, record them, and/or save them. When students want a quiz to be graded, they submit it, and the computer corrects their answers and sends the results back to the student along with the correct answers, feedback from the author, and the student's score. A graded quiz has been corrected but is not automatically added to the Gradebook. Once a student is pleased with her progress on the Practice Quiz, then she can take a quiz and have it recorded in the Gradebook. The quizzes—whether just graded or graded and recorded—can be saved in the Student Folder. Practice quizzes can be changed after they have been graded and saved in the folder. The recorded quizzes from Onward & Upward, however, can be saved but cannot be modified after they have been recorded. These various features encourage students to practice, to learn from their practice, and then to strive for success on the quizzes to be recorded. Plenty of time is scheduled for students to take the quizzes. They are encouraged to take the quiz well before the deadline. Deadlines are real and non-negotiable. A positive feature about QuestWriter™ is that it takes care of telling the student where she stands and when various activities are required. Schori comments that the students do not argue with QuestWriter™; however, if they were in a face-to-face classroom, they would try to get excused from deadlines with a multiplicity of stories and excuses. Students do not know how to plead their case with QuestWriter™ so they do the work before the deadlines since nothing can be made up after that time.

Three types of questions make up the quizzes: true/false, multiple choice, and essay. QuestWriter™ grades the first two types of questions automatically but sends all essay questions to the instructor to grade. QW also sends the quiz results along with feedback to the students.

CalculusQuest™ includes three proctored tests: two midterms and one final. OSU students come in at designated times for the tests; distance students have their tests proctored at their own educational institution before the prescribed deadline.

Support

To help ensure that the technology does not get in the way of learning, it is recommended that before students begin CQ that they purchase and view the video "InterQuest" User Preparation Program. This video can be purchased at the university bookstore. It prepares students for a new way of learning with Web courses. This tape is used for all Oregon State University Web courses.

"First Aid" is a section for technical help when the Web site does not perform as it should or if there are other technical difficulties. This is a FAQ (Frequently Asked Questions) list and it covers topics such as:

> What if I get the message 404 Not Found or File Not Found when I try to load a page?
> What if my computer freezes up and nothing I type or click on has any effect?
> What if I get an Authorization failed error?
> What if I get a bad-cookie error? (Vol. 2, p. 72)

Web Design and Construction

Web design can make or break an online course. If the content is excellent but the design is confusing and difficult to read, the course will not be successful. The authors carefully analyzed their content, their goals and objectives, and their understanding and

beliefs about pedagogy before beginning to design the pages. As a result, the course Web site is coherent and effective. The course design is complex but consistent. Once students understand the course components and system, they can easily navigate and function within the resources provided for their successful learning experience.

Introduction pages for each main section have the standard CalculusQuest™ banner at the top of the page. The banner has a stylized rendering of the name of the class set on top of a mountain range background, thus setting the visual stage for the course metaphor. Most of the subpages within the main sections of the Stages also have a smaller rendition of the CQ banner. This reminds the student where she or he is inside the course.

Web page length is an issue that course designers discuss with differing opinions. Some authors like to have long pages with navigation links at the top and anchors set throughout the page. Others are convinced that short Web pages are most effective. CQ authors endeavored to keep pages as short as possible. In many cases this is a screen or two on an average-size monitor. In other cases some of the pages are necessarily longer due to the nature of the material being presented. Robson commented that the ideal length of a Web page is not yet known but that they believe it is short.

This course was built before Web-page editors existed; consequently, everything was done in raw code. Robson and Bogley, the original course authors, were working with Netscape 1.0 and 2.0 and JavaScript 1.0. There were no course management systems such as WebCT or Web Course in a Box which meant that they had to carefully think through what they wanted to do and then find ways to make it happen even with limited tools.

Navigation

CQ authors carefully crafted the course's navigation system with a series of hubs, spokes, and buttons. As already noted in the Instructional Design section, each Stage has a cover page that introduces the overall objectives and activities for the week. In addition, each cover page also has links to various resources, Tips for the Week, a mailto: link for Richard M. Schori, Chat Group topic links, and What's Next. Each of these is included on the cover page so students can go where they need to go quickly and with as little frustration as possible. Further, each of the three parts in a Stage has a hub that clearly organizes all of the activities for the Stage. Anything on the Web site that confuses a student will slow her/him down and ultimately impede the learning process. Each link that goes out from the hub is a spoke, and the graceful integration of the hub and spokes works as smoothly and as efficiently as a wheel.

Additionally, the authors integrated judicious use of color backgrounds to help students understand the function of each page and its relationship to the course. For example, khaki pages are the Lesson pages, pale blue pages are for enrichment, lilac pages are for Onward & Upward activities and information, and so on for a total of six colors and functions. Thus whenever students are on a page the color of the page's background reminds them why they are there or what is the nature of that page's function. This is a simple but effective navigation technique.

At the end of each page is a button bar with links to key places in the course: Cover (for the Stage where that student is currently located), CQ Directory, Hub (again for the Stage where the student is currently located), and CQ Resources. This means that

students do not have to rely on their Web browser Back and Forward buttons in order to get around in the course.

CQ authors have carefully designed a dynamic and effective navigation system that supports the learners in their quest to understand differential calculus.

Interactivity

A course should have some interactivity. "In my experience, when students see a Web page they want to do something. If there is nothing to do, the default action is 'print'," asserted Dorbolo, who worked on the InterQuest™ Project (Vol. 2,. p. 206). CalculusQuest™ is built on the concept that students need to interact with the content, with other students, and with the instructor. Schori explains how the team encouraged students to interact with the content:

> In the Lesson part of the web site, we utilized Java Script quizzes for self evaluation. In the testing part of the course we used weekly on-line quizzes over the material that the students were studying from the web pages. (Vol. 2. p. 3)

An additional way that students interact with the subject is with black box-type problem activities. On one side of the black box the students put in some numbers. The black box does something to these numbers and sends them out the other side. Students then are supposed to repeat this process with several other numbers until they can figure out the formula (within the black box) that is being applied to the numbers.

The students also interact with each other through a variety of interaction activities including the discussions on HyperNews, a bulletin board program, and the paired Communication Activities that are defined more in depth in a later section.

Interactivity is also important between students and instructor. Schori was involved with the students. He gave a lecture once a week in the enhanced version of the

course, answered a multitude of person-to-person email messages from the students on technical problems and course content problems, gave Chat Topics to students to discuss in HyperNews, and gave three graded tests.

Interactivity was integrated throughout CalculusQuest™ in ways that are not common in traditional settings and with typical methods.

Course Management Software

Course management is done with a special program called QuestWriter™ (QW). This program was developed by the InterQuest™ Project before there were any commercial programs available such as WebCT, Asymetrix, Top Class, Web Course in a Box, and such. QuestWriter™ includes the following items:

1. Quizzes—interactive Practice Quizzes (no grade) and Recorded Quizzes (grade)
2. Communication Activities—partners work on solving problems
3. Gradebook—students can view their own automatically tabulated scores and grade
4. What's Next—keeps track of Recorded Activities for each student and sends out reminders of impending deadlines
5. Sign-Up—handles course registration online {check}
6. Sign-In/Sign-Out—students let instructor know how they are doing
7. Student Folder—saves students' Practice Quizzes and other work as a portfolio.

The Gradebook does more than just record the activities and grades. It actually helps both students and faculty keep pace. Regarding assignment deadlines, CQ

instructors found that students do not argue with the Gradebook. When the Gradebook tells students that assignments are due by a certain time, they do not argue. Assignments are turned in on time. Students do not take their excuses to the instructor to try to negotiate a new deadline outside of the Gradebook's deadline.

In the CQ environment, students discuss how they learn best. They analyze what are their most effective study and learning strategies. Because QW makes students' phone numbers easily accessible, Schori made many more phone calls to students in the Web-enhanced courses than he usually did with face-to-face students. It is optional as to whether or not the students give their personal addresses to QW—most do—but phone numbers were required.

Effectiveness

Scott Chadwick of OSU and Iowa State, an original member of the CQ team, did some interesting research on this course and on a philosophy course. He found no statistical difference between the face-to-face or Web versions of each course. Three or four areas scored higher for the Web-enhanced course above the straight Web course, however. This combined approach builds on the strengths of each method of instructional delivery. Robson contends, however, that it is not good enough for us to say that an online course is as good as a face-to-face course. He challenges other Web course authors that the real question is to find out *how* we can make the Web courses *better* than face-to-face courses.

Considerations

Distance Instruction

Distance instruction or distance learning can have many names and multiple definitions. Robson believes that this new platform for learning introduces an opportunity to reconsider the epistemology of the learning process in general. He asserts that "the learning takes place where ever the STUDENT is. If we stop viewing ourselves as the center of the universe, we see that the TEACHING can be distributed as easily as the students can be distributed" (Vol. 2, p. 234).

As noted previously, this course was originally designed to be strictly an online course for distance students and was delivered that way exclusively in the beginning. However, when Schori discovered that almost all of the enrolled students were not distance students but were local OSU students, he decided to modify the course to take advantage of some face-to-face advantages. There were some distance students, but they were all people who already had established connections with some type of connection to Oregon State University. For example, a parent could have been teaching at OSU or some similar type of connection existed.

The CQ team members were not marketers so most students did not know about this class as a result of marketing efforts, either on or off campus. The university also did no marketing of the course. Schori reflects:

> There's a philosophy I developed and have been promoting around the country that most of us do not have that many distance students at this point, and if we can go ahead and build up incrementally web sites that self-support a standard course and eventually push it to a point where you can then teach distance students, then this makes more economic sense than just putting [in] a lot of money. . . . I mean these guys were quite well supported, but those of us following these guys, we don't have the support. We have to think about those economic issues. (Vol. 2, p. 243)

Subsequently, the CQ team has backed off developing strictly Web courses because of marketing and PR problems since they must rely on the administration to market their courses. As yet the university has not accepted this vision and responsibility. For this reason, the CQ team focuses completely on a combination of face-to-face and Web course design which is called Web-enhanced instruction.

The CQ team's modified course is now a Web-enhanced course, which Chadwick found was more effective on three of four objectives when compared to either face-to-face or Web courses.

Face-to-Face Versus Virtual Considerations

Sometimes in large face-to-face classes student attention tends to drift during lectures. This Web-enhanced course included only about 40 students; however, Schori observed that these students were more engaged than those in typical face-to-face classes.

He also observed that students work harder in the Web course because it requires more focused attention. It is usual for students to take calculus without realizing how much work it is going to take no matter whether it is face-to-face or on the Web.

One of the things Schori likes about the Web-enhanced class over the face-to-face is that he gets to know online students better because there is more teacher-student interaction in the Web-enhanced course than in the face-to-face version. He gets to know a few students by name in face-to-face class, but not very many.

Problems

One of the weaknesses students complained about was that there were not enough problems in the practice area. This was true because CQ authors wrote their own text and

had to generate all their own problems in a relatively short period of time. If they had been able to take problems out of a textbook, they would have had a much easier time and would have ended up with an even more robust course. Copyright issues prevented this. Currently, Schori is developing another course. Because his attention is focused elsewhere, the CQ course will not be revised for the time being.

One of the things the team tried to address in the CQ course is learning styles. Consequently, this focus has ascribed some unusual features to this calculus course. CQ authors require student portfolios and students must write reflectively. Some students do well with communications but not so well in preciseness with numbers. For others the opposite is true. Schori asserts that it is probably good for both types of students to go through both kinds of experiences. In his opinion each student should have opportunity to perform in his or her preferred mode of learning some of the time.

Low enrollment was a problem, as noted earlier, but this was probably because students on or off campus did not know about the course. It was definitely a marketing issue.

Unquestionably "administration can shoot you in the foot in ways that you may not expect," Schori suggested (Vol. 2, p. 202). This is more than the typical support issues of not having enough money, not getting release time, or not getting other things that we want universities to do to support faculty. Administration often does not communicate course information properly. For example, they may omit the information in the course schedule that the class is online. Such course mislabeling is not limited to the Oregon State University. This simple but critical omission creates difficulties for students and faculty alike.

Students

Student reactions to the course were mixed but generally favorable. Many students liked having material on the Web and most liked having face-to-face lectures and labs. Surprisingly, students seemed drawn to the Chat Topics.

Negative feedback comments were few. Unexpectedly, students wanted three lectures a week rather than just one. Others wanted more of a traditional format. Schori contends that it takes specially motivated students to be successful and contented online. Further, some felt that there was too much reading on the Web. They got tired of staring at the monitor screen. They also asked to have alternative methods of presenting material such as audio or video lectures.

Changes in Course

When we try something new, we tend to learn from it. Schori was no different. Some of what Schori learned related to what not to do. Now he has definite ideas on what he would change in the course.

1. Make individual lessons shorter so that students can achieve a sense of satisfaction by studying for a shorter period of time, say one hour. A lesson which consists of a week's worth of material is too long for the patience of most students to handle in one or two sessions.
2. Have a book going along with the course. Reading much material on a computer is not a good idea.
3. Use some audio clips to help reach more students.
4. Use some email or on-line group activities where students can teach each other.

In addition to this list of changes, Schori makes other suggestions. He suggested that all course materials could be desktop published and sold to students at the campus bookstore. This would be another way to cut the amount of time students must spend

reading on the computer screen. Also, he would encourage greater use of digital libraries, like the one at Duke University.

Unexpected Discoveries

When asked what were some unexpected discoveries, Schori replied "Students are much more willing to express themselves by typing into a computer than speaking up in a classroom, even if their comments are exposed for the whole world to see" (Vol. 2, p. 4).

Challenges and Satisfactions

There were many challenges to overcome in developing this exemplary course. First, the team had to agree on the "format, content, and style of the course" (Vol. 2, p. 4). There were teaching challenges, also. Schori reveals that "battling with the Registrar and Schedule Desk on how to list and advertise the course" was frustrating. The specific challenge was to agree on "how to identify the course as having web content and at the same time keeping it in the same pool of courses with the 'regular' sections of the same course" (Vol. 2, p. 4).

In addition to these troublesome challenges, Schori had some satisfying experiences as well. He states that there were two things that were especially meaningful to him: "Being able to creatively experiment with pedagogical ideas. Also learning the technology needed to implement the pedagogy we wanted" (Vol. 2, p. 4).

Instructors

Richard Schori, Ph.D.

Helping students to truly understand math is important to Schori. As a small boy, Schori had an experience that set the stage for the way he thinks about math and the way he teaches. He relates:

> In sixth grade I missed school for the day when rounding off decimals was explained. I came back to school, heard the teacher remind the class on some rule for rounding and then I flunked a quiz on it. Later, after working on it I understood it. I think it helped me realize that to really understand something is different than memorizing rules. (Vol. 2, p. 44)

Pedagogy is also important to Schori who believes it is a challenge to develop and deliver online instruction. He cautions that it is dangerous to try to take a standard course and put it on the Web without trying to develop and implement innovative pedagogical strategies that are appropriate for the Web.

Schori is a full professor and believes this gave him some freedom that his associates did not have. They had to be concerned about tenure and promotion, whereas he could afford to work on this project without those concerns. Schori has an adventuresome and pioneer spirit; in fact, he climbed McKinley in 1988.

In the next course that Schori develops he will move to the second level of calculus. He will add video and audio clips. As yet, he does not have the pedagogy worked out for this new course. So far what he has built is an extended study guide for the next level of calculus (http://iq.orst.edu/mth252).

Since two courses are considered a full-time teaching load at OSU, Schori did not think that teaching two online courses at once would be a good idea. The big problem would be that he would not know which course student emails involved. It would be

difficult to keep everything straight. He could have them put their course number at the beginning of the subject line, but it is likely that some students would forget to do this and would thus cause problems. Therefore, Schori did not think he ever wanted to teach more than one online course at a time.

Robby Robson, Ph.D.

Robson, one of the original CQ author team members, is an Associate Professor of Mathematics at Oregon State University. Robson is nationally recognized for his expertise in instruction. He has given numerous presentations, workshops, and inservices on this topic and has published various academic papers on the subject as well. In addition, he has authored an extensive online tutorial: Web-Based Instruction (http://math-classes.orst.edu/workshop/tutorial/). Robson explains the importance of having an online tutorial:

> To serve the needs of the increasing number of educators who are looking for practical solutions and want to cut through the hype. Many of those wishing to put instructional material on-line either have unrealistic expectations of Web-based instruction are acting at the behest of leadership which harbors unrealistic expectations. Others are just trying to find out solid information and cannot turn to the experts within their organization because the experts are overworked and cannot keep up with demand. (Vol. 2, p. 51)

William Bogley, Ph.D.

Bogley is an Associate Professor in the Department of Mathematics at Oregon State University and was one of the original CalculusQuest™ team authors. He described his experience with CQ:

> Together with OSU Mathematics colleague Robby Robson, I spent much of 1996 writing CalculusQuest™, an all-inclusive web and internet course in differential calculus. CalculusQuest has been used at Oregon State University and at Linn-

> Benton Community College for web-based distance learning and web-enhanced classroom instruction since the fall of 1996. (Vol. 2, p. 49)

Teamwork

Although William Bogley has not taught CQ since 1996, he was one of the key producers of the course. He and Robson taught it originally. Schori describes Robson and Bogley's roles and implications of their efforts in developing CalculusQuest™:

> They took at least a year out of their lives from the traditional activities for promotion at a research oriented university. In some ways you have to be aware of that. . . . This is a non-standard activity to develop a web course, by today's standards anyway, and so I am very appreciative of them for that. I was a full professor, and so I didn't have to worry about those things and there's a real advantage in that. They were the pioneers and the risk takers. (Vol. 2, p. 243)

Later Schori took the course over and taught it one time online and then modified it into a Web-enhanced course for his face-to-face class.

Reflections and Advice

As Schori reflects on his experience with teaching CalculusQuest™ he shares what he has learned: "It became clear that learning styles of students are dominated by the student's preference to learn by reading or to learn by hearing. We should pay attention to these first before trying to get more sophisticated in our teaching" (Vol. 2, p. 4).

He further urges instructors and developers to "Keep each HTML page short, at most two screen fulls," since this would help with reading on the computer (Vol. 2, p. 4). In addition, he adds "use the computer as more of a communication device instead of as a source of information" (Vol. 2, p. 4). He believes that by talking in a learning community, students will learn more and learn better.

Schori gave one last suggestion to all those interested in developing online instruction:

> Don't try to mimic a successful classroom strategy for teaching on the web. Rethink the pedagogy relative to the new medium. It should be significantly different than a classroom pedagogy. The teacher really needs to learn how to be a facilitator instead of the focus of the teaching. (Vol. 2, p. 4).

CalculusQuest™ has been an interesting learning journey for the design/instructor team as well as for the students. Schori's closing words of advice to the "Creating Effective On-line Instruction" Conference at the University of Kansas, Lawrence, were:

> In conclusion, the web course is a wonderful place to experiment pedagogically. You have a lot of freedom. There's no really right way to do it, but what we want to achieve and try for and encourage you . . . to do it a little better and better each time. (Vol. 2, p. 247)

Summary

"CalculusQuest™" is a level-one differential calculus course based on a mountain-climbing metaphor. The course is complete with its own interactive hypertext textbook including hypertext pop-up glossary, interactive quizzes and tests, and gradebook. There are many course features such as the mysterious black box. In addition to addressing the typical concepts and skills, the course requires reflection and encourages collaboration. Students participate in a learning community to make connections to their lives.

CHAPTER SIX

CURRICULUM DEVELOPMENT

Overview

Streaming audio lectures help to make Curriculum Development a special, content-rich course. It is designed to encourage robust student interactions with content, instructor, and other students and is a completely asynchronous, online course. Students apply what they learn about collaborative curriculum development by actually participating in cooperative teams in an eight-step curriculum development model to create a curriculum product. This unique course is offered through two departments at University of Kansas (KU), Lawrence: Special Education, and Curriculum and Instruction.

The course was developed by Ed Meyen, Paul Tangen, and Cindy Lian. Meyen, a professor at KU, had already taught this course for 20 years when Tangen, a graduate student, talked him into developing and teaching the course completely online. Lian, another graduate student, completed the team. Tangen and Lian did most of the technical work and collaborated on some of the instructional design with Meyen who developed the content and most of the instructional design.

Course Design

Meyen maintains that online teaching is a pedagogy not a delivery system; it "is a continuous process versus scheduled sessions" (Meyen, Lian, & Tangen, 1997b, p. 12).

"We are not experiencing a threat to traditional instruction," he contends, but "what we are experiencing is the emergence of a new mode for delivering instruction" (Meyen et al., 1997a, p. 160).

This subject-centered course originally began as a successful face-to-face version. Although at first glance it might appear to be based on the old paradigm of the "sage on the stage" method of teaching, the course actually is based on active learning. The RealAudio lectures are time-sequenced with visuals that enhance the students' understanding of the lecture, and it all works well. Forty-five activities are built into the course, and students are required to participate in all activities. The instructor's goal was to replicate the face-to-face course and learning experience to the Web.

Professors frequently wander off topic in the classroom when students ask questions that are interesting but not directly related to the topic. Students and professors alike may enjoy such side trips once in awhile; however, course goals can be compromised in the process. Meyen explains "I really believe that in many traditional courses we really fall short in terms of the design aspect." On the other hand, "in an online course, it has to be designed and it's very public" (Burgos, 1998, p. 5). Online teaching gets beyond the temptation of getting sidetracked in "entertaining" students and concentrates on the content and interactions. Meyen reflects:

> This way you can really examine the content and that creates a level playing field. That's not to suggest that online instruction will replace traditional instruction, but I think there's a real place for it and for many people it will become the instruction of choice, not for all that they learn, but for a substantial portion of what they learn. (Burgos, 1998, p. 6)

Instructional Design

"Teaching on-line is a combination of the instruction delivered and the instructor's role interacting with students as they progress through the course," Meyen advances (Meyen et al., 1997b, p. 4). The Curriculum Development course is based on this belief.

An instructional design principle of this course is that unlike face-to-face courses there are no midcourse changes. After the first week students were at all different levels. If a change had been made after that point, it "will not uniformly affect all students in the same manner" (Meyen et al., 1997b, p. 5).

Course Supports

The course has various means of both supporting and engaging the learner. Since the learner studies in an environment that cannot be set up or controlled by the instructor as in a face-to-face course, it is critical that the instructional design create the appropriate environment through course supports.

Syllabus

The online syllabus is more detailed than the regular face-to-face syllabus because it needs to answer the inevitable questions that students are sure to ask. Meyen comments about the student tendencies: "The first thing they print out is the syllabus" (Vol. 3, p. 192). He defines the function of the syllabus in the syllabus itself:

> The syllabus serves as a contract for the course in that it details the content of the course and instructions for using the Internet to complete the instructional tasks. . . . The syllabus has been designed to be the students' primary source for information regarding the course. (Vol. 3, p. 8)

Lesson Schedule

The Lesson Schedule is the "main directory to the course," Meyen informs students in the syllabus (Vol. 3, p. 9). The course schedule divides the 16 lessons into three units. Each lesson is described with a sentence or two and includes a target due date. Each lesson has links that go to the lesson index. The regular lesson activity schedule dates are recommended only; however, the graded items—mid-term exam, final, focus presentation, cooperative project—all have definite due dates. Meyen discussed the effect on students of not having a strict lesson schedule:

> They do what is best for them, which means that I have activities coming in and communications coming in at all hours of the day. So they now go through an entirely different shift in terms of how they participate in instruction. They're not going to class on a schedule. They can get ahead or they can fall behind. The typical pattern is they get ahead. (Burgos, 1998, p. 4)

Listserv

The course listserv was the key means of group discussion. The course syllabus, however, describes the differences between other various types of communications that are possible in the class:

> If you wish to communicate with a fellow student or all members of the class, this is the mechanism you use. While E-mail Prof is confidential, Course List Serve is public in that messages can be accessed by all students. This approximates a traditional class discussion in that other students listen to the comments of students and respond. They can do that in this course through Course List Serve. (Vol. 3, p. 9)

Roster

A feature that promotes student interactions in the course is the class roster which "allows students to enter demographic information along with biographical data. Photos, phone numbers and addresses are optional. The student's email address is required"

(Meyen, Lian, & Tangen, 1998, p. 3) because this is the main method of communication. Tangen further explains about students supplying personal information in the roster: "Probably 95% of the people submit it, and we haven't had any problems with privacy" (Vol. 3, p. 195). Even though students insisted on seeing pictures of the instructor, and "they want to look at other people's pictures, but they don't want to submit their own . . . so that means we have no pictures. It's an interesting situation," Tangen reflected (Vol. 3, p. 195).

Technical Support

Technical support is a critical item in online instruction. Meyen declares "We didn't want the problem with the technology to interfere with the content, with the pedagogy. Paul made a major effort to design the course in terms of technology in such a way that we could minimize the problems" (Vol. 3, p. 192). In fact, during their most recent version of the course, there was only one technical support call, and it involved a problem with a firewall at the woman's work rather than with a problem at the KU end of things. Overall, the careful design and rigorous testing of the course have reduced the problems with technology.

Lesson Page

The Lesson Page "is an index containing a listing of all lesson elements and a method for navigating to those elements" (Meyen et al., 1998, p. 3). It is designed simply and clearly, making it easy for students to find the lesson components whenever they need them.

Advanced Organizer

Before each lecture Meyen provides an Advanced Organizer which is a 2-minute mini-lecture that briefly reviews the previous lecture's content as well as "describes the major components of the lecture" (Vol. 3, p. 9). He explains why he uses this technique to help students learn:

> In online instruction you can't predict how much time a student might allow to lapse between a lesson. They may do Lesson One and two days later do Lesson Two. Or has happened a couple of times they do Lesson Three and two weeks later they do Lesson Four. The advance organizer is a two minute lecture that reminds them what they learned and tells them what they're going to learn. . . . We do that for every lecture. The first one is just what they're going to learn obviously. That precedes the lecture. (Vol. 3, p. 193)

Lectures and Visuals

Meyen had taught this course for a number of years face-to-face, then "in the Spring of 1995 he taught it on television in an interactive model from this campus to other campuses" (Vol. 3, p. 189). When Tangen persuaded him to develop an online version of the class with streaming audio, they already had all the taped lectures from the television course to pull from. They also had every activity, every assessment, and everything else that was used in the course. Meyen reflects that it was difficult to watch himself lecture for 3 hours at a time. Like most professors he integrated various non-content material throughout the lectures; he figured that most lecturers only teach about 1 hour and 20 minutes of content for every 3 hours of presentation. He determined to refine the lectures for the online course so they were focused on content only.

Most online courses do not have full streaming audio lectures. Meyen describes the process that he used in developing them:

> I wrote scripts for every lecture. There's a tendency for professors when they write, to write like they're writing an article. What I wanted to do was to write lectures like I lecture. I use a lot of transparencies and such in my lectures in the traditional course. So I wrote the scripts for the lectures in an informal type of language like I was giving a lecture. Then for all of the content I created graphic illustrations.

The audio lectures drive the visuals which means that the visuals are timed to come up at the correct time to match the lecture content. It works smoothly. When the team did a pilot study, however, they discovered that the students wanted to see a picture of the professor. When there was no picture, they had the feeling that the computer was teaching them rather than a human instructor. In responses to this feedback, the course authors took the video lecture tapes from the 1995 television course, selected various frames and poses of Meyen, and put these pictures online. Meyen explains "We just went to the tapes when I talked on television and captured little images of me with my arms flaring and talking about this and that. They appear on all of the lectures" (Vol. 3, p. 24).

Then he put these images on most of the visuals. Although it was not streaming video, the effect is similar because the action photos of the professor are next to the content graphics and all are perfectly timed with the audio lectures.

Students appreciate the streaming audio lectures because they are in full control of how they want to listen to them. They can pause the lecture or repeat a small section or even the whole thing as often as they want. This is not an option in a face-to-face classroom.

Notes

Meyen prepared notes for the students on each lesson. These notes can be printed out either before or after the lecture. The syllabus describes the notes further:

> As you listen to the lecture and view the graphic illustrations, brief statements will periodically appear on the top monitor screen. These represent brief notes much like those you would record while listening to a lecture in a traditional course. (Vol. 3, p. 9)

Activities

Students like to print out the activities before listening to the lecture. This helps them to stay focused and to know for what they should look. The forms can be simple or fairly complex, but each one has adequate directions to guide the learner through the activity. When they click on the "Send to Dr. Meyen" button, all the box's contents are sent to Meyen in one email message. He then personally responds to each student's activities.

Outline

An extensive outline is provided for each lesson. These are the actual outlines from which Meyen wrote his lectures. Students like to print out these outlines before listening to the lecture. The outline helps them better understand the lecture and the relative importance of the various items. It is not meant to be "a substitute for the lecture, rather, it is designed as a supplemental instructional aide" (Vol. 3, p. 9).

Glossary

Meyen insists on having an online glossary because "I think it's very important to teach the language of the subject matter" (Vol. 3, p. 193). Each lesson has its own glossary page, and all of the lessons' words are combined for a full-course glossary. He explains the nature of the glossary:

> The terms are not unique but, rather, represent concepts important to the lesson. . . . The definitions provided will not be of a dictionary nature, instead, they will be descriptive of the way the term applies to the focus of the lesson. (Vol. 3, p. 9)

Readings

There are 10 required readings and 15 recommended readings. All of the required readings are articles that are posted within the course on the KU server. None of these are outside links, so students can always access the articles. The recommended readings, however, can be found in common academic journals but are not posted on the Web. A link to the Reading List is provided on the Course Introduction page. Meyen keeps a notebook filled with copies of the recommended articles at the University of Kansas, Lawrence, campus library. This benefits only local students; however, distance students can access the articles from their local libraries.

Lesson Assessments

At the end of each lesson there is a 10-item, non-graded, multiple-choice quiz. This quiz gives the students immediate feedback on their grasp of the lecture topic. If they do poorly, there is no penalty. They may take the quiz as often as they like; however, the very first time they take it the score is captured and sent to the instructor. Meyen reports that this information is useful for him to know because "either the item is bad or I didn't teach it" (Vol. 3, p. 200). He always writes the key first and puts down what he wants the students to know. Then he figures out the questions, and by then he has developed the key as well. These lesson assessments are designed to help the students in their learning process.

Focus Presentation

Each student must read in the content literature and write a report to be shared on the class listserv. The student must send her topic submission to the professor to get approval before writing and submitting the report. Both the topic proposal and the Focus Presentation itself are based on CGI scripted forms with text boxes where students fill in the appropriate information. Although these structured reports are sent out to all students in the class, the instructor's feedback is sent directly to each student as a private communication.

Collaborative Project

The collaborative group project is one of the most difficult things to do online. Meyen explains that his method of working with groups is never to put groups together himself. When he has done the assigning, the students tended to blame him even though he tried to make heterogeneous groups this way.

Meyen tells students at the beginning of the course that by a certain date everyone has to be on a team and by another date the group project is due. Students have an online class roster so they get to know each other in class as soon as possible. Next, they start emailing each other with project proposals that meet the given parameters, and they try to develop a team. They may get together because of common interests, regional areas, or friendships. Students negotiate to get certain people to work together on a team. The bad side of this method is that some people are so busy that they do not get into the team negotiations early enough and thus miss out on getting onto a team that best suits them. Sometimes Meyen has ended up with a group of only one when the group should have included three. Occasionally, he has allowed a group of one when there were special

circumstances not due to missing the team negotiations. Meyen is flexible and sensitive to student needs. Once the teams are formed and each has designated a team leader, Meyen communicates only with the team leader about the group project. He asserts:

> The reason I do that is not just to cut down the work for me but to build collaborative behavior on the part of the teams, the students . . . not knowing where they are, they're not going to be beside each other, they're going to be communicating. That's how I try to build that communication across students. (Vol. 3, p. 192)

"Students' prior experience in using the Internet will influence their readiness for engaging in collaborative projects during the course," comments the development team concerning student success in online collaborative groups (Meyen et al., 1997b, p. 10).

Interactions

Interactions are a key to the success of the course. Of the three types of interactions noted in chapter 2, all three are present in the Curriculum Development course. For learner-to-content interactions there are 16 lessons in which students participate in one to two activities per lesson, take a non-graded quiz, and evaluate the lesson itself. They also prepare literature reports and share them with the class. Learner-to-learner interactions include a class listserv for group discussions, for sharing Focus Presentations, and for negotiating team formations. Listserv messages are public. Meyen further explains team interactions:

> Each team negotiated their membership on a team. They worked cooperatively to complete a project. Each team selected its own leader. Once a team was formed I corresponded with the leader who was responsible for sharing my communications with team members. (Vol. 3, p. 3)

Equally important, there are rich instructor-to-learner interactions which are private. Meyen averages 50 responses per student for an average of 598 minutes (9.67

hours) per student in personal communication throughout the course. The first time he taught the course he averaged 959 minutes (15.98 hours) per student. This is much more direct and private time between instructor and student than is typically achieved in a face-to-face course. The development team had a favorite quotation from Sherry (1996, p. 5): "The most important factor for successful distant learning is a caring concerned teacher who is confident, experienced, at ease with the equipment, uses media creatively, and maintains a high level of interacting with the students" (p. 5). They added their own item to Sherry's list: ". . . . and is tolerant of changing technology, policies and expectations" (Meyen et al., 1997b). The teacher makes the difference in this course with all his personal interactions with the students and with the content design.

These interactions make the course much more personal than one might expect. "It is extraordinarily personal the way I designed the course," Meyen discloses "because there's lots of interaction. And you become acquainted with your students. You're communicating with them almost daily" (Burgos, 1998, p. 4). Most of the time graduate courses are in the late afternoon or evening. Students frequently are tired after a day at work, plus they have other responsibilities facing them once the class is over. Consequently, they often do not stay by after class for personal and private conversations with the instructor.

> In online instruction, every question that they ask and every activity that they submit is theirs and you're responding only to them and they begin to realize and sense that. I think that one of the real strengths of online instruction is the personal nature of it. (Burgos, 1998, p. 4)

This is not, however, what most students expect when they think about taking online instruction. They are often fearful about the whole situation "My goodness I'm

going to sit here looking at the monitor and hit a few keys and be expected to learn" (Burgos, 1998, p. 4).

The interactions in this course were asynchronous. "It is technically possible to communicate in real time, but to some extent that defeats the advantages of online instruction," observes Meyen (Meyen et al., 1997a, p. 162). However, the use of the telephone—a synchronous communication—is acceptable to use whenever students want to do so.

Assessment and Evaluation

Curriculum Development includes informal student assessments as well as formal ones. Tangen recounts that "it's just a multiple choice quiz as is quite common but this has the unusual feature of immediate feedback" (Vol. 3, p. 198). These quizzes are not graded and can be taken as many times as students want, which students often do because they are not satisfied with a poor score. The first score is captured, however, for every student and then is sent to the instructor. This allows the instructor to ascertain if there are trends of confusion in the class that need to be addressed.

More formal student assessment is done in several ways. There are only four graded activities: mid-term test, final test, focus presentation, and group project. The first two items evaluate the individual's knowledge and ability to explain and apply what she has learned. The tests are distributed by email, and once taken, the students email them to Meyen for evaluation. The Focus Presentation is actually an article review which gets students to read the literature on the topic and share what they learned with the other students in the course. The collaborative group project is the most important assessment and the most challenging. Even in face-to-face courses it can be challenging to get

collaborative groups to work together effectively, so it is easy to understand how much more difficult this is when all work is done via email. There are times, however, when students get on the same team together because they live near each other and can get together face-to-face to work on the project. Those who do not live near each other, however, simply have to develop good email collaborative skills. "I have found that as students take more courses online they become far more adept at collaborative projects," Meyen testifies (Vol. 3, p. 199). This is good news for the future of online instruction.

Formative and summative evaluation are significant whenever developing a new course. This team integrated formative evaluation into every lesson. Meyen observed that students gave feedback: "At the end of every lesson they had a little 10-item questionnaire about the quality of the lesson, did they learn anything, clarity of instruction, encounter any problems" (Vol. 3, p. 28). The instructor never saw the student's name with the feedback. In fact, all these anonymous formative evaluations were sent to a "separate source," and then the "aggregate data" or group information was sent to Meyen for each lesson. Students are "very willing to give that kind of feedback" (Vol. 3, p. 28). Students also were open and frank in emailing Meyen when something was confusing or when they needed more information. These private messages from students were also useful to the instructor. At the end of the course the team also provided the obligatory, standard, university student questionnaire for the course summative evaluation.

Technological Aspects

Online courses are, of course, built and delivered with technology. Other than the streaming audio lectures, Curriculum Development used simple and available technology

to make the course accessible to as many students as possible.

The course was developed long before there were any Web page editors or course development software, so the whole course was created with raw code, as were most of the other Paul Allen Virtual Education Foundation Outstanding Online courses, as well.

Support

A big question always surfaces concerning the kind of support that was given to the development team. Since many Web-based course development teams are funded, Meyen clarifies their team's situation:

> I want you to know that we too are funded . . . in a little different way. . . . The Lord gave me all the nervous energy required and then the department gave me all the free time I could get from Paul. . . . That was our institutional support. (Vol. 3, p. 2)

In addition he believes that Web-based training is becoming an industry investment. Education is also having to deal with this phenomenon so universities must address the support issue. He expounds "In every academic discipline the situation is there, it just needs to be created into a culture. Universities are all trying to create support offices, but it's going to be a challenge just to determine how it ought to function" (Vol. 3, p. 30). For the most part he believes that courses are not being systematically produced with university support, but are being developed rather by "the entrepreneurial spirit of individual faculty members" (Vol. 3, p. 30). Of course, he admits that there are a few examples of systematically produced courses but that most of the fully online courses "are still coming in as a consequence of fortuitous situations" (Vol. 3, p. 30).

Web Design and Construction

The most unique technological component of Curriculum Development is streaming audio lectures which also drive the visuals as previously described in the Lectures and Visuals section. Other features are more simple and include structured activities made with CGI scripts. Each activity form includes text boxes for students to fill in information. Directions for the activity are included. There is also an unusual warning that "Responses over 50 words will not be accepted" (Vol. 3, p. 159). On every activity there are boxes for: "Sender's Name," the "Sender's Email Address," and other required responses. Some activities require more responses than others. When the student clicks on the send button, a CGI script puts the contents of all the text boxes into an email and then sends it off to either the instructor or the Course Listserv, whichever is appropriate for that particular activity.

Navigation

Navigation support for students and faculty actually begins with excellent course and Web design. Tangen recommends "As you develop these things to watch people go through the courses. Sit people down and watch them do it. Find out what they're having trouble with. Little. . . . decisions that you make really affect people a lot," and he adds: "Try not to torture your students with a bad interface" (Vol. 3, p. 197).

Because of the extensive testing and experimentation, the navigation in Curriculum Development is clear and simple. The course has a Table of Contents (TOC) page after the course entry/welcome page. The TOC has a brief description plus a picture of Dr. Ed Meyen along with several important links. The four main links are: Table of Contents, Technical Requirements, Course Orientation, and Email Prof. Meyen. There

are two additional links to the two sponsoring departments, Special Education and Teaching and Leadership. A course TOC link is at the top of each page in the course. Each Lesson Contents page also has a link back to the Lesson Schedule, which is an index of all the lessons, their overviews, and their recommended due dates. Each of the actual lesson pages has only a link back to the Lesson index. From there the student can get back all the way to the Course TOC with other links, as already mentioned.

Most of the major course pages have the "Computer Based Education at the University of Kansas" emblem on it (a crow with KU on his shirt sitting next to a computer). This graphic lets the student know he is still on a page within the Curriculum Development course. This technique helps students keep their bearings in cyberspace.

Course Management

Approximately 80 % of the interactions in this course were "based on those activities that they submit their responses to and they average about two activities a lesson" (Burgos, 1998, p. 4). There are 16 lessons for a total of about 32 activities. Also, there are additional activities that bring the total to 45 per course. Multiply this number by the number of students, and the results look overwhelming for the instructor. In addition to sending in their responses to the activities, students send the instructor other personal messages with comments such as "I'm not quite clear on this in the lecture, have you ever thought about this. . ." or "In my class I had this experience. . ." (Burgos, 1998, p. 4). Meyen says he typically answers all this personal email:

> First thing in the morning and I'll periodically check it during the day, if I need a break to do something different when I'm working on some other activity, and I try to check at the end of the day as well. I teach 100 percent online, I teach no traditional courses right now. And so, I've just gone through a total transformation in terms of what I do as a faculty member. (Burgos, 1998, p. 4)

Meyen has been teaching completely online since the spring semester of 1997. When other instructors think of teaching online—particularly of teaching more than one course—they do not understand how they could keep all the email straight, and indeed, this does appear to be a daunting task. Yet the Curriculum Development team found a simple solution that did not require fancy software or expensive technology. Meyen explains their simple resolution for handling multiple class personal email messages: "I have a separate e-mail account for each one of them" (Burgos, 1998, p. 4). Further, Meyen reflects on the challenges of communicating accurately and expressively the students' messages:

> There are challenges in communication because you cannot have non-verbal cues on either end. When you're trying to correct a student that's not doing well, you have to be a little bit creative because you can't reach over and pat him on the back or touch him on the shoulder as you correct him a little bit. (Vol. 3, p. 199)

Distance Instruction

Distance instruction involves many aspects of teaching that are somewhat different than in face-to-face instruction. For example, in face-to-face courses, lectures, activities, handouts, and soon, can be developed at the last minute rather than as part of a whole, complete instructional design. Meyen regards the importance of the role of development in online instruction as

> integral to teaching online and if you really push me hard I might say it's 90% of teaching online . . . not in terms of time so much but in terms of creating the construct, in terms of the quality of instruction. (Vol. 3, p. 199)

Up-front content development is critical to online instruction as is developing and keeping up with student interactions, as noted in an earlier section.

Students

A series of focus group sessions with the students was held after the course was offered the first time. The following were some of their observations and conclusions:

1. Students value the flexibility of the format.
2. Students value the personal interaction with the instructor.
3. Students become very conscious of course design.
4. The technical skills of students need not be an important consideration.
5. Students value the ability to review all material in its original form.
6. Students value the private nature of communication with the professor.
7. Collaboration can be effectively achieved online.
8. Students do better work where products are involved.
9. Response time expectations increase as students progress. (Meyen et al., 1998b, p. 5)

Problems

The Curriculum Development online course does not require a textbook but rather posts published articles at the course Web site for students to read. These articles are required readings and thus pose copyright problems. These copyright problems are dealt with by paying one-time copyright fees for each article as course designers set up the course. Tangen notes that these fees for all the articles cost approximately $500. Publishers are willing to have the articles posted because the courses are password protected. Only registered students can access them.

Besides published articles and recommended readings, Meyen develops his own content in lectures and other means. He clarifies “Keep in mind you don’t do this each semester,” but further cautions that “If you’re going to develop a course, develop one that’s relatively stable” (Vol. 3, p. 200). For example, a course on contemporary issues would not be the best course to develop for online delivery.

Changes in Course

Although Curriculum Development was and continues to be a very successful course, there are some changes that the team would like to make based on what they have learned so far. Meyen relates the following desired changes he would like to make to the course or has already made in the course: "reduce the number of original responses on my part and develop some model responses, invest in developing an instructional management system, and use a Directed Discussion model that I have since designed and tested" (Vol. 3, p. 4).

Already some changes have been made in the course. For instance, originally all the activities were embedded within the lectures, making them difficult for students to find when they wanted them. They could not look at them before the lecture so they could listen to the lecture more productively. Consequently, they have moved the activities "up front so they could click and look at the activities in advance" of listening to the lecture (Vol. 3, p. 28). In addition, Meyen went through and "took notes" for the students and then put them all together so students can print them out. He related:

> I identify the key points maybe in ten word statements and as the media aided presentation is operating those will appear in yellow . . . they'll just appear, be on the screen for a second just to kind of remind them pay attention, what I'm saying is important at the moment. Also they can print out and they've got the key points which is a very brief perspective of the course. (Vol. 3, p. 28)

He added that by giving the students the notes "in advance, they anticipate what those discussions are going to be" (Vol. 3, p. 28). These notes are in addition to the extensive outline that is also provided for the students' learning benefit.

Instructor/Development Team

This course was developed by a unique professor-and-student team. Meyen declares "In developing online courses I have worked with students as a team. They contribute ideas to the instructional design and assume primary responsibility in the technical aspects of the development work" (Vol. 3, p. 103). Curriculum Development was the first course that Meyen and his students made but then were inspired to develop more courses based on the model of this course. Meyen highly valued his student team members and felt that this experience was important for them as well:

> I think that at the present time, when you look at the professional opportunities for students who are in college today, in any field, the student who gained some experience while they're in college, not only in taking instruction online, but designing instruction online, working with a prof or someone else to create it, no matter what field their going into, they're going to have a real edge and they're going to have a better future. (Vol. 3, p. 30)

Ed Meyen, Ph.D.

Meyen, professor of special education at the University of Kansas, has initiated himself into the task of understanding what effective online instruction is, has developed it, and has demonstrated its use successfully. While some instructors and administrators hope that teaching online takes less time and is more efficient, it is not. In fact, if not controlled, teaching online can be a 24/7 working arrangement. When asked how being a face-to-face instructor compares with being an online instructor, Meyen replied:

> From my point of view as a prof, I no longer go to class at 4 o'clock and give a lecture. I no longer plan for Thursday afternoon or Wednesday night to teach. I teach everyday. I start my day working on my courses and responding to e-mail. That's the first thing I do when I arrive in the morning and it's the last thing I do in the daytime. (Burgos, 1998, p. 4)

Whether it is interacting with students or developing new courses, Meyen comments that he has changed as an instructor:

> My behavior is very different as a teacher today in online instruction than it was before. I am far more focused on individuals than before. I am just as focused on the content but I've already taken care of the content and so as I teach the course I'm focusing on the students and that personal relationship does emerge there. (Vol. 3, p. 199)

Concerning his role as an online course developer and instructor Meyen comments "It is difficult enough to be part of an experiment without also having to convince others that what you are doing not only has value, but is important to the mission of the institution" (Meyen et al., 1997b, p. 3). Then he added a word of encouragement "At the present, on-line instruction is an investment that may not pay off immediately, but the future is bright" (Meyen et al., 1997b, p. 4).

Paul Tangen

Tangen was a graduate student in the Department of Design at the University of Kansas when he worked on Curriculum Development. His background, skills, interests, and knowledge made him an excellent partner for Meyen:

> Paul Tangen is an interaction designer with bachelor degrees in both industrial design and business administration. He has a Masters in Special Studies from the University of Kansas, where he did pioneering work in the new field of Interaction Design. Paul applies the concepts of interaction design to electronic and built environments so users are able to understand the space they are navigating and able to reach their destination easily. . . .He designed several of the first interactive distance learning graduate courses in the country. Other clients include, AT&T, Sprint Telecommunications, Commerce Bank, and Douglas County Convention and Visitors Bureau, Johnson County Community College and The University of Kansas. (Vol. 6, p. 108b)

Cindy Lian

Cindy H. T. Lian was a graduate student in music therapy at the University of Kansas. Lian was one of twelve recipients in 1998 of the University of Kansas "School of Allied Health's Dean's Scholarship winners--Recognizing their academic achievements, professionalism, long-range goals and leadership" (http://www2.kumc/edu/publications/Topics/Topics07-22-98.htm). Lian is now a speech-language-hearing doctoral student expecting to graduate in 2004.

Teamwork

After developing Curriculum Development and other online courses, the team wrote five goals to be considered at the planning stages for creating online instruction:

1. To produce instructional content that is effectively designed.
2. To achieve a functional delivery system that is accessible to the target population.
3. To produce a program with stable content and stable technology.
4. To develop a supportive relationship between the instructional designer and the technical developer.
5. To create residual conditions that contribute to further instructional development. (Meyen et al., 1998, p. 10)

Meyen's team discovered that there are three types of responsibilities for design team members: "(a) mutual responsibilities, (b) responsibilities specific to instructional developers, and (c) responsibilities specific to technical developers" (Meyen et al., 1998, p. 10). The mutual responsibilities correspond to team collaboration skills and were defined as:

1. Working relationship—"Effective collaboration occurs when all team members understand the common goals and share in the collective effort to complete the tasks associated with meeting the goal."

2. Mutual respect for respective roles—both instructional and technical developers must respect both fields of expertise "because this is an interdependent process." Further, "no one person has exclusive ownership of the needed expertise."

3. Language—Members show a willingness to learn the other team members' technical language.

4. Shared expertise among team members—"in transdisciplinary practices individuals are taught the skills and expertise of other team members and over time come to assume some of the responsibilities that were previously the purview of the other team member's discipline."

5. Shared values—"The common goal must be to teach the students as effectively as possible; this means attending to those design features that enhance learning," whether or not the issues are within each team member's realm of expertise (Meyen et al., 1998, p. 11).

Unexpected Discoveries

Meyen had some surprises as he developed and taught this course. He had not expected "the value placed on the personal nature of the instruction by students" Nor had he anticipated "the quality of the student work" (Vol. 3, p. 4).Further, most students adhered overall to the suggested schedules. On the average, 86% complete the course within the prescribed time frame of the semester and 95% eventually completed the course. What is more, Meyen did not anticipate the students' desire to take more courses like this one. This desire was surprising because online courses are more work for the student (and instructor) than are face-to-face courses. In a typical face-to-face course, many students sit back and allow the vocal few to do all the discussion with the instructor

or with each other. In online instruction each student is required to respond to every single activity or question. In Curriculum Development there were about two activities for every lesson, in addition to a quiz and evaluation assessment on the quality of all parts of the lesson. These were all non-graded activities but were all required just the same. So the usual quiet, dozing, non-participating students had to sit up and become engaged.

Challenges and Satisfactions

Certainly there were challenges to face as this team developed and delivered their online course. Probably Meyen's biggest challenge was "the extraordinary amount of time required on my part to develop and to teach the course" (Vol. 3, p. 4). He and Tangen kept detailed records of their time and experiences in developing the course and found that Meyen on the average spent 40 hours per lesson in development time. This totals 640 hours for the course itself or approximately 4 months of dedicated, full-time work. Tangen spent 16 hours per lesson for a total of 256 hours to do the technical development for the course.

However, the invested time paid off, Meyen declares, because of the "reaction of students to the course" (Vol. 3, p. 4). A number of students have since taken additional online courses from Meyen and others, and they "have gone on to dl[distance learning] theses etc. on technology" (Vol. 3, p. 4).

Students persevered in spite of technical difficulties. For the most part students took the course at their work place and had some initial technical difficulty. Nevertheless, Meyen declares that

> over half completed each lesson in one sitting. That really needs to be looked at because they had to be tired. These lessons are not really short. We've had no problem with completion. Data continues to get stronger on that. (Vol. 3, p. 201)

As previously mentioned in the "Unexpected Discoveries" section, even though the lessons were long, there was a high rate of course completion within the semester timeframe and even higher completion rate when not limited by the semester time limits.

Reflections and Advice

Meyen has practical advice for others who want to develop fully online courses. First of all, he believes that "any teaching principle can be applied online" (Vol. 3, p. 29). "Make the courses content rich," he urges. "Don't begin developing the course until you've worked out an instructional design and planning strategy" (Vol. 3, p. 29). Expanding this concept, he urges:

> Develop a design that will fit and work well online and maintains the integrity that the instruction has to offer and creates the level of communication with students that you want. Don't compromise a bit on content, you don't have to. Don't compromise a bit on quality of the student performance, you don't have to, you can get better performance. (Vol. 3, p. 29)

Meyen further observes that using URLs to sites outside of the course was risky because "unless you monitor them carefully they tend to disappear" (Vol. 3, p. 4). "Plan to work hard," he details as he remembers the long and hard hours he put in on course development. He encourages others to "approach the development as an R&D project. Research what you do and use the results" (Vol. 3, p. 4).

What effect will online instruction have on traditional education? Meyen declares:

> I think that online instruction will have a very significant positive effect on traditional instruction, because of the fact that it does focus on engaging students. It focuses on making good decisions about content, structuring content, and providing assessment that's really relevant to what you taught. . . . I just think that the instructional accountability that's placed on you in teaching online eventually will splash over to traditional instruction and will drive the quality of traditional instruction up. (Burgos, 1998, p. 6)

Summary

"Curriculum Development" takes lectures to the Web with streaming audio and synchronized visuals. However, this is not a typical didactic course of sit, listen, and recite back to the instructor. Embedded within the lectures are many Web-based form activities for students to interact with the instructor. Students actively dialogue *one-on-one* with the instructor (600 minutes per student) more than in most typical courses. Students also learn to function as a virtual team to collaborate on developing a real curriculum project. This learner-centered course creates a supportive learning environment for the students.

CHAPTER SEVEN

INTEGRATION OF THE DISCIPLINES

Overview

"Integration of the Disciplines" is an interactive learning journey where the instructor is the guide and fellow learner along with the students. Students learn to prepare integrated instructional strategies that include "the concepts of inquiry learning (problem-based learning strategies); the change process; teaming, partnerships, and collaboration; curriculum design; authentic assessment strategies; and reflective practice and leadership" (Vol. 4, p. 55). The course is not known for its remarkable or cutting-edge technological features, as course author Dr. Merickel points out: When asked why this course received recognition, he replied "In a word it's pedagogy" (Vol. 4, p. 35). Further, the course models what it teaches by actually integrating the disciplines. Merickel, the course's author and instructor, crafted this interactive learning experience "based on four important elements: 1) reflective practices, 2) context, 3) instructional design, and 4) leadership" (Vol. 4, p. 15). Merickel states "This course was founded on the premise that learning is inclusive, contextual and most of all, it must be meaningful" (Vol. 4, p. 16). It is a graduate-level course and is part of the teacher education program at Oregon State University.

Course Design

Orienteering is the course metaphor that guides and connects all aspects of the learning experience together. The content and technical design features of the course are all based on orienteering. Merickel indicated, "This course is designed as an interactive journey," and the orienteering "metaphor is throughout this course. It is an overarching theme" (Vol. 4, p. 36).

Instructional Design

From the beginning Merickel believed that it was neither possible nor desirable to simply take a face-to-face course and put it on the Web. He quotes McLuhan (1965): "It would be a mistake to think that we can simply apply technology to a curriculum without changing that curriculum" (Vol. 4, p. 6b). Merickel explained that instructors and course designers first thought that the technology of the course should be invisible and that "the focus of the Web course must be on the content, interaction, and learning objectives, while the Web environment must not affect the learner" (Vol. 4, p. 21). After some time of actually teaching at a distance with technology, however, many are discovering that this assumption is not necessarily true. Merickel reflects "It soon became apparent that the environment itself was important and may have the potential to provide learners with different ways of knowing" (Vol. 4, pp. 21-22). Another aspect of all this is the socio-technical perspective. Merickel contends:

> In a socio-technical relationship, it is necessary that the learner concentrate on interaction, learning objectives, and content. The socio-technical perspective, therefore, provided that part of the Web course framework which focused on the human, social, and organizational effects within the new context. This meant that the content, instruction, interaction, and context (i.e., the World Wide Web and Web tools) needed to compliment each other. (Vol.4, p. 22)

Cognitive Flexibility

Before creating this course, Merickel read an article that made a tremendous impact on him. "Cognitive Flexibility, Constructivism, and Hypertext: Random Access Instruction for Advanced Knowledge Acquisition in Ill-Structured Domains," by Spiro, Feltovich, Jacobson, and Coulson (1992a), gave him inspiration as he wrestled to develop an online course with ill-structured domains. Spiro et al.'s understanding of theory and the application of theories to the hypertext environment helped Merickel to design the present course structure of "Integration of the Disciplines." One of the points the authors make is to include a type of planned redundancy:

> For learners to develop cognitively flexible processing skills and to acquire contentive knowledge structures which can support flexible cognitive processing, flexible learning environments are required which permit the same items of knowledge to be presented and learned in a variety of different ways and for a variety of different purposes (commensurate with their complex and irregular nature). (Spiro et al., 1992a, p. 58)

Thus, the course is built on cognitive flexibility theoretical principles and instructional strategies (Spiro et al., 1992a; Spiro, Feltovich, Jacobson, & Coulson, 1992b) with the intention of using the unique advantages of Web technology. In the process of studying all these things, Merickel developed two models to help guide Web course construction.

Constructivist Web Pedagogy Model

The first model is a "mostly constructivist web pedagogy model" with three components "content, process and environment, with the environment of the World Wide Web being the arena that supports learning opportunities unavailable in face-to-face

classroom teaching" (Vol. 4, p. 22). The content and environment components both support the process component, and each of them has three points of their own:

Content
1. Provide appropriate content information and guiding schema
2. Provide motivating and challenging examples and problems
3. Emphasize concepts, relationships, cognitive flexibility (Spiro & Jehng, 1990) and metacognition

Process
1. Support individual and social construction of knowledge
2. Provide for various learning modalities; accept diversity of outcomes
3. Use authentic assessment techniques

Environment
1. Support learning in the WWW environment
2. Encourage and facilitate electronic interaction
3. Provide knowledge repository for dialog and learner-constructed products (Vol. 4, pp. 23-24)

The new term in this model is "dynamic knowledge repositories," which describes the students building on the knowledge of others and to create their own new knowledge. Merickel explains that the term dynamic knowledge repositories, although apparently a contradiction of terms, is a "wonderful tool for creating threaded archives or repositories of a knowledge base. If we think about our courses as creating a dynamic knowledge base . . . what a powerful tool" (Vol. 4, p. 8).

Pedagogical Model for "Integration of the Disciplines"

This second model was created for this specific course and blends theory, instructional strategies, and technical tools as seen in Figure 1.

Theoretical Framework

The theories included in this framework are active and ensure that this course does not become a mere correspondence course. All of the theories are listed as having equal importance in the model. Constructivism provides "a metaview of learning" (Vol. 4, p. 7). Social learning establishes the space necessary for students to not only individually construct their own knowledge but also to have a place to construct knowledge with others in ways that they could not do alone. Cognitive flexibility sets the scene for "making connections and multiple pathways to learning" (Vol. 4, p. 7).

Technological Tools

The World Wide Web is the main technological tool for this course which includes using Web browsers, languages such as HTML, CGI, and JavaScript. Development tools such as editors, FTP, Imagemaps, etc., are included here. Asynchronous communication is supported in several ways. Email is used in P-T-P (Point-to-Point) and P-T-M-P (Point-to-Multiple-Point such as a listserv) communication. Other hypertools are used such as HyperNews (threaded archival) and Allaire Forums. In the first version of this course, synchronous chat was also used.

Instructional Strategies

Many instructional strategies are used in this course including inquiry learning and problem solving. Because of its constructivist foundation, students actively and consistently interact with the content, problems, instructor, and other students. Students participate in simulations and are presented with real-world problems along with the typical resources available to educators.

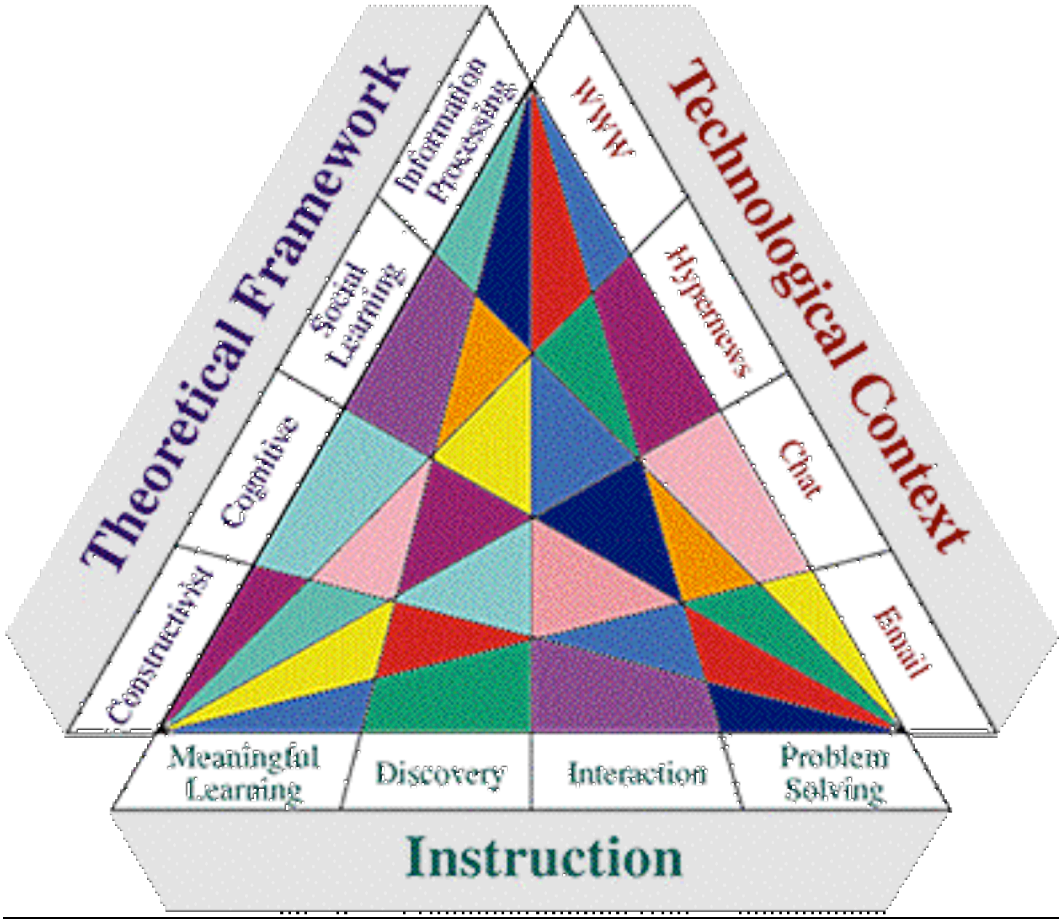


Figure 1. Pedagogical Model for "Integration of the Disciplines." From: Mark Merickel

Then the students access various short resource/content pieces on topics that can help solve problems. They are not required to read or listen to lectures or readings; yet the nature of the problem encourages enough in-depth reading that they cover what they need to learn and access it when they need it. Then in order to actually solve the problem, they must reflect on what they have learned and synthesize a new solution to the problem. Interactive content delivery keeps students engaged along with guided practice. They apply learning theories, instructional strategies, leadership skills, and change strategies to authentic dilemmas. After they create their lessons, they peer review other lessons by students in their class.

The learning experience is not solo, however, in the social constructivist mode students worked together to create new understandings. In collaborative teams they solved problems and worked on projects together.

Course Components

Syllabus

Two syllabi are posted in "Integration of the Disciplines" and are provided to meet the varied learning styles of students. The first one is nontraditional and keeps within the orienteering metaphor of the course as it describes the journey ahead and the rationale for the orienteering metaphor. Although it addresses such issues as quality, process, and product criteria and grading procedures, it does not have a long list of learning objectives. There is, however, a link at the end of the page that goes to a traditional syllabus for those who need that structure of information. The traditional syllabus is more straightforward and does not have the orienteering metaphor narrative. Having the traditional syllabus also satisfies any university concerns.

Survival Gear & Skills

"Survival Gear & Skills" is the course calendar. There are 11 weeks and each has from one to four things to do. This listing gives the succinct version of the course assignments and projects. Some of the assignments have links to the pages where the activity takes place. For instance, in Week 1 students are supposed to take the Keirsey Temperament Sorter, reflect on the results, and then submit their reflections in the online reflection form, but there is no context given in this list for the activity. The context is provided elsewhere, so this page just gives a quick overview of activities and projects.

Student Activity Pages

There are also student activity or direction pages for each theme section (see Figure 2). The student activity pages have two parts: Learning Process, and Performance Task. Reflections are integral to this course and so reflection questions are given under "Learning Process." Students are sometimes directed under "Performance Task" to respond to the reflection questions in their weekly journal. Sometimes as many as four or five suggested reflection questions are given; then students are either told which ones to reflect on or the students can choose two. One of the activity pages simply gives a provocative quote and then asks the student to pose his own question and then reflect on the question. The variety of reflections and activities helps keep the student from taking anything for granted; yet there is enough structure to keep things comfortable and familiar.

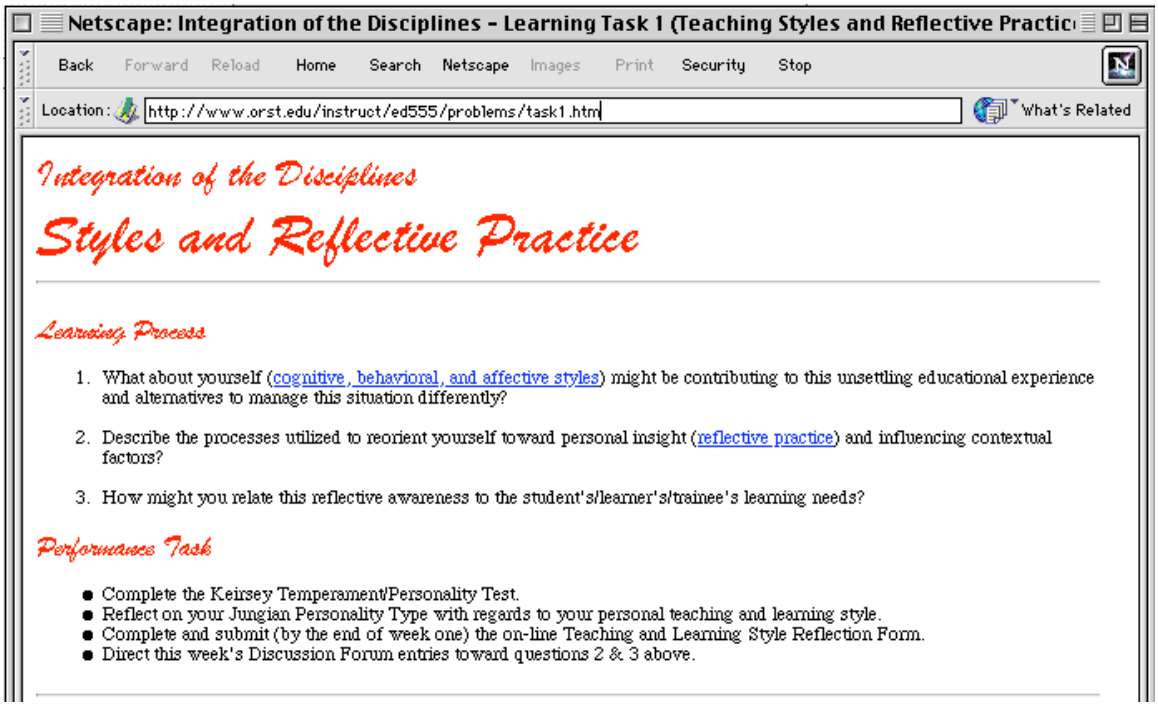


Figure 2. Student activity page.

Simulation: Problem Scenarios

Simulation is used in this course to create an authentic context for learning. These short pages give a brief background of the problem to be solved. There are a series of buttons on the right side of the page with links to various tasks related to the problem, such as:

Task 1 – Reflective Practice

Task 2 – Learning Theory

Task 3 – Pedagogy & Change

Task 4 – Instruction

Task 5 - Leadership

These take the students to rich resources that now have meaning because of the problem they are trying to solve. In addition, there are more buttons at the bottom of the page that take the learners to realia-type files (see Figure 3).

The student can access as many or as few of the resources as she likes, when she likes, and in the order she likes as they are not linear activities. The content resources provide scaffolding for the students as they learn how to solve the problem. Because the problem scenario is presented first, students are naturally motivated to learn more about the connected content issues. In the case of "Problem Scenario 1," Reflective Practice and Learning Theory are two of the topics to be learned and applied. In a traditional course, lectures would be presented first on these topics and then some application activities may follow either in class or as homework. In the contextual situation, however, students are presented with problems first even though they are not yet ready to deal with them. This imitates real-life learning: When people discover a problem, they then try to learn all they can in order to solve the problem.

Reflection

Reflection is an important part of the learning experience of "Integration of the Disciplines." This fits with adult learning needs by encouraging them to make connections with their life's experience and with their previous learning to synthesize new knowledge. Merickel remarks "Reflectivity is extremely important, if you're going to take a course and direct it towards higher order thinking" (Vol. 4, p. 37). This course

does indeed strive to promote higher-order thinking. Merickel further describes the value of reflection as a learning process:

> As Shone says, 'Situations do not present themselves as givens but are constructed from events that are puzzling, troubling, and uncertain.' In my opinion in order to provide instructional design environments or curriculum classes, web based courses that do honor the reflective practice it is extremely important to utilize a repertoire of understanding images and actions to reframe a troubling situation so that problem solving actions are generated. Throughout this entire course using orienteering as a metaphor I try to maintain a process that allowed for higher order thinking, graduate level synthesis course. (Vol. 4, p. 45)

Students wrote weekly reflective journals which were private interactions between the student and the instructor over weekly experiences in the course. Trust was developed since students could be open with the instructor knowing that other students would not see their thoughts. Journals were not part of the threaded class discussions.

Content

There was no textbook for this course. Merickel lives by the philosophy expressed by John Adams and quoted in this course: "The textbook is not a moral contract that teachers are obliged to teach. . . . Teachers are obliged to teach [students]" (Vol. 4, p. 118). Merickel teaches students by creating an information-rich environment that stimulates interactions and learning.

"Content was provided to assist students with solving problems, completing tasks, and answering questions. The content was organized thematically and associated to the required performance tasks. Content was all on the web, mostly developed by myself," Merickel reports (Vol. 4, p. 3).

As noted earlier, most of the content is given as Web-page resources along with problem scenarios. In fact, Merickel wrote approximately 750 pages of content.

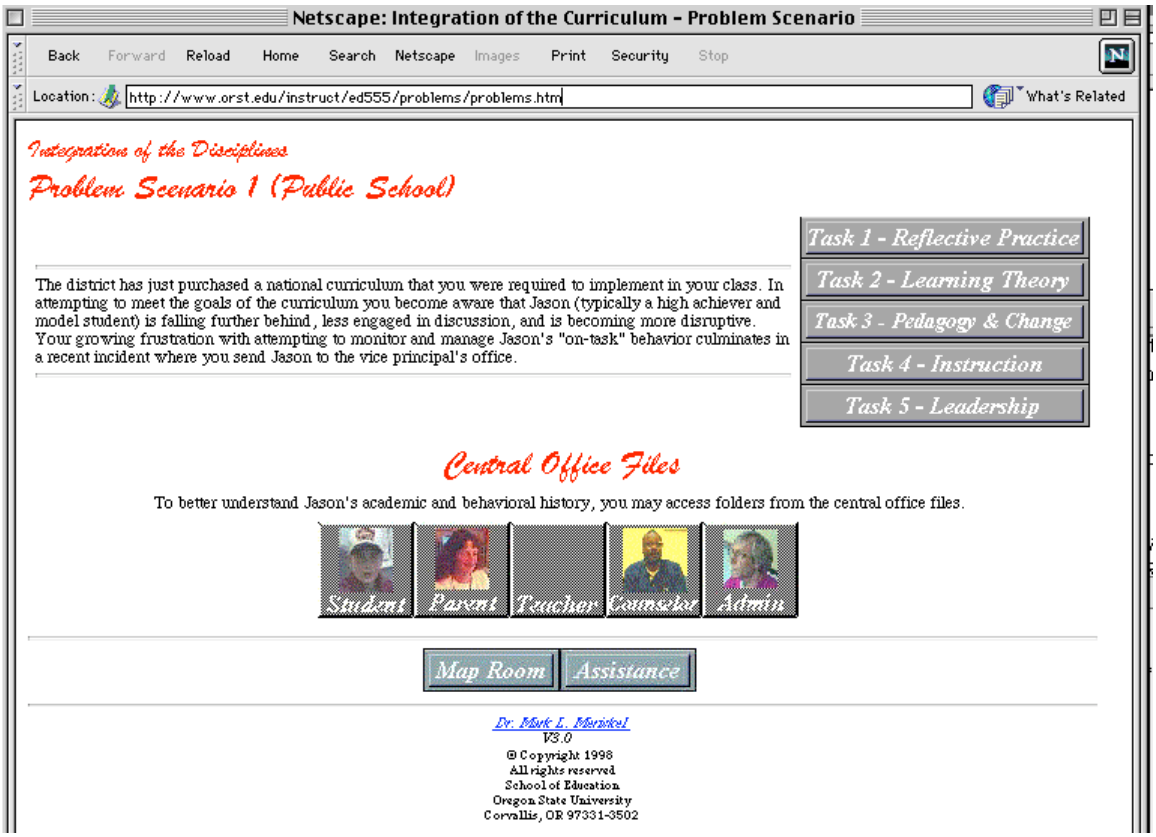


Figure 3. Problem Scenario 1 (Public School).

He unexpectedly discovered this at the end of the course when a student came in to see him with three large binders filled with pages. The student had printed out every single page Merickel had written plus every site linked to the course which brought the total of pages up to about 1,900. Merickel reveals the student's question to him and his own answer: "'Did you know that we have to go through this many pages in order to understand and answer your questions?' Of course my response was no . . . and that was not my intention" (Vol. 4, p. 44).

There is plenty of information to support and stimulate student learning, but the caution comes in how many external resource sites should be linked to the course. The more global channels (outside resource links) that are used, the more surfing the student is likely to do. The instructor does not know if the student can or will find her way back to the course content in a timely fashion. Having a good navigation system is important and is discussed in the section on "Navigation."

There are other issues to consider, however, when using outside links or global channels. Merickel proposes that each external site needs to be peer reviewed to make sure that there is valid and valuable information related to the content of the course. Most of the time the best solution is to develop original material.

Stability of the links is another ongoing problem he mentions and says it can take much time to constantly check them. If the instructor does not check them, he says that students let him know. Links that are down are frustrating to students who perceive that the link is necessary for the learning experience, otherwise it would not have been linked to the course Web site. Merickel poses the ultimate question when considering using any external links: "How much surfing will you sponsor?" (Vol. 4, p. 44).

Context

Learning context is important in adult learning experiences. “The entire course is designed around contextual learning. It was the intention to make the authentic scenarios meaningful for the learner. Scenarios were those that all students in the course ‘related’ to as authentic,” Merickel notes (Vol. 4, p. 2). But it is not the instructor who creates the context, however. Merickel discusses adults and context: “I truly believe the adult learner always creates the context. I can create an environment or an ecology but they create the context” (Vol. 4, p. 37). In regard to content versus context some say that “if we concentrate on process we can’t deliver as much content. . . . That’s the debate that we have. Which side do you choose? Which side do you err on or how do you make those complementary?” (Vol. 4, p. 42). “Integration of the Disciplines” appears to be an artful balance of the two in this ongoing debate.

Interactions and Learning Community

One of the important features of “Integration of the Disciplines” is building a learning-centered environment that includes interactions. Merickel asserts “I believe in this environment and the reason I say learning centered is because I learn as much from the interaction as the student does” (Vol. 4, p. 41). The student-to-student interactions and the student-to-instructor interactions are asynchronous now, although the first time the course was offered, synchronous chats were used. This did not work out well, so they have not been used since. Merickel has strong views on synchronous chats with adult learners based on this experience:

> I did use chat. I will never, ever use it again, ever. I found that the limitations of chat and synchronous environments are totally against what I believe is fundamentally important for the adult learner who is learning at a distance who needs an

> asynchronous environment because of their schedules, because of their familial responsibilities, because of their financial responsibilities and saying you all come together at one particular time creates a tremendous problem for individuals who need an asynchronous environment. (Vol. 4, p. 6)

Therefore, asynchronous interactions rather than synchronous were used to create the environment for learning. "I don't believe the web should be used for correspondence courses. I think that we need to use the web not only to present information and content, but it is becoming a rich environment for interaction." Students realize this when the instructor respects and encourages interactions. But first students must learn to trust each other and to trust the instructor. Merickel says students

> have a lack of trust in the pedagogy as much as they do in me. It has a lot to do with power differential on the university, and you build environments, you build methodologies, you build exercises, you build tasks that want reflectivity, you want to hear what they have to say, you don't want them to say back to you what you said. It takes trust. (Vol. 4, p. 49)

The summative evaluations of the course by the students reveal that they appreciated the richer dialog and discussion in the Web-based course than in face-to-face. Everyone "got an opportunity to talk" (Vol. 4, p. 46). In addition, students found they were able to be more reflective with their responses to questions and ongoing dialog. Yet in spite of the public nature of threaded lists, students enjoyed the feeling of "privacy of thought" (Vol. 4, p. 46). Merickel notes that

> it's really interesting considering that every student in the course posted their responses to the questions or the activities to a threaded discussion list that all students could look at, but yet this [privacy of thought] was a response that they gave and felt it was one of the benefits of the course . (Vol. 4, p. 46)

Assessment

Student assessment in "Integration of the Disciplines" is not based on objective true or false or multiple choice quizzes and tests. The concept of the course is that there

will be many right answers given for the authentic problem scenarios based on the individual students' prior experiences and synthesis of the content resources given in the course.

Students wrote weekly in electronic journals. These were private interactions and reflections between the student and the instructor. The instructor was able to see quickly if there were any basic misunderstandings of the concepts and could ask the necessary questions or make timely comments that would help redirect the students back on track. The instructor could also encourage divergent, creative thoughts and applications of concepts. There were also individual and team projects where students crafted real-world solutions for authentic problem scenarios.

Self-assessment is part of the course. Scoring guides and check lists are provided for various assignments so students can evaluate their own work before turning it in to the instructor. For example, "Integrated/Contextual Lesson Check List" includes the following directions:

> The following checklist should be used to insure that your instructional design is, and remains, integrated/contextual. You should use this checklist to aid you in your integrated/contextual instructional design for this course. Complete the form and send it to the instructor. You will also receive a copy of this information for your records. (Vol. 4, p. 158)

This checklist includes 22 points and questions for students to evaluate their work. Each item has a basic yes or no question and then a text field is given for the student to answer a more in-depth, reflective question. For example, the second item has these two questions: "2. The lesson design encourages teachers from multiple disciplines to collaborate. Yes. No. How does your lesson encourage teachers to collaborate?" (Vol. 4, p. 158)

The main topics of assessment are: integration, contextually focused, reflective practice, conformance, and high quality.

Electronic portfolios are also part of the course and assess both product and process. The limitations of this assessment are that portfolios are strictly text at this time. Merickel reflects "As we move toward more graphical interfaces, that is, we're able to use draw programs, FTP and upload things to files, create student portfolios that allow these kind of things to happen, we will get richer and richer courses" (Vol. 4, pp. 47-48).

Evaluation

Oregon State University has developed Quality Standards for Electronic Delivery of Instruction. Merickel made sure his course met these standards and based the course evaluation survey on them. Quality Standard 1 states: "Electronically delivered instruction must be comparable in quality and content to the corresponding campus instruction" (Vol. 4, p. 18). There are six ways for courses and programs to demonstrate this standard:

> A. That the instruction is making appropriate use of currently available technologies.
> B. That appropriate methods will be used to assess students' achievement of learning objectives.
> C. That the instruction will provide appropriate amounts and types of interaction between students and instructors.
> D. That essential student services and course-related material (books, journals, computer material) are accessible at all receiving sites.
> E. That fair and appropriate staffing policies have been adopted by the delivering unit as it relates to electronically delivered instruction.
> F. That the units proposing electronically delivered instruction will describe a process for how and when the proposed course and/or programs will be evaluated.(Vol. 4, p. 18)

Only items A to D were used in this course's evaluation since the last two items are administrative in nature. Items A to D were used to determine the quality of this

online course comparing it "to corresponding campus-based face-to-face instruction" (Vol. 4, p. 18). The results show "that the course was highly successful according to the criteria measured, and that the quality of the courses was equal to or better than traditional face-to-face teacher education courses" (Vol. 4, p. 17).

Course Size

Often universities are interested in online education as a way to do courses to scale so they can save money and increase revenue. This course, however, is learner oriented so there are many one-on-one interactions between each of the students and the instructor. This would be impossible to do well or at all with a large class, as Merickel makes clear: "This course is designed for 25 to 30 students. This pedagogy is not scalable; end of deal, it is not scalable. This pedagogy, this course would be a disaster for 50 students, an absolute disaster" (Vol. 4, p. 46).

Role of Instructor

The role of the instructor in this course is that of a facilitator or guide. The instructor is a fellow learner with the students even though he crafted the "learning ecology" in the first place. Before developing this course, Merickel had not moved to the role of being a facilitator but found that teaching on the Web opened a way for him to accomplish this goal.

He describes his experience:

> I had a unique opportunity in building web courses to move away from my existing pedagogy and I took advantage of that opportunity. Built within that opportunity was to truly move beyond the rhetoric and become a facilitator within a teaching and learning environment. It worked. (Vol. 4, p. 36)

The online instructor, however, has a role of support that is even more important than in face-to-face situations because online students often easily feel isolated and therefore need lots of feedback. The instructor has Virtual Office Hours that are not dependent on time or space limitations and gives feedback to students' messages, assignments, and projects within 24 hours. This is rarely done in face-to-face situations, but with email it is much easier for instructors to do. While this is a personal time challenge for the instructor, it is best for the learner, as Merickel explains:

> When I responded to email or to activities, [it] had to be within 24 hours of a posting. . . . Those of you who have taught on the web know that if something sits there for more than 24 hours the students are wondering where you are, why there's not a response, and they want to make sure that you have received their posting. But, providing a 24 response time is certainly a benefit to the learner. (Vol. 4, p. 44)

Changing his way of teaching was difficult, however, and it was hard for students who were used to more directive instruction. "Change is extremely hard both for instructor and student" (Vol. 4, p. 48), Merickel testifies. "Trust became a very, very important issue" (Vol. 4, p. 48), he said, as the instructor and students explored new learning territory together. Students need to learn to trust the instructor in this new environment as well as to trust the new pedagogy. In addition, instructors need to trust students to transition to being more self-directed and motivated in this learner-centered environment.

Merickel discovered that instructors need to develop a virtual voice. He first became aware of this when he was co-teaching Web-based courses with his doctoral students. He describes his experience with discovering the virtual voice concept:

> The doctoral students would begin the interaction and the dialog and they would begin their responses in a very academic way, of course, that's how they were being trained. . . . They found that the dialog and the discussion were not as rich as they had hoped it would be. They also found that by watching my interaction that I

> interacted in a different way . . . not better, not worse, different. They asked what it was about my interaction that made a difference in the discussion of the dialog. I couldn't answer that question. I had to reflect on that process, and I had to reflect on what I was doing and I found that I was drawing greater on my own experiences than I was on the knowledge base or the theory. (Vol. 4, p. 40)

As he reflected back over his experience, he realized that it took about 1 year for him to develop his virtual voice; the interactions in cyberspace were different than in face-to-face situations. He had gradually changed his writing style accordingly without even realizing it. Concerning virtual voice Merickel adds,

> I found that that is part of the art of pedagogy that I knew nothing about before I began getting those questions from students who were working with me. . . . We will ultimately begin to learn a little bit more about the science of teaching on the World Wide Web. I think we know very little . . . very, very little. (Vol. 4, p. 40)

Technological Aspects

Although "Integration of the Disciplines" was built with several unique technological tools, they were used to create a simple but effective Web-based course. There are no glitzy bells-and-whistles features to this course. As noted earlier, pedagogy is its noteworthy feature.

Support

Support for the student comes in several ways. First, there are several tutorials for students to take at the beginning of the course to familiarize them with the unique features of Netscape and/or Netscape Communicator. There is also a tutorial on how to do effective searches on the Web. Merickel states that good online assistance is leveling the playing field as much as one can by "providing help, tutorials, assistance links, definitions, glossaries are all extremely important and fundamental to the design of a web

course" (Vol. 4, p. 44). Making everything as clear as possible is another support for the student.

Web Page Design

This course has many unique Web design features. First of all, the Web pages are short and vary in length between one-half to one and one-half pages long; although, most pages are not over one page in length. This makes fast loading pages and well-chunked, easily understood information. Having the content in short chunks also means that the information can be hyper-linked more effectively. Even when students print many pages, short ones work well.

The content resource pages are grouped around various themes that are all connected contextually to the problem scenario. Usually, Merickel uses one unique outdoor photo on each page within a theme section. For instance, in the "Reflective Practice" section he uses a photo of a mountain whose image is reflected in the lake (see Figure 4). Not all sections have photos that fit as well as the reflection one, yet by using a consistent photo per theme the student is less likely to get lost in any of the theme sections.

Each theme section of the course has a similar Web-page design, which makes it easier for students to quickly know what to do and where to go (see Figure 4). Titles are always in styled fonts that are unique to the theme section. The photo is next to a brief explanation or background paragraph or two. Under the paragraph and picture are hypertext links to various components of the theme section. Always the course index is visible in the left sidebar frame.

At the bottom of most pages are various help buttons, such as “Map Room,” “Context,” or “Assistance.”

Navigation

A good navigation system is a key to helping students feel secure in the online learning environment. Students often get lost and wonder where they are in some online courses; so helping them orient themselves to know where they are and how to get to where they want to go is critical.

“Integration of the Disciplines” has approximately 750 pages of original, in-course material. Since the course is not linear, this could be a recipe for disaster; but, unique navigation features are part of the course design such as Java applets, frames, and indexes that each help to orient the student at all times. Merickel emphasizes the importance of redundancy in navigation design that includes both buttons and links and states: “A consistency and constancy are extremely important” (Vol. 4, p. 10). If the student cannot find the desired page, however, the Excite search engine is provided for them to search the course site. Even design elements such as color and icons, name conventions, and multiple options should be consistent. This way students will be confident that once they learn what the various navigation items mean and how to get around in one part of the site, they will be confident that they can get around throughout the entire site.

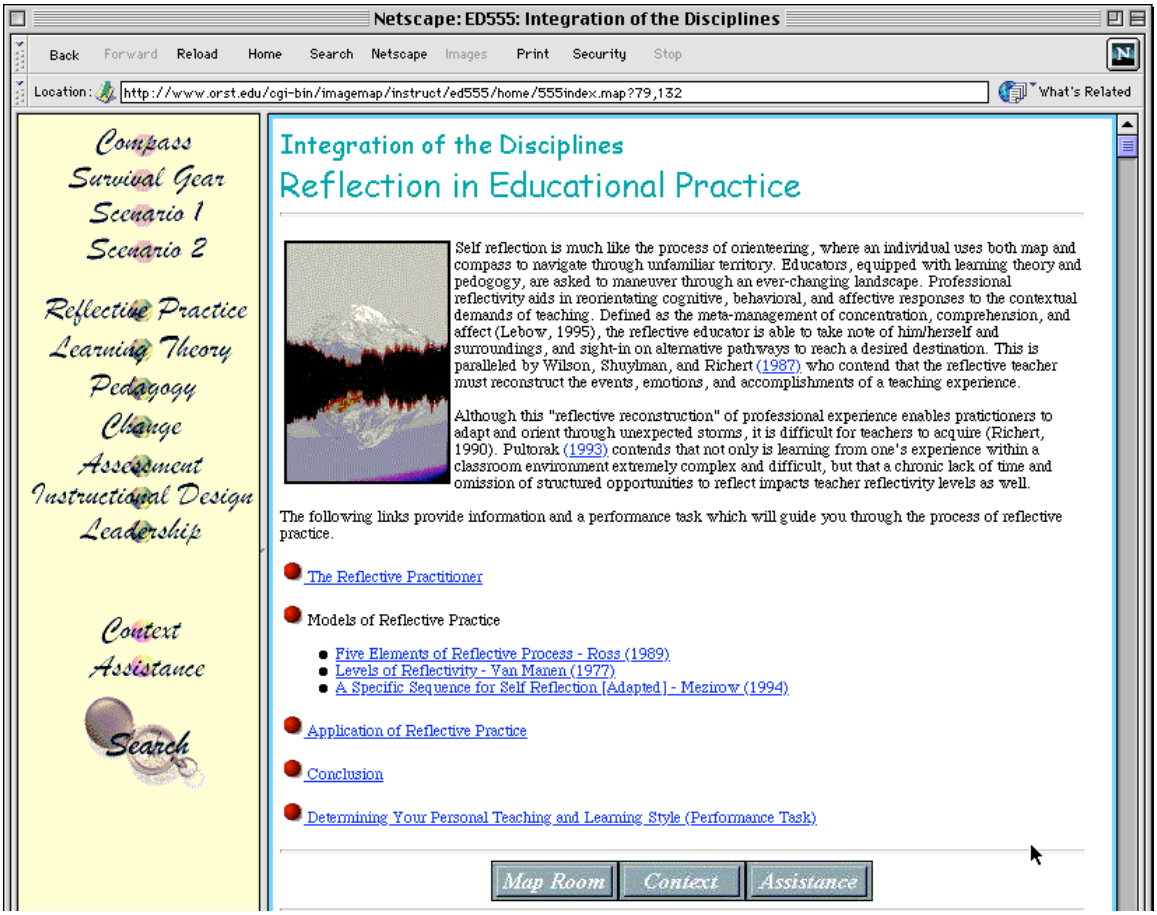


Figure 4. Theme Page.

Interactivity

Interactivity is important in the course and students appreciate this feature as Merickel relates:

> They liked the interactivity of the content. They liked being able to go into content resources and when they wanted to say something about that and post it either to their fellow students or to the instructor within the content itself, they could do that. They liked that capability. (Vol. 4, p. 46)

Every page has a button that goes to a Web-page form called "Send Mail Message." Students can fill out the regular email blanks on this form and send it to the instructor. This encourages regular and immediate feedback while the student is interacting with the content: she can also interact with the professor.

Task Tracker

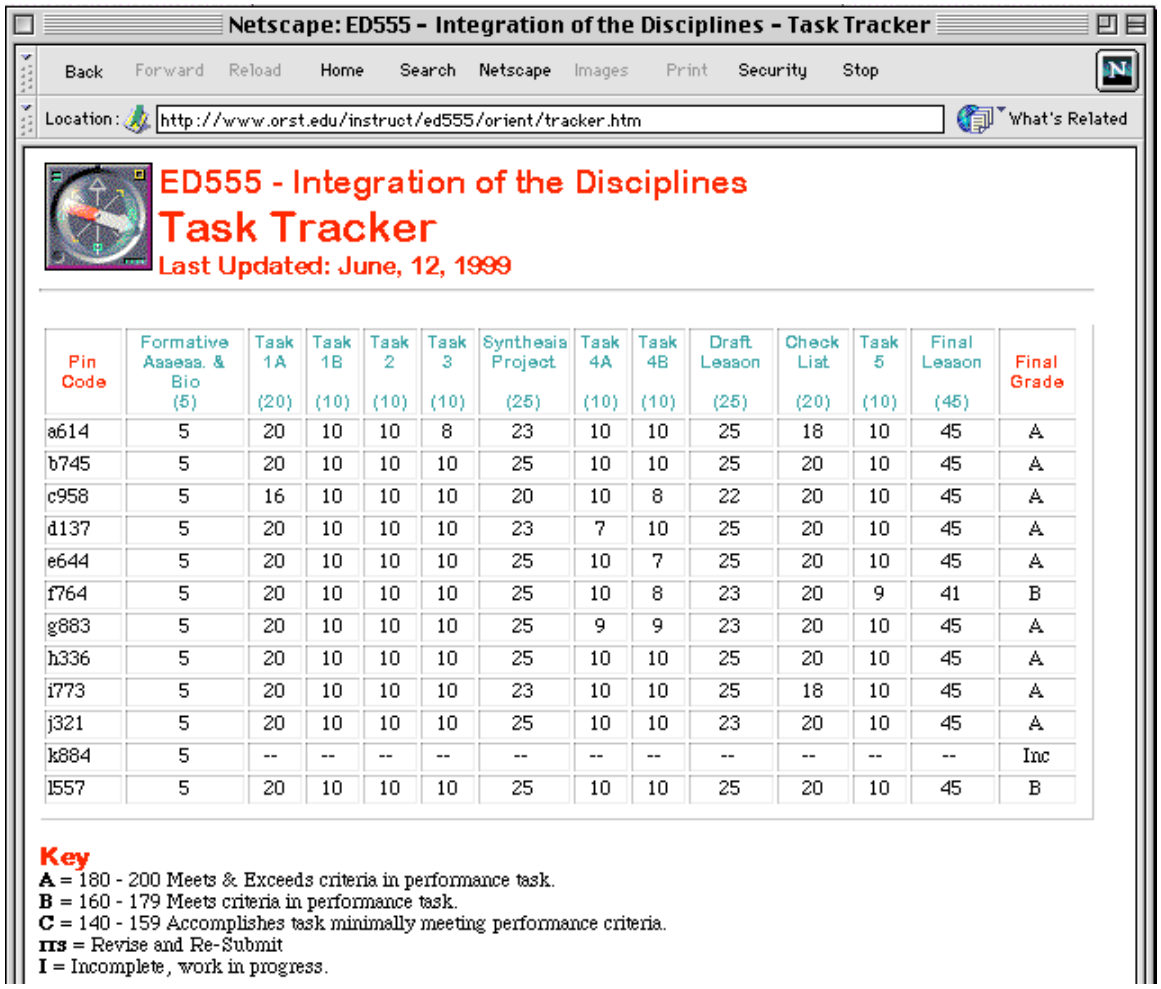
Students need to know how they are doing in a course especially when it is online. They need to know that the instructor has received their assignments and projects and how well they did on each one. In "Integration of the Disciplines" each student is given a unique pin code and all their scores are posted under it on the Task Tracker (see Figure 5).

The Task Tracker is a large gradebook table with Pin Codes in place of names, names of assignments and projects, and the points possible, plus the students' scores and grade. Each person can see where he or she stands at any time of day or night. In fact, everyone in the class knows how the class as a whole is doing without knowing exactly how individuals are doing other than him or herself, of course. If students see a problem with their scores, they can contact the instructor to find out what the problem is. There is a "Last Updated" date at the top left of the page so students know that if they handed in

an assignment or project *after* the last updated date, they are not going to contact the instructor. However, if they handed it in *before* the last updated date, they know they need to email the instructor quickly to find out the problem. The Task Tracker is a simple but effective feature for student feedback that can be created and kept up without fancy software. One apparent problem, however, with the Task Tracker, is that the instructor must remember to manually change the letter grade when scores are added or changed.

Students

The bottom line in many universities is whether or not the students perceived they had a good learning experience in a course. The summative evaluation at the end of the course found some interesting results. One hundred percent of the students "perceived the Web course 'articulated appropriate learning strategies'" while 82% "perceived the Web course as 'matching their preferred learning style'" (Vol. 4, p. 18). Forty-seven percent of the students said that there was "more" or "significantly more interaction" with the instructor as compared to regular face-to-face courses. Some people fear that interactions and social constructivist learning will be lost in online courses, yet 34% perceived that there was "more" or "significantly more" interaction between students than in regular face-to-face courses. Another set of questions asked about the quality of the interactions, not the amount of interactions as previously noted. The perceived level of quality for interactions between both students and instructor and between the students themselves was 100% for each group.



Pin Code	Formative Assess. & Bio (5)	Task 1A (20)	Task 1B (10)	Task 2 (10)	Task 3 (10)	Synthesis Project (25)	Task 4A (10)	Task 4B (10)	Draft Lesson (25)	Check List (20)	Task 5 (10)	Final Lesson (45)	Final Grade
a614	5	20	10	10	8	23	10	10	25	18	10	45	A
b745	5	20	10	10	10	25	10	10	25	20	10	45	A
c958	5	16	10	10	10	20	10	8	22	20	10	45	A
d137	5	20	10	10	10	23	7	10	25	20	10	45	A
e644	5	20	10	10	10	25	10	7	25	20	10	45	A
f764	5	20	10	10	10	25	10	8	23	20	9	41	B
g883	5	20	10	10	10	25	9	9	23	20	10	45	A
h336	5	20	10	10	10	25	10	10	25	20	10	45	A
i773	5	20	10	10	10	23	10	10	25	18	10	45	A
j321	5	20	10	10	10	25	10	10	23	20	10	45	A
k884	5	--	--	--	--	--	--	--	--	--	--	--	Inc
l557	5	20	10	10	10	25	10	10	25	20	10	45	B

Key
A = 180 - 200 Meets & Exceeds criteria in performance task.
B = 160 - 179 Meets criteria in performance task.
C = 140 - 159 Accomplishes task minimally meeting performance criteria.
RS = Revise and Re-Submit
I = Incomplete, work in progress.

Figure 5. Task tracker (gradebook).

One-hundred percent of the students also "perceived that 'the teaching and learning strategies were appropriate for the subject matter and achievement of learning objectives'" (Vol. 4, p. 20). The most dramatic item concerned the quality and content of the Web-based course compared to corresponding campus instruction. Eighty-eight percent of students perceived the content and instruction of "Integration of the Disciplines" as 'excellent' or 'above average.' Clearly the students were well satisfied overall with the course.

There were many things that the students liked about the course and things they did not like (see Table 8; Vol. 4, p. 12). For instance, while they appreciated that the course was non-linear, they also did not like the freedom of having multiple pathways. Apparently even though they liked the flexibility of multiple pathways, they wanted a little more structure and direction. Table 10 gives a concise overview of student reactions to the course.

While there are problems still to be solved and overcome, the students were clearly satisfied with their learning experience.

Changes in Course

Merickel is satisfied with his course pedagogically and if he were to make any changes at all they would be only infrastructure changes. He no longer teaches the course but has his doctoral students teach it. Once they have taught this course then they are better able to design their own Web-based courses.

Table 10

What The Students Say

Benefits	Limitations
1. Visual & Auditory Learning	1. Not = to Learning Style
2. Non-Linear Multiple Pathways Nature of Hypertext	2. Multiple Pathways 3. Standard Cues (emotion) Reduced 4. Technological Requirements
3. Time & Space Independent	5. Time Management—Self-Directed
4. Local and Global channels	6. Time at the Computer
5. Interactive Content	7. Technological Limitations/Problems
6. More Dialog/Discussion	8. Hardware (Display) Differences
7. Richer Dialog/Discussion	9. Necessary to Print Pages to See the Whole Picture and Read Offline
8. Integrated Strategies	
9. Learner Centered	10. Want to See the Instructor's and Students' Faces for Validity Reasons (real person on the other end)
10. Time to be Reflective and Formulate Responses	
11. More Resources	11. Putting Responses, Thoughts, and Answers into Textual Formats
12. Choice of Resources	12. Change Is Hard
13. Control Over One's Own Schedule for Learning	13. Unwilling to Take Risks
14. Sense of Privacy of Thoughts	
15. One-on-One With the Instructor	

Unexpected Discoveries

No matter what the learning journey is or where it takes the learner, there are always unexpected discoveries along the way. Merickel also had some of these discoveries. He had prepared the course for education preservice and inservice teachers, but about 10% of the students were people from business and industry. He describes the solution to this problem: "Therefore the scenarios were considered as not relevant by these individuals. I had to make a quick adjustment and create another scenario for the adult learner. I must add that this did turn into a positive" (Vol. 4, p. 4).

He had pleasing discoveries as well which included the positive reception of the students to the course. He reflects "Students claimed the learning opportunities and opportunity for discussion were superior to face-to-face. I had not expected a "superior" rating" (Vol. 4, p. 4).

Challenges and Satisfactions

The biggest challenge that Merickel encountered as he designed, developed, and taught this course was time management. Although he was highly technically skilled and used technically advanced programs for the time that he was building the course, he was overwhelmed with the amount of time it took to keep up with the technology as well as to do the actual course development. Finally, he admitted to himself that he could not build courses like this by himself again in the future. He expressed his frustration:

> The environment is so dynamic that the tools are changing constantly. . . . The tools that I'm using today are completely different than these. Bottom line…I can no longer keep up. . . end of deal. I could never do this as an individual again. I could not do it. (Vol. 4, p. 35)

Now he has turned to course-builder programs as many others are doing even though he is not comfortable that this is the best way to go. He describes his dilemma:

> Too resource intensive, too much time, too many other responsibilities that I have and so my transition has been to using the new development tools. . . . Those are dynamic development tools that are generally related with relational databases, auto-course builders, etc. I have been forced, by myself and maybe the culture around me, to move that direction also. For better or for worse.

Designer/Instructor

Over the past 4 years Dr. Mark Merickel has "created and delivered twenty one graduate level web courses for teacher preparation, professional development, and degree programs" and is a specialist in "virtual/cyber teaching and learning environments" (Vol.

4, p. 28). Currently he is involved in developing an online teacher education program to serve the needs of students across Oregon regardless of their time and location limitations.

Merickel explains his goals and work:

> The web provides educators with a unique opportunity to create new ecologies for teaching and learning. It has been my intention to create educational opportunities that are meaningful and motivating to the learners. I have attempted to create web courses where the elements of my web pedagogy (content, process, and environment) complement each other and facilitate the learner's construction of knowledge. I believe that if web 'courses' are designed in keeping with these educational principles, the difference between teaching and learning on the web, and traditionally, can be profound. (Vol. 4, p. 28)

Reflections and Advice

Merickel had an intense experience in designing and building this course and then in teaching it. Naturally, he learned many things along the way that should be shared with others. As he reflected over his experience he had some inspiring advice for those who desire to enter into this new world, this new learning ecology:

> Don't begin the development of a web course thinking that you will take your face-to-face curriculum and experience and simply make web pages out of them. The web presents educators with the opportunity to rethink curriculum, teaching and learning. The web presents a new ecology. Take the time and opportunity to deeply think about this "new" medium and begin to design teaching and learning opportunities that are more than iterational. . .think transformational! (Vol. 4, p. 4)

Summary

"Integration of the Disciplines" does just what it says—integrates the disciplines—in an webbed environment. The course metaphor is orienteering, which keeps the learners on track. The course does not use a textbook approach either with print or hypertext. Instead, it has completely original resource materials posted for the students

to access whenever they need them in a non-linear manner. Students prepare a variety of integrated instructional strategies while they experience them in the course to solve an authentic problem scenario. Reflection, interaction, and collaboration are all part of this well-crafted learning experience.

CHAPTER EIGHT

BIOCOMPUTING

Overview

BioComputing is a "large scale, transnational collaboration that the Internet uniquely makes possible" (Paul Allen Virtual Education Foundation, 1998, p. 1). This interactive course sponsored by The Virtual School of Natural Sciences BioComputing Division (VSNS-BCD) at the University of Bielefeld, Germany, was developed by an international team of over 50 researchers and consultants from various academic institutions and industry. This interdisciplinary course addressed the fields of molecular biology, computer science, and biomedicine. BioComputing is designed to fill an instructional void (http://www.techfak.unibielefeld.de/bcd/Transfer97/people_e.html):

> Today, every molecular biologist has to use several software tools on the Internet to analyse the rapidly growing amount of biological sequence data (genes, proteins, structures). Many scientists lack the understanding of mathematic and algorithmic basics of these tools. At their own institutes or work places they cannot find any training in this respect. The BioComputing Course of the *Virtual School of Natural Sciences* is intended to close this gap. (Vol. 5, p. 33)

Features of this free course include a custom-written BioComputing Hypertext Coursebook and BioMOO, a "'virtual meeting place' for scientists interested in using Internet technology for scientific exchange" (Vol. 5, p. 125). BioMOO was used both for consultant and faculty meetings as well as for the student discussion groups. One class had "37 students from 14 countries" (Vol. 5, p. 33).

The vast collaborative process of developing this two-time-award winning course was principally coordinated by Georg Fuellen of the Department of Computer Science and Biotechnology, University of Bielefeld in Germany. He was closely assisted by Robert Giegerich, also of Bielefeld University, and, joining the core team in 1997, Rebecca Parsons of University of Central Florida. Georg Fuellen was the individual who worked with me in this case study, however, and who is, therefore, primarily featured.

International Course Development

Whenever a team develops an innovative course, it can be challenging even when they can meet face-to-face. BioComputing is remarkable because it was developed virtually by an international team of instructors and students dedicated to creating much-needed instruction for an infant field. Naturally, outside observers might be curious to know how they were able to effectively work together to create this special course. It won the German award, Multimedia Transfer ’97 by Learntec ’97, plus an Honorable Mention in the 1998 Paul Allen Virtual Education Foundation Outstanding Online Course Award competition. The original concept was first developed by Fuellen and Giegerich, who then recruited additional qualified and willing scientists to actually create the course. Seven authors from Germany, Mexico, and the USA wrote the BioComputing Hypertext course book. Fuellen notes “Beside the relevant definitions, algorithms and illustrations, it includes hypertext-links to the BioComputing tools on the Internet” (Vol. 5, p. 33). The course itself was developed by a team of “three computer science and biology professors, 2 graduated biologists and one Ph.D. bioinformatics student (from Germany, USA, Mexico and France) in 1996. Prominent scientists were invited to give occasional guest lectures” (Vol. 5, p. 33).

The first BioMOO meeting to lay the groundwork was on September 20, 1994, when nine virtual education pioneers representing at least five countries met. Fuellen had prepared and posted an agenda in advance to help the meeting be productive. They began with brief, one-sentence introductions of each participant and then launched into the course business. Fuellen was appointed the chair of their meetings. Then they developed a mission statement, and decided to set up listservs "to discuss syllabus and other topics in depth" (Vol. 5, p. 203).

Minimal rules and regulations were also accepted that determined the process of working together. Fuellen and some others had done their homework before this first meeting so there were specific topics and issues to discuss. An outline of the proposed textbook was presented and accepted by the group along with the agreement that "the editorial process for the hypertext book (peer review, etc) shall follow the path established by scholarly journals" (Vol. 5, p. 205). Further, they also set up their future schedule of meeting at the BioMOO on the fourth Tuesday of each month. All VSNS BioComputing Division Meetings BioMOO transcripts from 1994 to 1996 are posted on the web (http://www.techfak.uni-bielefeld.de/bcd/Adm/meetings.html).

Subsequent meetings were held but not all had the necessary quorums to vote on issues or make binding decisions. In spite of hectic schedules and widely differing time zones around the world, there were enough virtual meetings with quorums to get things going.

Course Design

VSNS BioComputing is an 11-week course based on the six-chapter BioComputing Hypertext Coursebook with regular study group meetings at BioMOO.

Instructional Design

This course is based on active learning and constructivist theories. Students are active in their learning throughout the course with instructors acting as guides to student study groups rather than being the "sage on the stage." Fuellen believes that one unique feature of this course was active and engaged interactions in small groups, which are specifically addressed, however, in a later section.

Course Supports

Several components to this course worked together to support student learning. In addition to the BioComputing Hypertext Coursebook and BioMOO, the course also had "some interactive animation and visualization applications of important algorithms and data structures, and a glossary" (Vol. 5, p. 32). All worked together for a cohesive and dynamic whole.

Hypertext Coursebook

As with any text, the course hypertext coursebook was the foundation of the group discussions. Fuellen and Giegerich describe the text as dealing "with the usage of Internet resources, the calculations of the alignment of two or more sequences (Pairwise / Multiple Alignment), with searches in databases, with phylogenetic trees and various other topics" (Vol. 5, p. 36). The text also includes practice problems for the students. Homework was turned in each week with solutions sheets available. Some students eagerly searched for homework samples among the other study groups' Web pages.

BioMOO

BioMOO is an "electronic conference system" (Vol. 5, p. 35) that makes it possible to have synchronous or real time communication between small groups of people no matter where they live. It was used to discuss the text, homework, lectures, and also have fun getting better acquainted.

Animation and Visualization

There were several tools for the BioComputing students and faculty to use. The "Aligner" was installed in BioMOO to help students calculate sequence alignments. One of the course's innovative students created a Web page where others can experiment with "important variations of the algorithm" (Vol. 5, p. 36). An engaging Java-Applet helps students explore the alignment of three biosequences that "can be demonstrated in a three-dimensional cube" (Vol. 5, p. 36). This cube is rotatable and shows "the red 'alignment path'" (Vol. 5, p. 36).

Glossary

As with the previous courses that have been examined thus far, this course also has an extensive, searchable glossary. Besides the glossary, the hypertext material includes "Java Applets visualizing the biomolecules mentioned in the course" (Vol. 5, p. 37).

Interactions

BioComputing was developed through virtual interactions and collaboration. Faculty and students from around the world desiring to promote this new field agreed to work together for the good of all. This course was only partially funded. Fuellen was

partly funded for about 20 months by the "Stifterverband." Faculty, consultants, and BioComputing Hypertext authors volunteered their time to work on this remarkable course. Individuals volunteered time and expertise to develop tools that would enhance students' understanding of biocomputing. Professors and students alike worked together to help this unique course grow and prosper.

BioMOO is where everything got started and where the study groups did their work: "BioMOO is a professional community of Biology researchers. It is a place to come meet colleagues in Biology studies and related fields and brainstorm, to hold colloquia and conferences, to explore the serious side of this new medium" (Vol. 5, p. 29). Interactions are at the heart of BioComputing. Collaboration, information sharing, and networking all occur in BioMOO making it a unique way to learn and grow professionally. Faculty and consultants used BioMOO for their meetings, and it was where students gathered in their study groups to grapple with weekly topics and debate exercise solutions. Guest lecturers were also invited to BioMOO to share their expertise and to interact with others as well. Most of the session transcripts are posted at BioComputing.

There are three types of interactions as previously defined by Moore and Kearsley (1996). BioComputing had many examples of learner-to-content interactions according to Fuellen, which included the students reading the hypertext coursebook, working with some animations, doing their homework, and participating in study group sessions and email/mailing-list discussion. "A few students (co-) developed animations, visualizations, popular-science articles, pieces of software and such" (Vol. 5, p. 3), which also required interaction with the content. The learner-to-learner and learner-to-instructor

interactions worked well with students participating in vigorous discussions during study group meetings and in mailing lists, and "in very few cases, personal local interaction was possible because students lived in close proximity" (Vol. 5, p. 3).

Some instructors believe that synchronous activity is not compatible with adult learners and their busy schedules. Fuellen, however, explained the reason for choosing BioMOO rather than solely relying on asynchronous listservs and email for interactions:

Study group meetings via BioMOO were chosen to enable an active engagement with the content, by encouraging questions and discussion; they also helped to avoid procrastination by giving a weekly stimulus; some animations were very useful to explain and motivate difficult concepts; active participation by volunteering for certain tasks enhanced the learning experience even more. (Vol. 5, p. 3)

BioMOO Study Groups

The faculty worked together to appropriately divide the students into groups of four to seven for each instructor. The instructors grouped the students according to their time zones and endeavored to achieve a good mix of computer science and biology people. In the 1996 version of the course, there were six groups with the following distinguished instructors, as shown in Table 11.

Each group of students met with their instructor once a week for 2 hours in BioMOO. They sent their homework to the instructor by email before each designated class meeting. Instructors then could refer to the success or difficulties of the students' homework that needed to be addressed as a group during the meetings.

Since faculty and students were located in many places around the world, all meetings were announced in Greenwich Mean Time (GMT). A special interactive

Table 11

BioComputing Instructors, 1996

Instructor	Bio Information
Dr. Wolfram Altenhofen	PostDoc at the Drug Design research group of the BASF AG, Ludwigshafen, Germany. He is interested in characterizing ligand-receptor interactions using biophysical and molecular biology methods as well as computer modeling.
Georg Fuellen	PhD student at the Research Group in Practical Computer Science, Department of Computer Science and Biotechnology, University of Bielefeld. He is investigating methods for identifying phylogenetic information, and thereby improving multiple alignments.
Dr. Robert Giegerich	Teaches programming languages, compiler construction and sequence analysis algorithms at the University of Bielefeld, Germany. He is also in charge of the new curriculum in Bioinformatics at Bielefeld University. His research interests include methods for approximate matching of complex structural patterns.
Dr. Rebecca Parsons	Assistant Professor of Computer Science at the University of Central Florida, in Orlando, where she teaches programming languages, compilers, and program analysis. Additionally, she is teaching a survey seminar course on Computational Biology, focusing on algorithms in the area of DNA sequence analysis, image analysis, biological modeling, and protein structure.
Dr. Paul St. Amand	Post Doctoral researcher at the United States Department of Agriculture (USDA) at Kansas State University. His current project is modeling the rate of transgene escape from plants via pollen. His main areas of research are quantitative genetics and molecular biology.
Dr. Francisco De La Vega	Assistant Professor at the Department of Genetics and Molecular Biology of the Center for Research and Advanced Studies of the National Politechnic Institute (CINVESTAV-I.P.N.) located at Mexico City, where he teaches a course on Computer Applications to Molecular Biology each year. He is interested in searching sequence patterns that might be related to gene expressivity using statistical, graphic, and artificial intelligence methods.

Note. Data from Vol. 5, p. 44.

support was provided to help everyone accurately determine their own local times. A person types in the name of her own city—or closest large city within their time zone—and then finds the difference between GMT and their local time, enabling them to determine the time for her meeting. Some instructors further assisted students by posting a list of introductions by each study group member and thoughtfully included the correct local meeting time for each of them (http://leonardo.ls.huji.ac.il/967Eidoerg/bioinfo/group_mirror/1996Students.html).

Although synchronous activities do not always meet the needs of adult learners and their busy schedules, the BioComputing groups found ways to deal with these concerns. Instructors posted the meeting transcripts which allowed absent members to catch up on the given topics and discussions. Frequently, both students and instructor would continue the discussions via email so traveling students could also keep up and so that their problem solving would not be interrupted.

One of the challenges of online communication is that there is neither body language nor voice inflection that so much affect the meaning of our messages. BioMOO, like any MOO, partly addresses these concerns by having an "emote" command. This command allowed participants to show their feelings which helped everyone in the group to better understand each other. For example, the dialog below is about when corrected homework would be ready to return to them. It occurred at the end of a study group meeting where Dr. Paul St. Amand (PaulSt) was the instructor (http://leonardo.ls.huji.ac.il/%7Eidoerg/bioinfo/group_mirror/T4.html):

> **PaulSt** says, "The homework will be ready late tonight!"
> **SDelinger** says, "Bye, Dag."

SDelinger says, "Paul, your timezone is showing!"[1]
Gautam waves to Dag
--snip—
PaulSt [to SDelinger]: What?
SDelinger says, "Late tonight: Iddo thinks it's already late tonight!"
Iddo grins. >The homework will be ready late tonight!<
SDelinger grins.
Ulf says, "Have a nice sleep!"
PaulSt finally understands!
PaulSt says, "Bye all!" (Vol. 5, p. 152)

MOO dialogs are fast moving and often disjointed when there are technical difficulties of people dropping off and coming back on again, or when questions are asked and comments made out of sequence. I have taken the liberty to "snip" out portions of the dialog that do not apply to the example and indicate whenever I do this with—snip.

MOOs have various commands that participants must learn in order to take advantage of its many unique features. The "say" command puts quotes around whatever the person writes as words that are actually spoken or written. The "emote" command allows people to show feelings or physical movements as in the example above when Gautam waves and SDelinger grins, and so forth. The emote command opens up a new dimension that is not readily available in regular synchronous chats; however, there are emoticon symbols for various emotions and behaviors (<Grin>, :-)", and :-|) that are used in email correspondence, but they are not as fluid as in a MOO.

MOO messages are usually only a line or two long but longer messages can be copied from a word processor and pasted in to the MOO when giving reports or explanations that require more cohesive text. This made the reports easier to read both on

[1] MOO discussions are often typed so quickly that there are frequently typos and other errors. I have retained these errors to maintain the true MOO feeling.

the screen and in the transcripts. It also made a difference which MOO client the participant used since some were more limiting than others, particularly in the mid-90s.

Since a MOO is an object-oriented environment, people can find out about other people, objects, and rooms within the discussion by typing certain commands (http://bioinfo.weizmann.ac.il/BioMOO/FAQ.html). When a person registers at BioMOO, she/he writes up a description of herself/himself that others can access whenever they want to learn more about her/him. This especially helps when there are larger discussions and the participants want to know more about others in the group.

Because MOOs are object oriented, they have "virtual space." Figure 6 shows the BioCenter Building where BioMOO meets; there are additional virtual rooms downstairs where groups can meet. The graphic organizer helps people comfortably navigate to their meeting place. Gustavo Glusman, a biologist with the Weizmann Institute of Science in Rehovot, Israel, created and maintains BioMOO.

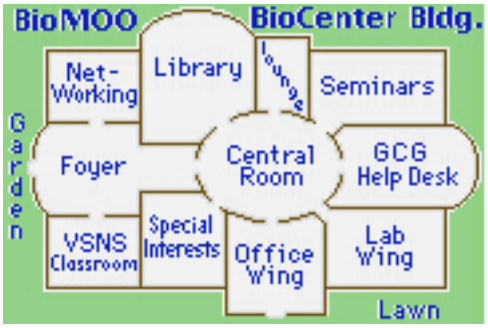


Figure 6. BioMOO BioCenter building.

One of the unique things that the study groups could do in BioMOO, however, was to have their Web browser open to look at presentation slides, content Web pages, or special interactive tools all while being able to interact live with the instructor and other students. This created a dynamic learning environment in spite of the complications of time and distance. A special tool was built into BioMOO called the "Aligner." It allowed students "to calculate an alignment of two biological sequences step by step in front of everybody" (Vol. 5, p. 35)in real time. Below is a dialog clip of Fuellen's study group when they were learning to use the aligner. Some of the experiences are the same as in a face-to-face class. Petec eagerly starts working on the aligner before specifically being told how to do it:

Petec sets the seq1 to: AGCACACA
Petec sets the seq2 to: ACACACTA
Petec performs an alignment on the pc'saligner:
No alignment - fill the matrix first!
GeorgF [to petec]: Uh, not so fast :-)
Petec says, "just testing :)"
Petec fills the matrix up to (1,1).
Hrosa finds its way in.
Petec fills the matrix up to (1,1).
GeorgF [to petec]: Now, pls wait a sec
--snip—
GeorgF says, "Everyone should now re-load
http://bioinfo.weizmann.ac.il:8000/32/view/4066"
SophiaK done
Hersh nods.
GeorgF says, "As we can see, Petec has already entered the sequences, and"
Hersh says, "so we should hold off on creating our own aligners ?"
--snip—
GeorgF [to hersh]: I intended that everyone creates his own one now, so that we can fix any problems with that
GeorgF [to hersh]: Then, so avoid confusion, let's use Petec's aligner first
GeorgF [to HLA]: why is the first clickable matrix entry 0 ?
--snip—
GeorgF [to HLA]: From which 3 values was it calculated ?
GeorgF says, "Oops, I meant Petec"
--snip—

Petec looks confused.
--snip—
GeorgF [to hrosa]: Can you click on the next zero, where A (first row)..
GeorgF [to hrosa]: and C (second column) meet ?
GeorgF says, "For me there's also a zeroeth row/column, with no letters)"
Petec fills the matrix up to (1,2).
Petec says, "were you talking to me?"
Hrosa fills the matrix up to (1,2).
GeorgF smiles.
GeorgF says, "Now both Petec and Hrosa did it, but no problem :)"
Hrosa says, "Ops have I done someything wrong george?"
Petec fills the matrix up to (1,2).
GeorgF [to hrosa]: No, you did it right !
--snip—
GeorgF [to Petec_and_Hrosa]: it's very important to understand how these matrix entries are calculated
--snip—
GeorgF says, "The entries are calculating according to the dynamic-programming recursive equation." (Vol. 5, pp. 162-163)

MOO Rules

BioMOO started out with very simple rules that the BioComputing faculty hoped were already part of their students' everyday lives: "Be polite, but don't be afraid to ask for help" (Vol. 5, p. 198). There was at least one study group, however, who developed additional MOO guidelines to facilitate better discussions since things were getting confusing for everyone and especially for the instructor. Dr. Paul St. Amand's group agreed on more rules after discussing them first: 1) "Avoid whispering to Paul, 2) Stay on the current topic, 3) Deal with one question at a time, 4) Keep questions short and focused" (Vol. 5, p. 148). Because some students were reticent to share their questions in front of the entire group at the beginning, they had been "whispering" their questions directly to the instructor so the rest of the group could not see them. Dr. St. Amand discovered the general group discussion lagged while he answered all the private questions, which is why he brought up the problem. He maintained that the whole group

needed to hear all the questions and because he was a slow typist, he needed to be able to address one question at a time for the benefit of all. The group readily agreed to these new MOO rules and felt that their discussions would be more productive because of them. Dr. St. Amand, however, did not want so many rules that they would stifle the group, as this part of their closing dialog on rules demonstrates:

> **PaulSt** says, "What do you all think about these Mooing suggestions? Are they too rigid? OK? Not helpful? I REALLY want your input on this!"
> --snip—
> **PaulSt** says, "Georg has a lot of moo experience, what do you think?"
> **GeorgF** thinks ‘‘as much chaos as possible and as much order as necessary" :-)
> **PaulSt** says, "I would love to have a chaotic discussion, but I can't type fast enough!"
> --snip—
> **GeorgF** says ‘‘…as much order as necessary!!!" (Vol. 5, p. 148)

Fuellen (GeorgF) and Dr. St. Amand (PaulSt) point out a problem that could limit the number and quality of online interactions. People who cannot type either very well or very fast are not able to dialog as fluently as they would normally speak. This limitation could affect virtual learning groups if those with specific knowledge and experiences are held back due to the lack of keyboarding skills. The brief bit of discussion above also points out more reasons for a few well-chosen discussion rules to keep things running as fluently and as coherently as possible.

MOO Instructional Strategies

In face-to-face classrooms there are various techniques to get students involved and to enhance learning. One can ask questions, direct activities, and encourage those who have responded with their growing thoughts. Similar strategies can also be implemented in a MOO. Fuellen demonstrates one way of making sure that no single

student dominates the discussion and also that no student can comfortably sit in the back of the room without actively participating:

> **GeorgF** says, "That is, we'll now do alignments on the MOO"
> **Hersh** nods.
> **GeorgF** says, "The text is mirrored in the US and in Manchester if the connnection is slow"
> **SophiaK** smiles broadly, she has done this before !
> **GeorgF** says, "First, I'd like each of you to create your VERY OWN aligner"
> **GeorgF** says, "Then, I need a volunteer whose Aligner is being looked at first !"
> **Petec** drops the pc'saligner.
> **Hersh** [to GeorgF]: i'll volunteer once i get this working
> **GeorgF** [to hersh]: Uh, not always you:)
> **GeorgF** would like to see someone else volunteering :)
> **Petec** says, "ok..."
> **Petec** says, "..i'll volunteer" (Vol. 5, p. 162)

Fuellen artfully holds back eager Hersh without discouraging him and opens the door for Petec to volunteer. Notice how Fuellen uses emoticons to show that he is being kind with his request. One of the dangers of using text exclusively is the absence of physical cues and verbal intonations. Therefore, it is helpful for instructors and students alike to use emoticons to increase the likelihood that the correct communication will be received as it was intended.

Another MOO instructional strategy is having students prepare and give reports to their study groups. These reports are fairly short since MOO sessions do not tolerate long speeches. Each student prepares a report and then copies and pastes it into the MOO discussion. It is set off nicely so others can easily read it. Below is a short example:

> **Gautam** says, " I have a short excerpt from Doolittle's book""
> **PaulSt** [to Gautam]: Go
> ----------Gautam at BioMOO----------
> > >"DNA is composed of only four kinds of units -A, G, C and T- and even if
> > >gaps were not allowed, it would be anticipated that, on the average, 25% of
> > >the residues of any two aligned sequences would be identical. In fact,
> > >there would be a dispersion around the mean expectation, and a predictable
> > >fraction of random cases would be as much as 35% identical. Once we decide

> >to allow gaps in the sequences, then the range of chance similarities
> >between two unrelated sequences can exceed 50%, thereby obscuring any
> >genuine relationships that may exist" [2]
> This is the quotation of Doolittle [1987, Of URFs and ORFs,
> University Science Books, p.5]
----------Gautam----------
PaulSt says, "Any comments or questions on Gautams' info?"
Iddo says, "Yes. But if you start from local no-gap similarity, then the range of chance similarities decreases, no?"
PaulSt agrees with Iddo (Vol. 5, pp. 151-152)

With six study groups going on at the same time there were bound to be rich discoveries in each one that the others should know about. Thus intergroup reports came into being where a member from one group would send out a synthesis report of their group's progress, discoveries, or problems to all the rest of the groups. Fuellen expanded what these reports could contain: "These may be interesting WWW-resources discovered by the group, creative solutions to some of the exercises, resources developed by a student or the instructor which may be valuable for others, questions the group could not answer, etc." (Vol. 5, p. 142).

A further learning benefit of having discussions in a MOO, live chat, or email is that there is a transcript of all that has been said. Such transcripts are useful for both instructors and students to review and to evaluate what was or was not said.

Guest Lectures

Sometimes special guests were invited to give a lecture for the students at BioMOO. These lectures were not the same type as if they had been given in a face-to-face situation. In face-to-face situations guest lecturers often give their lecture for a designated length of time before the floor is ever opened up for questions from the students. In MOO lectures, however, students are much more involved with the lecturer

all the way through the lecture. The following is an example of a guest lecturer from Israel, Rebhan. The dialog clip shows one method of giving a MOO lecture:

> ----------Rebhan----------
> The first slide may be found at:
> http://bioinformatics.weizmann.ac.il/cards/biomoo/seminar_WebHCI.html
> If you have questions or comments, feel free to speak your mind.
> ----------Rebhan----------
> **Morna** says, "Shalom !""
> **EitanR** says, "Shell we all keep our comments to the minimum? Past seminars thought us that talking in a virtual seminar room"
> **EitanR** says, "is utterly confusing unless things of relevance are discussed."
> **Rebhan** says, "If too many people speak at once, I will tell them to stop speaking."
> **Rebhan** says, "Does anybody have problems to see the slide?"
> **EitanR** don't have web conenction yet (mac crashed).
> ----------Rebhan----------
> As you see on the first slide, my training is in Biology, with a focus on the biology of disease (esp. Alzheimer's). To see the next slide, just click on the button 'Continue'.
> ----------Rebhan----------
> **Rebhan** says, "Please load now the second slide."
> ----------Rebhan----------
> On this slide you will find some information about HotMolecBase, a project I began to work on while finishing my Ph.D. thesis in Stuttgart. HotMolecBase is a collaboration with Dr. Jaime Prilusky (Bioinformatics Unit, Weizmann Institute), whom I met during a one-week visit at the Weizmann in 1995. The more I was working on the topic, the more I got fascinated by the potential of the Web for organizing information and making it easily accessible.
> ----------Rebhan----------

Notice that Rebhan gives short blocks of information along with directions to the audience on how to access his slides and when to do so. In a face-to-face situation Rebhan would have complete control over the timing of the slides, but in a MOO lecture he must tell the audience when to load the next slide. Also note in the following dialog clip that the lecturer insists on an interactive exchange once he has given the preliminary information:

> ----------Rebhan----------
> If you click on the picture, you will see the first entry in HotMolecbase.

This entry is a fact sheet about tau protein, the focus of my Ph.D. thesis. My feeling was that tau protein is a very interesting cellular player, and I wanted to use it as an example for how information about genes and proteins could be organized.
-> I would like to hear your opinion about this approach!
----------Rebhan----------
Rebhan is waiting for feedback
Gustavo says, "If I understand it properly, there are currently 13 entries in HotMolecBase?"
Rebhan says, "yes"
Gustavo wonders how big such a personally-curated database can get.
EitanR likes the detailed, human readble presentation, but can you efficently run searches to find things expressed "mainly in brain?
Rebhan says, "The information is collected manually, and focusses on selected proteins that are of interest for a large group of researchers."
Morna says, "who select the researches?""
Ofer says, "is it constantly growing?"
Rebhan says, "That's a good question. Those researchers who have interesting homepages and who have publications in good journals."
Rebhan [to ofer]: It is growing constantly, but not very fast. This is due to the fact that I can spend only a very limited time for this project at the moment. However, some people are interested in contributing, although not many already contributed in a substantial way.
EitanR says, "So, is HotMolDbase a set of web pages in a more or less standard format?"
Gustavo says, "A set of articles."
Rebhan [to EitanR]: Right. This collection of Web pages is searchable, but is not a database in a narrow sense.
Rebhan says, "You could also call it a collection of short electronic reviews of Web information"
Rebhan says, "We are also thinking about providing computational tools that will enable researchers to easily compile similar pages."
----------Rebhan----------
To go back to the slide, use the 'Back' button on your browser. Then click on 'Continue' to see the next slide. (Vol. 5, p. 186)

BioComputing Mailing Lists

Of course, both the faculty and students also used email extensively for more in-depth communication. Fuellen and Giegerich note, "We found that e-mail and mailing-lists represented valuable media for subsequent discussion of open questions" (Vol. 5, p. 33). There were 11 mailing lists designed to meet a wide variety of needs for both the

faculty and students plus those who were interested to learn more about the course, as seen in Table 12 (http://www.techfak.uni-bielefeld.de/bcd/Adm/lists.html).

Table 12

BioComputing Listservs

Name	Description
Students	For any kind of discussion about the GNA-VSNS Biocomputing Course, questions by students about the Hypertext Coursebook, etc.
Administrative Matters	During the Course: For organizational issues concerning all consulting students. Anytime: for discussions about rules and regulations, student admission, etc.
Ethical Issues	For discussion about Ethics in Biocomputing.
Curriculum Issues	The discussion list on "curriculum issues" of the GNA-VSNS Biocomputing Course. For discussions about the hypertext book, Master Outline, individual chapters, style questions, technical comments, etc.
Media Issues	For discussions about "Interactive Media" use, etc.

Note. From Vol. 5, p. 144.

Certain types of discussion were best conducted on the asynchronous mailing lists, while others were better suited for the synchronous BioMOO chats. Sometimes when certain questions or issues were brought up during a MOO meeting, they were deferred to an appropriate mailing list for more in-depth discussion. Email allowed for

longer and more complicated questions and answers. In the example below, the student asked a challenging question near the end of the study group session:

> **Gautam** says, "This is just what to expect. I am still working on the significance of observed similarity. I.e. if a biologist observes that the two sequences are 65% identical, what does it really mean. I.e. what is the probability that he/she is observing it just by chance.. (They would like that to be less that 5% typically)."
> **PaulSt** says, "This is a complex topic. Can we discuss this more on email or in next class?"
> **PaulSt** says, "Our time is up for today!"

Virtual Environment and Community

Complex topics were the norm in BioComputing but these special scientists were normal, fun-loving people who enjoyed friendship and camaraderie with one another. At the beginning of one study group's weekly session, a virtual, ASCII-art birthday cake was served—and exploded into everyone's laps:

> **PaulSt** tries to eat the falling parts of cake
> **SDelinger** says, "Thanks Georg!"
> **GeorgF** says, "everyone's looking pretty messy ... ;-)"
> **Iddo** removes crumbs from tux. "Chocolate."
> **PaulSt** wonders about Georg's fascination with fire (crackers and candles)!
> **SDelinger** says, "That's what happens with firecrackers buried in cake!"
> **GeorgF** says, "The cake needs some more work, though.. It looked molten.."
> **PaulSt** says, "Are we all here?"
> **SDelinger** says, "Digital chocolate cake. Eat your hearts out, Wired subscribers!"
> **SDelinger** says, "I don't see Lisa."
> **Dag** thinks we are missing Richard
> **Iddo** says, "I'll mail Lisa and Richard"
> **PaulSt** says, "Richard might not make it, lets wait a few minutes though."
> **SDelinger** scoops up more cake crumbs, washes them down with Coke ™.
> **Iddo** mailed Lisa a reminder
> **PaulSt** says, "Thanks Iddo for the mail to Lisa"
> **PaulSt** says, "Lets go ahead and get started!"
> **Iddo** nods (Vol.5, p. 147)

The above dialog also shows a sense of community developing where members watch out for other members who are absent. Having a bit of joviality at the beginning of

a study group is one way to help members bond, connect, and get comfortable with each other. Then when they tackle difficult concepts and problems together, they are more likely to feel safe and ready to learn.

Assessment and Evaluation

Partly because this course was not officially offered through a university and partly because there was no credit given to students who successfully took the course, there were no grades and no tests. Students were asked to respond to the instructors for formative and summative evaluation on the course design and effectiveness, but there were not the usual quizzes and tests. Each chapter and weekly assignment had challenging problems, however, for students to solve. Then study group instructors or their cooperating consultants would correct the homework and return it to the students. Students did the work because they wanted to learn, not because they wanted a grade. Instructors and consultants corrected students' work and dialoged with them because they wanted to facilitate learning—even their own, not merely because they were being paid to do so. BioComputing challenges traditional ways that instruction is delivered because this group of instructors and students cooperated and collaborated to learn together—even without official negotiations, agreements, or guidelines between their respective institutions.

Technological Aspects

No matter where students are located around the world, they need only to have a computer plus an Internet connection in order to take this course. Only "established

technologies – HTML, Java, CGI-scripts, and a textbased virtual conference system" (Vol. 5, p. 32) were used, thus the course required only a WWW browser to participate.

Although the technology requirements were kept simple for the students, it was not so simple to develop the course and to keep things running smoothly technologically. As mentioned earlier, this project was only partially funded, but there were many eager volunteers to help make things work. Fuellen and Giegerich explain further how things worked:

> Many students 'paid' for the course by providing assistance. They offered their special expertise and helped
> • Solving technical problems on PCs, Macs and UNIX-machines,
> • Developing a mirror-system, which makes the WWW-pages of the course easier available e.g. in the USA,
> • Introducing newcomers to the BioMOO conference system. (Vol. 5, pp. 33-34)

Additional volunteer students created registration pages, "evaluation forms, graphics and diagrams, and animations and visualizations of algorithms" (Vol. 5, p. 34). There was a neighborly pioneer spirit as in helping with an old-fashioned barn raising. More was accomplished together than could ever have been accomplished alone.

Yet technology can be balky, and it was with BioComputing at times. Because of phone line problems there were often long and aggravating lags in BioMOO. This meant that sometimes for up to 3 minutes there would be no activity on a person's screen even though she knew there was an active discussion going on. As one otherwise happy student complained "Net lag is a problem. Also it takes me far more time to type things than to speak. This all makes communication via BioMOO difficult—maybe it's something to get used to (I'm new to MOOs)" (Vol. 5, p. 229).

At other times students and instructors alike might get dropped out of the MOO session and would have to reconnect as quickly as possible. Only 50% of the 1996

students agreed that "the technology is easy to use" (Vol. 5, p. 228). Yet these frustrations did not keep anyone from participating in the course even though some weeks were worse than others. Most participants persevered and had relatively few technology problems.

Changes in Course

Upon reflection Fuellen had only one thing he would change in the course. He would like to add an anonymous multiple-choice assessment to determine the students' level of success at the end of the course. This would help the instructors to know whether or not the course was truly meeting its learning objectives rather than solely relying on student satisfaction surveys.

Not all students were satisfied with their online learning experience in BioComputing. One student shared his problems with the class plus possible solutions:

> It seems that the Text book was very wordy and hard to follow. A lot of conversions on MOO were more like guessing games over trivial issues that would eat up most of the time. My suggestion would be to try to cover more material by maybe taking interactive trips through the web, something similar to going on a class trip to a museum, park, country, or cave. So that one can experience more then just discussion by a text window. I hope I haven't insulted anyone with my comments. I think that everyone tried hard to do a good job. (Vol. 5, p. 229)

Instructor/Coordinator

Georg Fuellen was the glue that held the course together and the energy that made it happen. His goal was not to attract attention to himself, however, but rather to facilitate learning. He is a member "of the Research Group in Practical Computer Science, Department of Computer Science and Biotechnology, University of Bielefeld, specializing in biocomputing" (Vol. 5, p. 60). Fuellen articulates his philosophy:

> Education is an attempt to enable people to deal with technology in some better order. It is my firm belief that we and our children will only be able to cope with today's and tomorrow's challenges, if we are aware of the hazards resulting from influencing complex systems like the Earth, or the human body. We now realize that these systems may react in ways that we did not anticipate, and that we need to be careful if we confront them with something new, e.g. novel chemical substances. The better we know what we're doing, the better we can introduce and/or utilize technology in such a way and to such a degree that the result is beneficial for ourselves. Education via the Internet may be one small contribution furthering this goal. (Vol. 5, p. 60b)

Certainly he is well on his way to achieving his philosophical goals by all he did with BioComputing.

Unexpected Discoveries

Fuellen was the powerhouse coordinator of BioComputing. When asked what he had unexpectedly discovered in working with the course, he shared:

+ Instructors and students showed a lot of initiative developing e.g. teaching tools; some instructors introduced the students to some basics of their own area of research
+ Later, we received two major awards, and one honorable mention
- It all took me much more time than expected, e.g. selecting and allocating students to study groups such that time zone constraints were met, that there was a mix of biologists and computer scientists, etc, took me >24 hrs. (Vol. 5, p. 4)

Challenges and Satisfactions

Developing any online course is a definite challenge, but this one uniquely posed even greater challenges because of the international development team and students. As Fuellen looked back over his experience with BioMOO he reflected on his challenges:

> It's receiving commitments that I was able to rely on; for this reason, we had:
> + self-selection of the most motivated students by arranging some "hurdles"
> + a mission
> + an instructors' pledge
> I attribute the high retention rates to these measures, even if they look "overdone" in hindsight :-) (Vol. 5, p. 4)

Fuellen further declared that his greatest gratification came from the satisfaction of the students and instructors. He noted that regarding "instructors: one instructor got a job because he participated, one instructor got premium coverage in the 'Chronicle of Higher Education', one instructor was first author of our paper, and one instructor co-authored the Paul Allen submission" (Vol. 5, p. 4). He added: "These 4 are all the non-Bielefeld instructors that participated in the 1996 course, and everyone benefited :-)" (Vol. 5, p. 4).

One particularly challenged student commented:

> Summarizing I find there was much more self-discipline needed to keep track with the course, to read the chapters in time than with real-life learning, because it's easier to back out when the subject is on less interesting aspects. But, as a compliment and a fact, only technical problems or illness could keep me away from my classes !" (Vol. 5, p. 229)

Reflections and Advice

When asked what he would advise to other instructors who are wanting to develop effective online instruction, Fuellen counseled:

1. Consider the option of using a MOO for conferencing.
2. Be skeptical of most tools that want to automate administrative tasks for you—many are a waste of time because they introduce as many problems as they solve.
3. Fight procrastination as much as you can.
4. Things always take longer than you think they do, and using computers usually makes this statement even more true ;-) (Vol. 5, p. 4)

BioComputing could lead the way to change how universities develop and deliver instruction. This international team of instructors and students exemplified cooperation and collaboration in ways not usually seen even in face-to-face course development.

Summary

An international team collaborated virtually to develop and instruct "BioComputing." The course structure is based on small study groups each with its own instructor. All the study groups use the same original hypertext textbook and discuss topics together asynchronously on the various course listservs. Each week there is a 2-hour live chat at BioMOO. Students and instructors are grouped together partly by their time zones. Special software is included so students and instructors can learn to work with real biocomputing concepts.

CHAPTER NINE

TAMING THE ELECTRONIC FRONTIER

Overview

Taming the Electronic Frontier, the Paul Allen Virtual Education Foundation Outstanding Online Course Award winner, artfully combines theory and practice to prepare students for the challenges of the rapidly changing work world. The course is interdisciplinary and "…explicitly integrates: Technical skills in web publishing, Writing skills, Philosophy (What is Quality? Value?), Interpersonal skills (group dynamics)" (Vol. 6, p. 6). Students create real-world products that must meet the test of quality. Teams work on group projects that they develop for external customers and must meet the firm deadlines. A special "web-based coordination tool" created by the course author and supplemented with "email, chat rooms, web-crossing and telephones" assists students. All of these things are guided by the course philosophy of "Use the right tool for the job philosophy" (Vol. 6, p. 18). Although the course uses television and videotape to deliver lectures, they are not key to its success but merely provide the background and direction for experiential activities. This course can successfully handle large enrollments of 50 to 100 students particularly because of its unique, technological automated features. Dr. Brad Cox, presently with Virtual Education and formerly at George Mason University (hereafter GMU), is the course designer, developer, and instructor.

Course Design

Every course has design—or lack of it—and good course design separates Taming the Electronic Frontier (hereafter TTEF) from a plethora of insipid online courses available on the Web today. Although this course features learning technology, it is not a technology course per se because it goes far beyond merely learning HTML codes and CGI scripts. Cox describes the nature of the course:

> This course emphasizes dialog between producers and consumers of information age goods via television, telephones, and the internet; even face to face meetings when that's the right tool for the job. Organizational learning exercises, based on these technologies, will challenge power relationships between teachers and students, producers and consumers, universities and customers, broadcasters and listeners. These new relationships, in turn, provide further chances for learning and collaboration. (Vol. 6, p. 80)

People not technology are at the center of this unique course, and this unexpected fact sometimes throws students off when they begin the course because they want to bury themselves in the technical aspects rather than deal with ethical issues, philosophy, human relationships, group dynamics, or quality.

The course is divided into two sections. The first 5 weeks emphasize technical skills while providing a beginning background of philosophy for the coming tasks and

> will bring us all to the point where we see telecomputing infrastructures as just plumbing. It will disappear into the woodwork to become an invisible window through which *people* communicate, cooperate, coordinate and complete as members of an advanced electronic community. (Vol. 6, p. 80)

The second section of the course starts integrating and applying philosophical principles to real tasks. Cox explains: "The final ten weeks will concentrate on sociocentric skills of working effectively in virtual and/or physical teams, fluidly choosing and using the right tool for the collaborative jobs at hand" (Vol. 6, p. 80). One student described this artful balance in TTEF: "This course was like a well prepared meal

that has enough interesting things to eat—of the theory and practice dishes" (Vol. 6, p. 200). Cox sets up the course as a preparation for the new challenges of the work world in which students must survive and flourish.

Instructional Design

The instructional design of Taming the Electronic Frontier includes many unique features. First of all, it is an interdisciplinary course. Cox believes that theory and technical skills need to be integrated and that

> the ongoing disputes between 'academic rigor' versus 'relevance to industry' factions are fundamentally misguided and wrong. I've tried to show that both training and education can be delivered in a single course without diminishing either. For example, most students sign up expecting a course in html coding tricks. But they soon discover that the course spends as much time on philosophy (what is quality?) and on interpersonal relationships (group dynamics). Based on student feedback, this seems to be a winning formula that I'd love to see more widely adopted, both within academia and within industry. (Vol. 6, p. 20).

Active learning is a principle piece of the instructional design. "The primary teaching technique is experiential learning," Cox remarks (Vol. 6, p. 6). Regular instruction is given through lectures, required text readings, and Web links. Then students almost immediately apply what they have learned to real tasks thus using new technical skills to work while applying theory to guide the development of those tasks.

Course Supports

Every course has supports that hold up the instructional design. This course has some special features that either are done very differently or are completely original, such as the Student Lockers and Weekly Tasks.

Syllabus

TTEF's online syllabus does not fit the typical format yet includes everything that students need to know to be successful in the course. Before students can begin working, however, they need to set up a non-proprietary Internet account and configure their browser correctly. All the necessary information that a student needs is included within several introductory pages. The syllabus covers Television Requirements, Telecomputing Requirements, and Textbook Requirements.

Once all the technical items are covered, then comes the meat of the course, which includes Learning Objectives and Competencies both Practical and Conceptual. Brief philosophical explanations of where the course is going and why are given to prepare the student for some remarkable differences in this course as compared to many traditional courses either face-to-face or online. Although the Weekly Assignment schedule is included in the Syllabus, detailed descriptions of the tasks are reserved for the weekly pages. Nevertheless, the schedule gives the students a comprehensive overview of what to expect and when.

Student Lockers

The TTEF virtual student lockers are much more powerful than physical lockers at a face-to-face school. In face-to-face situations, students keep their texts, notebooks, assignments, gym clothes, and other personal items in the lockers. The virtual student lockers at TTEF, however, are somewhat similar yet also very different. TTEF lockers are created and set up by Cox who defines the locker as "simply a dynamically-generated web page which is the first page they encounter when they enter a course" (1998b, p. 3). He continues: "This page does not display everything they might ever need to know

about the course (signal + noise) but just what they need to know to be successful this week." Further, "…it shows only tasks that have been assigned but not yet accepted as complete" (Cox, 1998b, p. 3). If students want to see the entire list of all the tasks and the complete schedule, they must access different pages from hotlinks on their locker pages. Additional resource communication hotlinks are provided as tools to be accessed when needed. They include Web conferencing, chat, email, and telephone numbers. The Student Locker is an example of coordination technology that helps separate signal (timely and important content) from noise (not timely and important) and can help busy students focus better and manage the information overload that often accompanies students in online courses.

Lectures

Taming the Electronic Frontier includes weekly lectures as support for learners, as noted previously, and they are distributed in three ways: local cable TV, videotapes, and face-to-face in the GMU TV studio. Cox continues to use these methods until better technology comes out that successfully addresses bandwidth issues. Cox does not consider the lectures, however, to be the most important part of the course, as he points out:

> But television is the least important and most expendable and problematic part of our infrastructure. Its bandwidth requirements inhibit the potentially global reach of this course. But most of all, it perpetrates and reinforces the traditional stand and deliver approach to education. (Vol. 6, p. 22)

A student concurs with Cox on the value of the lectures, "I did not really get much out of the lectures because everything I needed was in the required tasks" (Vol. 6, p. 200).

Weekly Tasks

The Weekly Tasks provide experiential learning activities for students to develop budding skills and to apply philosophical principles. These activities are like training wheels for a new bike rider: They support the student while he learns to get his balance in developing valuable technical skills and in applying key, theoretical principles. The tasks vary in content and style as Cox points out:

> Each task presents instruction, invites the student to put it into practice and reports the results in the context of the material that preceded this task. Some tasks have students read web-based or paper-based material, summarize what it says, and demonstrate that they have applied each lesson to their web-based portfolio. Other tasks, such as the desert crash simulation, portfolio peer assessment, and web-based sociometric tasks, take a more quantitative approach. (Vol. 6, p. 19)

Individual Portfolio

Each student starts building a Web-based portfolio right from the beginning of the course. Many of the Weekly Tasks set up an additional phase of construction concerning technical aspects and quality of content of the portfolio. The students can choose any topic they want for their portfolio, and they are told early in the course that they will need to make the portfolio desirable for their peers. Some do not fully understand why this counsel is given until the market-based assessment process begins, and then the reason becomes very clear. The activities take the students through a directed process of building the various parts of their Web site. Cox relates:

> The apparent purpose is to demonstrate newly acquired technical skills. However students gradually become aware that there's a larger purpose, which is to raise the theoretical question, 'What is Quality', in connection with the practical question of what should be included in, and what excluded from, a published work. Since quality and value (particularly objective, subjective and intersubjective meanings) have been introduced in advance, students have a theoretical vocabulary to apply to a practically grounded task. (Cox, 1998b, p. 1)

The process of evaluating student portfolios is described later in the Assessment and Evaluation section.

Team Project

Group projects are a tremendous undertaking at any time but especially when they are done virtually or largely so. The team project comprises the major part of the course grade. It is the laboratory where students—in teams of five to eight—learn more about human group dynamics and the foibles of technology when under pressure. Cox describes the purpose of the team projects: "The goal is to foster cooperation between teammates, for example, by encouraging experts on each team to help their teammates to succeed" (Vol. 6, p. 19).

The project varies from semester to semester but is usually open-ended such as "Use what you've learned to make the world a better place" (Vol. 6, p. 19). One year he used another deceptively simple project: "1) Organize into teams and choose a team leader and a librarian, 2) Pick any breakdown that has annoyed you this semester, 3) **Eliminate it** for 30% of your grade in this course" (Vol. 6, p. 23). Normally students are adept at complaining about university problems and shortcomings, but Cox turned his students into "active change agents" (Vol. 6, p. 23). He adds, "Although bureaucracies can easily intimidate individual students, this doesn't work with scores of eager students applying what they've learned to make things better for everyone" (Vol. 6, p. 23). At other times he had Digital Product projects which he describes:

> The requirement for these is to build a web site with enough real value that other people will pay money to acquire it. These have been remarkably successful at turning unskilled strangers into cohesive (and usually profitable, at least on a small scale) virtual enterprises in just 15 weeks. (Cox, 1998b, p. 2)

Students have done some remarkable Web projects for the GMU departments and projects, such as the Career Center, for outside non-profits, such as Pet Centers, and for government entities, such as Department of Agriculture and the U.S. Marine Corps. In addition, students have also developed projects for industry.

Interactions

Most people expect that the remarkable features of this course are technological, and, in fact, there are many wonderful technical aspects of Taming the Electronic Frontier. Cox, however, explains the unique value of this course:

> Although the innovations are usually perceived as technological, the actual innovations are technology-enabled pedagogical approaches such as experiential learning in collaborative learning communities. Technology is only the enabler, and no single technology is sufficient on its own. Diverse technologies can be deployed in combination to achieve more than any one can do on its own. (Vol. 6, p. 24)

In order to create an experiential learning environment, Cox set up certain interactions or multi-way learning channels. His goal was "to put most of our emphasis on internet's compensating ability to weld students into experiential learning communities" (Vol. 6, p. 22). The technology was used to support a productive community that could not have existed as well—or at all—without it. Yet there are some cautions in developing a virtual community. Students can be overwhelmed with the volume of email they must read. Cox claims an original solution to this dilemma:

> Most web-based education provides exploration-style interfaces: typically a syllabus, web-based readings, and a chat or discussion tool. I tried this early in this course and discovered that busy students do not have the time for unstructured exploration and reading what other students have to say about a topic. This led to the far more structured approach that I use now. The coordination technology simply compares what each student has accomplished with the course agenda and presents only what they must do next to succeed. (Vol. 6, p. 20)

The goal of any course is to help all students to learn. Yet often there are some students in traditional courses who do poorly. TTEF, however, improves student success by showing them only what they need to see individually, so that

> even 'poor' students will do well because it shows them what they must do to succeed. Grades are almost all A's with a few B's with very few C's and below. Considering the 'Why can't Johnny learn' angst in the media, an approach that keeps even marginal students on track deserves very close scrutiny indeed. (Vol. 19)

The Student Lockers show students only what they have not completed for the week. This automatically updated individualized list of activities with their due dates and times simplifies life for students. It is a powerful feature that helps students not to be as overwhelmed with too many kinds of supporting information. A common complaint of online courses is that students tend to see everything as required rather than as enriching or optional, even if these things are noted as such. Thus, it can be difficult for some students to figure out what they really need to do and what is optional so they can ignore it, if needed.

Teacher/Student

Cox explains his function in Taming the Electronic Frontier: "I see my role as a teacher as coach, mentor and facilitator, 'the guide on the side, not the sage on the stage'" (Vol. 6, p. 18). His function is partly given through

> a sequence of 14 web pages, one for each week of the course. These weekly pages provides announcements, a synopsis of the material to be covered in the lecture, required readings, optional references, and the task assignments for that week. (Vol. 6, p. 22).

Cox coaches or facilitates the students through new content by providing them with the needed materials and links, and often follows up with individual or group messages through the class Web site. All this information connects with the lectures.

Email, phone calls, fax, and chat rooms are additional ways that the instructor uses as a learning channel for his students as he responds to their individual needs.

Student/Computer

About 20 tasks get the student intensely involved with his/her computer in building Web pages. These tasks require "student-computer interaction during which students learn by experiential immersion in the problem domain" (Vol. 6, p. 22). Everything in the course supports experiential learning.

Student/Student

Computers are known to cause even the most technologically proficient people to become frustrated and turn to others for help; this is even more true for those who are new to computers or to Web technologies. Cox relates "Although a certain amount of frustration is an inevitable and essential part of the experiential learning process, students regularly encounter difficulties that can only be surmounted by having someone to call for help" (Vol. 6, p. 22). This creates the perfect opportunity for students to turn to each other for assistance in solving problems. Because there are so many different computer set ups and potential causes for problems, no one person has all the answers—not even the instructor. Thus students are encouraged to share their problems and solutions by email, telephone, or newsgroup. Cox states that in the first versions of the course "the primary channel has been a class-specific newsgroup [News] in which students describe problems, post solutions, and otherwise discuss common interests" (Vol. 6, p. 22).

Many fear that technology will destroy relationships as Cox confirms "The popular myth is that computers isolate. In fact, networked computers multiply

opportunities for relationships" (King, 1997, p. 18). Therefore, he works to promote a human centric view in the course to develop a sense of community. Since team community and group dynamics are often part of today's work environments, Cox designed the group project to maximize the development of these relationship skills. In fact, "electronically mediated community building and teamwork are crucial features" of TTEF (Vol. 6, p. 49). Because Cox "was interested in how teams functioned in order to improve the structure and directions he gave to teams" (Vol. 6, p. 183), he teamed up with Thomasina Borkman, a sociology professor at GMU. She and some of her students conducted some casual research on several of the virtual groups near the beginning of one of the early sessions. Borkman studied two poorly functioning teams and concluded with some observations and recommendations as summarized below:

1. The course requirements are perceived to be extremely demanding in terms of time and difficulty by a number of team members.
2. Multiple factors "caused" the poor functioning of these groups.
3. People made assumptions that were unwarranted.
4. The teams probably need more structure in the beginning in order to help them identify people who are not carrying their weight so that they can sanction them.
5. Teams should be required to do a "contract" that is developed, agreed upon and signed by all persons as binding about one third of the way through the course.
6. Conflict can be a serious problem in these groups; perhaps some specialized help in conflict recognition and resolution might be sought and taught to all the groups.
7. A consultant who is not an authority could be made available to the group for help with problems of group dysfunction in order to catch some problems earlier. (Borkman, 1996, p. 6)

In fact, Borkman later volunteered to assist Cox as the consultant for virtual group dynamics in the course; the partnership worked well both for the students and for them. Afterward, two of Borkman's students, Fridley (1997) and Miller (1997), conducted further research on virtual teams in TTEF that functioned well. Fridley concludes with some cautionary advice,

> As video conferencing technology improves, people will likely become more comfortable with membership in virtual workgroups. However, members will have to be trained to work in this forum. And it still may be vital to hold an initial f2f meeting to charter the group's purpose, business objectives, roles, responsibilities, and operating ground rules. (Fridley, 1997, p. 5)

Student/Teacher

Taming the Electronic Frontier has several ways that the students interact with the teacher. Cox details:

> Students return each week's task results electronically by exercising tools as they learn them. As each week's results filter in, I use special-purpose programs, written in Perl, to publish their results back to the web so that they can be accessed via a hotlink in the page that assigned each task. (Vol. 6, p. 22)

Since the task results of each student are automatically published at the class Web site, all the students can view each other's work as soon as it is turned in. Cox sees this as a good thing and maintains that

> the public nature of the results pages makes them an unusually powerful channel for teacher/student interaction. For example, I've written my programs to mark incorrect information with an ugly flasher. Since all work is public, singling out incorrect answers, even without explanation, is a powerful way of directing students' attention towards problems I want them to fix. (Vol. 6, p. 22)

Student/Environment

Because of the types of projects that teams and individuals produce, students make an impact on their environment in many powerful and sometimes unexpected ways. Teams who were given the charge to find something at their university that was not functioning well and fix it, did just that. They found problematic situations, analyzed them with a fresh perspective, then designed and developed appropriate solutions. This caused many ripples at George Mason University. Cox points out the effect these students had on the GMU establishment:

> The initial mind set soon crumbled before the onslaught. A few of the old bureaucracy even left. The rest adopted a customer-oriented attitude that views student initiatives as the solution, not the problem. The university as a whole is beginning to consider how students can address breakdowns in other areas. We've even started aiming this powerhouse outside in search of more effective relationships between academia, industry and government.

Assessment and Evaluation

Cox believes that courses should evolve rather than be designed from the beginning but never changed. Because he comes from an industry frame of mind, he views the students as customers. He puts this belief into action by having students give him feedback after each lesson in a Web-based form called "Talk to Me" and he encourages them to give him frank and open feedback, which they are usually happy to do. This ongoing form of evaluation allows the instructor to make necessary course adjustments or address common concerns to the entire class when needed.

Perfection-based Grading

Perfection-based grading is an unusual feature of Taming the Electronic Frontier. Cox describes how he evolved into this type of assessment: "When I started delivering tasks and accepting student responses via Web forms instead of on paper, I realized that an entirely new approach to grading was possible that I call perfection-based grading. I use this for parts, but not all, of the student assessment process" (Vol. 6, p. 90). Perfection-based grading is just what the term implies only perfect work is accepted. Students are encouraged to submit their work early so that if it is less than perfect, they will have time to revise it and resubmit before the due date. "Tasks that are imperfect in any way simply get returned to the student for rework with instructions on what's wrong and how to fix it. For simple problems, the instructions are web-based. For complex ones,

the instructions simply say 'Call me on the phone so we can discuss this'" (Vol. 6, p. 90). Cox further defines his assessment procedures adding that "using telephones in this manner adds a high-touch option to the otherwise high-tech tone of the course" (Vol. 6, p. 90). He posts his telephone number on the Web site along with the generous hours of being available by phone: 10 a.m. to 10 p.m., 7 days a week. The only way students can lose points is by being late, since only perfect work is accepted. This type of grading may seem tough and arbitrary at first glance. S. J. King (1997), a student in one of the first classes, expressed her feelings on Cox's implementation of perfection-based grading:

> How many professors post their home phone number all over the coursework, welcoming phone calls 10am-10pm 7 days/week? How many professors consistently require perfection from their students—*but not on the first attempt at completing a task, and after receiving professor feedback and advice.* These are examples of adding care to the Quality formula, with Quality in this case referring to the learning process. (p. 17)

In traditional grading a student turns in her work and gets back a grade that she is stuck with; whereas TTEF students make sure that they submit their work early enough so they can make appropriate changes, if needed, and resubmit their work. The only way to lose points by turning in the tasks and projects late. Cox's special programs are designed to "enforce due dates to the second" (Vol. 6, p. 39), which takes the pressure off the instructor. Students do not argue with him to get deadline extensions because they realize it is the "program" that keeps track of their grades and determines when something is either on time or late; in addition, they accept that their work must be turned in by the deadline or 10 points will be taken off for each week late. Cox expands:

> Travel obligations and minor medical emergencies do not excuse late work in these courses because you can easily submit work from home and anywhere else around the globe. Although I'll occasionally extend deadlines for the class as a whole, I cannot make exceptions for individuals.

> I'm not just being mean here; the slightest exception means changing the computer programs that manage your grades. (Vol. 6, p. 39)

Students understand that no work will be accepted at all after the end-of the-semester deadline. Again, this is part of the custom-designed computer program function, therefore individual exceptions cannot be made as he would have to reprogram the software.

Importance of Deadlines

Cox learned early that it is deadly in online courses to have only a couple of student assessments required at the end of the course. He reminisced, "Based on one (disastrous) experiment one semester, I strongly believe time limits on the order of once per week or so are indispensable. One end-of-semester deadline for everything is a recipe for disaster. . . . People tend to procrastinate until so much work piles up that quality suffers" (Vol. 6, p. 92). This strong belief led Cox to develop a much more structured course than he originally made in the beginning.

Although the special computer programs that Cox developed automatically organize, record, and post student tasks and projects as they turn them in, he still has plenty of work to do. He describes how he handles student work: "The evaluation process itself is no different. I still have to read it and make comments" (Vol. 6, p. 92). Students appreciate this personal feedback as Beth, one of his students, expressed: "You get constant one on one feedback from the professor. I can't think of any other professors who would be willing to make this kind of commitment to their students" (Vol. 6, p. 9).

Innovative Assessment Strategies

There are additional unique features of TTEF student assessment including "professional assessment, peer assessment, and assessment by the external customer to which teams deliver a semester project" (Vol. 6, p. 93). These assessments do not fit into perfection grading. The professional assessment is his own way of implementing and extending his beliefs.

Further, there are also exams and quizzes that would first appear to be like any other course, yet these are different. Cox explains:

> Another component of your grade is from exams and quizzes. There is typically a midterm around the fifth week of the course and an exam at the end. Whereas the exercises focus on specific technical topics, the exams and quizzes are designed to demonstrate integrated knowledge of the skills covered in the course. These are all web-based, take-home, open-book exercises. Unlike the labs and projects, which emphasize teamwork and cooperation, exams and quizzes are solitary work and are governed by an explicit honor code. (Potter, 1998, p. 39)

"The grading policy changes each semester," Cox notes; sometimes student participation counts for 10% while other times his own professional "…assessment of the quality of their work counts as 10%" (Vol. 6, p. 19). Sometimes the team projects count as 30% and at other times 50%. This changing policy reflects Cox's ability to learn from each class and to be flexible. Being flexible is important in his online teaching.

Market-based Assessment of Portfolios

Yet another unique feature of TTEF is the method of assessing student portfolios. Cox explains that "quality of student portfolios is determined by peer assessment" (Vol. 6, p. 19) which is performed as market-based assessment. Each student designs and develops a portfolio that she must "sell" to her classmates who then critically examine it for quality and value. Here is the assignment as given to students:

> Good News!
> You have inherited 25.00 Trillion ElectroBux (TEB) from a wealthy electro aunt. They're in a checking account that this program will manage as your banker. The rules of this inheritance require that you spend it on portfolios that satisfy your Objective, Subjective and Intersubjective standards as Brad defined these terms in class. You may not keep it nor pay it to yourself. You must spend it all and earn what you can back from other students in your market. Everyone is bound by the same rules.
> Your role is that of consumer in this task. Producer-centric concerns should be submerged just as you aren't concerned about what the farmer must have gone through to produce groceries. Your evaluations must be based on your own Objective, Subjective and Intersubjective Quality standards, exactly as when choosing food to buy at the store.
> Pay each entrepreneur by using the menus to specify the number of TEB to pay to each entrepreneur. Use the text box to suggest how each entrepreneur could meet your expectations better next time. Provide constructive feedback of the sort you wish others would do unto you. . .helpful, thoughtful, honest, right from the heart, not pulling punches if punches are deserved, giving as much emphasis to what was done well as to what should be improved. (Potter, 1998, p. 6)

This authentic assessment plunges the students into a role that is traditionally the instructor's, forcing a type of thinking that rarely occurs in typical courses. Cox's reflections on the results of this power and paradigm shift will be shared later in the Unexpected Discoveries section. Because this is such an uncomfortable situation for many students, Cox always limits the amount of points that the project receives so students cannot either knowingly or unknowingly seriously damage another student's overall grade because of a faulty assessment of the other's project. He clarifies that this is worth only about 2 % of the student's grade or about "one task (out of about 20) is determined by a market-based peer assessment" (Vol. 6, p. 19).

Students are divided into "markets" to evaluate each other's portfolios. They perform their assessment on a Web-based form that includes pull down menus for amounts to be paid. This Web-form task also lists questions. These questions invite theoretical analysis of the portfolio as previously studied in the course with text boxes for

narrative responses for each question. The total amount of money earned along with all the written comments for each portfolio is automatically compiled and posted. After analyzing the results, students are encouraged to improve their product with what they have learned from their peers, and then they participate in the final market-based peer assessment. Cox discloses "Then the ranking process is repeated, this time knowing that the revenue bell curve will be used to assign grade" (Cox, 1998b, p. 1). He adds that even though it is only a small percent of their grade, it "…is sufficient to cause considerable reflection on how quality relates to grades and their lot in life outside of academia" (Cox, 1998b, p. 1).

Cox suggests online students are more likely to be focused on examining the portfolio rather than on considering the personalities of people in the course. Thus, this type of peer-assessment works especially well with distance education students because they often have different types of relationships with each other than those found among students in face-to-face courses.

Team Projects

Since the team project is designed and built for a real customer whom the team chooses, the customer determines the project grade. This strategy has worked well over the years for the team grade. But what about the individual team member's grade?

Even when instructors believe in the benefits of cooperative learning and group projects, they are often stymied on how to fairly determine individual grades. Since the teacher is not present with the group while they work, she cannot be completely aware of how well the group functioned or whether or not only a few people did the work while

the others rode on the working team members' virtual coat tails. Cox devised an ingenious method of Web-based, peer assessment that works well:

> Grades for individual team members are determined by flowing the team's grade to each member in proportion to the team's assessment of each member's contribution. This assessment is gathered during a project delivery task in which each member pulls down a menu to specify the contribution made by each teammate plus a narrative comment on their contribution. A custom end-of-semester grade reporting task provides this information to each student along with weekly averages, exam grades (if any), and so forth, including comments Thomasina and I make about their performance. (Vol. 6, p.19)

Team projects can be stressful to members particularly because there is a group grade and strict deadlines. As with face-to-face groups there are times when a member or two does not pull his or her fair share of the work. Since these projects are complex and the process for building them is intense, individuals need to know they will be evaluated by their peers on their performance in the group as part of the project grade. "I find that students respond better to pressure from their peers than from me, so I use this in my teaching" (Vol. 6, p. 19), Cox comments. This is not without its own challenges, however. The project grade is "determined by a customer that each team chooses and specifies during this task" (Vol. 6, p. 19). One student reflected over this experience and on the course structure in regard to the balance between theory and practice:

> I believe that this course succeeds in this goal in that it has aspects that lead to a grade which incorporates outside results for work done, such as the Peer Evaluation and Client/Product, while also keeping academia involved with all of the other tasks. Somewhere in the middle, I walk away with some basic skills and understanding about Web publishing, and a broader liberal arts understanding of Quality. (Vol. 6, p. 202)

Course Evaluation

Most university courses have a standard course evaluation form that students are asked to anonymously fill out at the end of the semester. TTEF modified GMU's

summative evaluation form that provided a positive twist by calling it "Appreciative Inquiry." This promotes a constructive mind-set rather than an invitation to "whine and complain." Students are encouraged to provide constructive criticism on a Web-based form:

> Students complete the Appreciative Inquiry Form by selecting answers from drop down boxes or by typing constructive comments in text boxes. The web-based infrastructure allows the professor to immediately collate evaluation responses. This allows the students to view the information in histogram format. They can see where their responses fit in with the rest of the students' and the professor is given the opportunity to act on that information much more quickly than information from traditional evaluations. (Vol. 6, p. 43)

The more quickly an instructor can get summative feedback, the sooner he can make the necessary changes in the course for the following semester.

Technological Aspects

Taming the Electronic Frontier is built on a custom-created Internet infrastructure that "relies heavily on cgi-scripting allowing the student to send and receive information. Information for each student is kept in a private course 'locker' accessed by password" (Vol. 6, p. 36). Students access their individual lockers for well-organized lists of the weekly activities along with their due dates and status.

Cox describes the technical underpinnings of the course:

> Each page of each task is not an ordinary static data file but a computer program that draws upon and updates an object-oriented database. This in turn relies on an underlying infrastructure that I developed from scratch, based on the Linux operating system, Apache web server, and Perl programming language. Developing the infrastructure and the tasks has been a full-time effort for the past five years. (Vol. 6, p. 18)

It takes much time to develop and maintain the Web site and the system that supports it. Cox confesses that "the time-consuming part is developing the computer-

based tasks, revising them each semester, developing the infrastructure they are based on, and ensuring that the system provides no-excuses reliability and transparency" (Vol. 6, p. 18). This is especially time-consuming, he adds, because these things "are both technically and pedagogically complex" (Vol. 6, p. 18).

Although Cox originally used email, newsgroups, and listservs in the first versions of TTEF, he now uses "handmade web-based conferencing tools, built with perl and cgi, that are technically superior. And since all required services are then provided over the web, a single name and password gives access to everything students may need" (Vol. 6, p. 25).

Instructor/Developer

Dr. Brad Cox, formerly of George Mason University at the time of the Paul Allen Virtual Education Foundation Outstanding Online Course Award, created the instructional design and developed each of the technical aspects of the course including Web site design and construction. He did this because his "research goal is demonstrating that it is possible to provide a better learning experience in this way than I could ever do face to face in the classroom" (Vol. 6, p. 18). Cox is truly passionate about learning and improving the student's experience in online courses. He comes to the classroom from a non-typical background:

> As co-founder of The Stepstone Corporation, a software development, training, and consulting firm specializing in object-oriented technology, Dr. Cox has both breadth and depth of experience, from executive management to hands-on software development. He has unusually strong credentials in public speaking, writing, consulting, teaching, and software research and development. (Vol. 6, p. 60)

His diverse experience and education include writing numerous books and articles, and founding a couple of national organizations. His doctoral work was in

"theoretical and experimental work in neurophysiology in an area that has since become known as neural networks" (Vol. 6, p. 59).

Unexpected Discoveries

Developing this course took much more time than Cox was accustomed to giving to a regular course:

> I spend far more of my time on this course than my brick and mortar classes. However most of this time is spent as an investment in building a distributed learning community and infrastructure as part of my research goals. Now that the infrastructure is in place, routine preparation for each week's class is smaller since prior semester's task and weekly pages can generally be reused. (Vol. 6, p. 24)

Cox shares another area that continues to be somewhat perplexing. The task where students "sell" their product to others in the class poses some problems, however, as he notes:

> Any shift in power from teachers towards students implies tension over differing ideas of quality. I regularly assign a task that instructs students to build an electronic 'product' (a web page) based on what they think their classmates might 'buy'. The grades for this task are assigned by 'selling' the products in an electronic market for peer assessment. I find it intriguing, but troubling, that students often assign high value to products that emphasize flash and glitter at the expense of academic substance. I look forward to refining this task to understand this better than I do now. But in the interim this is a clear caution that a careful balance of power between teacher and student is necessary instead of either extreme. (Vol. 6, p. 24)

Challenges and Satisfactions

Being an innovative electronic pioneer has its drawbacks which caused some major challenges for Cox. When asked what he would do to change the course, he simply replied: "Resign to get academia's lead foot off the brakes. Completed" (Vol. 6, p. 4). In fact, Cox resigned on January 1, 1999, to pursue his interests in "object technology, distance education, and superdistribution" (Vol. 6, p. 67). Faculty resistance was a

definite discouragement and challenge as Cox wanted to push ahead with more innovations in online learning environments.

Administration provided further challenges in areas such as registration. One example is when the registrar's staff would tell students that there was a cap on enrollment when there really was none thus causing distress to the students who were trying to get into the course. This also caused distress to Cox who was trying to get the students off to a good start in the course.

Another challenge occurred when students got so involved in the technical aspects of Web page design and construction that they forgot all about content and quality. Cox laments the difficulty of "convincing students that it is content that matters, not glitzy graphics and fancy coding tricks. Nothing I do or say seems to convince students that fancy animated graphics typically reduce quality as well as hearing this from their classmates" (Vol. 6, p. 19).

Despite the challenges, however, there were many positive experiences as well. "Student course evaluations" (Vol. 6, p. 4) were Cox's most satisfying aspect of the course. Many students consistently gave positive comments throughout the course on the weekly "Talk to Me" formative evaluation forms and also on the "Appreciative Inquiry" form at the end of the course. This is particularly remarkable since the course is truly rigorous for students. Here are a few samples of many student comments posted on Cox's Web site:

> As I stated in my course critique there should be little if any change to the course structure and expected deliverables. I cannot think of a class that has challenged me as much as TTEF resulting in a fantastic feeling of accomplishment. I truly enjoyed every aspect of your course. (Vol. 6, p. 9)

> I actually found myself opening up to you, with my concerns as I went through this calss, and felt as though I had more direct communication with you than most of my other professors in more 'traditional' courses. I attribute this to your dedication, and your caring for this subject matter and your students. (Vol. 6, p. 10)
>
> Brad, by far the most inovative course I've ever taken. There were times when I hated it and other times I saw the larger purpose. (Vol. 6, p. 12)
>
> This multidimentional/interdisciplinary course was a challenge for most of us. It was certainly relevant because of its focus on electronic frontier tools and issues. It was rigorous because of the heavy workload and sometimes difficult technical and intellectual (Persig) tasks. The best way to grow is to challenge your level of competance. Few courses are simultaneously rigorous and relevant as is this course. (Vol. 6, p. 203)

Reflections and Advice

Cox has many ideas on how higher education can address learning "that seamlessly integrates Rigor and Relevance, Education and Training, and Individual and Organizational Learning" (Cox, 1998b, p. 1). He has worked with a group on developing specific guidelines and recommendations for developing a new university but he also put into practice many of these principles in TTEF.

One of his recommendations is that universities should no longer expect content experts to develop and deliver online instruction by themselves, because usually they have neither the time nor the technical skills to do these things well. Teams of experts should be available to develop exemplary Web-based instruction. Cox suggests the following roles: content experts, producers, developers, instructors, and reviewers. In addition, there are other needed roles to support instruction and learners: sales and marketing, product delivery, product development, administration, management, and research. All these roles are needed to provide excellent instruction and a robust support system.

Cox further recommends that higher education needs to rethink the length of courses especially when they are online. He observes, "If we expect to serve several diverse markets in a cost-effective manner, an alternative to the 'course' as the unit of reuse is crucial" (Cox, 1998a, p. 2). He continues,

> The traditional unit of granularity, the 3-credit course, is so large that reusing course materials within academia and externally within industry isn't possible. A solution is to define a smaller unit of reuse whose modules can be combined to create larger-granularity products tailored to the needs of each particular market.

Cox finally reflects over his experience in this course and with technology in higher education institutions and gives a solemn projection for the future of technology in education. He proclaims:

> Technology is merely an enabler. However what it enables is nothing less than human individuals, organizations and cultures, newly empowered to understand and misunderstand each other across time and space boundaries that have separated us since antiquity. The implications are too vast to be predicted, controlled or designed. Established institutions must either evolve to compete in this new global climate or be displaced by emergent new institutions who can. (Vol. 6, p. 24)

Summary

"Taming the Electronic Frontier," the winning course, combines theory and technical skills to prepare students for the workplace. "Quality" is a theme of the course. Custom software makes the creative instructional design of this course possible. Individual "Student Lockers" automatically keep track of what the student needs to do, what the student has done, and only shows current assignments and projects. A unique form of peer assessment is used where students have to "sell" their portfolios to their peers in a market-based simulation. Teams work virtually to develop a product for a real customer who also gives them their project grade. Sociocentric skills are taught to enhance group dynamics and facilitate team collaboration.

CHAPTER TEN

CROSS-CASE ANALYSIS

Introduction

The purpose of this study was to determine instructional practices in exemplary higher-education Web-based courses and their perceived effectiveness. This chapter is a result of a cross-case analysis of the six courses as case studies and the information from the instructor questionnaires. It is organized with two major sections: discussion of the findings and recommendations. The section on findings addresses instructor issues and then answers each of the research questions:

1. How do faculty craft and deliver online courses to create effective learning environments?

2. What are the implications of new delivery models for higher education?

Throughout the discussion of the findings, I have a number of sections meant to connect my findings to the literature. These sections are not intended to be exhaustive but give a sampling of the available literature on the topic.

Because this is a qualitative study, I used typical qualitative tools to gather the data including a questionnaire, email correspondence, video recording, observation, interviews, course Web pages, plus articles and Web sites published by the instructors.

Discussion of Findings

The Instructors

The designer/instructors are a unique group of individuals who achieved recognition for crafting and delivering outstanding online courses. Much of the information on the instructors came from the Web-based questionnaires that they completed online. All six instructors/course designers completed the questionnaire. The goal was to learn more about the instructors as a group while looking for trends that could possibly illuminate keys to their online course success.

Demographics

When setting up the age brackets in the questionnaire, I used Levinson's Adult Developmental Periods (Levinson, 1986) as discussed in chapter 2 (see Table 6). In Levinson's Developmental Periods, there is an overlap in each of the age brackets; so in making my questionnaire, I altered the age groups slightly to prevent overlap (see Appendix A). Some have wondered if younger instructors have an advantage over older ones because they have better technological skills and a vision of what is possible. Others have suggested that those who have more experience may be better able to create online courses as they can translate their knowledge and wisdom into this new environment. There was no trend to support either view with these instructors (see Table 13). Of the six instructors interviewed, only two were in the same age category, Culminating Life Structure for Middle Adulthood, ages 55-59 (modified). Neither young nor later adulthood seemed to be a better time of life to get involved in developing online courses.

In addition, five of the six instructors were male and one was female. Is this proportionately representative of the 182 courses submitted in the competition? I was

unable to get this information from the foundation. Do males have advantages over females in developing WBI? It would be beneficial to study this more completely in the future.

Table 13

Age of Instructors

Value Label	Value	Frequency	Percentage
30-32	3.00	1	16.7
33-39	4.00	1	16.7
50-54	7.00	1	16.7
55-59	8.00	2	33.3
60-64	9.00	1	16.7
	-------	-------	-------
	Total	6	100.0

Background Experience

Experience often makes a difference in being able to do something well. Does having previous experience in online instruction give an edge in developing effective online courses? Not in this group of instructors. Only one instructor had developed any online courses previous to this one, and he had developed three to four. Two of the six instructors however, had taught one to two online courses before this one. Further, only one instructor had ever taken an online course, and his level of satisfaction with it was below satisfactory.

Did it make any difference whether or not instructors were tenured? Three of the instructors were tenured and three were not, so it made no difference with this particular group. Schori (CalculusQuest™) noted, however, that he felt it was an advantage for him to be tenured since developing Web-based instruction is not considered a scholarly activity at many universities and colleges. He felt less pressure than he believed his colleagues felt who were not tenured.

Perhaps teaching experience itself made a difference in this group of instructors. Yet once again, there was no trend here (see Table 14). Two instructors had taught only 0–5 years while two others had taught 26-35 years. In between these two, one instructor had taught 6-15 years and the other had taught from 16-25 years.

Table 14

Number of Years Taught

Value Label	Value	Frequency	Percentage
0-5	1.00	2	33.3
6-15	2.00	1	16.7
16-25	3.00	1	16.7
26-35	4.00	2	33.3
	-------	-------	-------
	Total	6	100.0

Benefits

There are many roles and skills for instructors to learn in order to be effective online course designers, developers, and instructors (Shotsberger, 1997; Williams & Peters, 1997), and all these things take time. Did these outstanding instructors receive extra benefits for their pioneering efforts? None of them received extra salary; however, three of the six instructors said that their online course development activities were recognized by their universities as scholarly activities. One of the six received training as a benefit.

Four of the six instructors were given extra time for planning and development. All of them found that the design, development, and delivery process took an incredible amount of time, much more so than any of them had anticipated.

Perceptions of Effectiveness

There is a continuing debate comparing face-to-face instruction with online instruction, so I presented these instructors with a rating opportunity: "Compared with face-to-face courses that you have taught, do you feel that learning in this online course was:" Not as good [1], As good [3], or Superior to [5]." The mean was 4.33 indicating a strong perception that online courses can be superior to face-to-face classes.

Research Question 1

Research Question 1 asked: How do faculty craft and deliver online courses to create effective learning environments? In order to answer this question, it was important to think about the concept of "effective learning environments." Typically, effective learning is assessed by evaluating student achievement. In this competition only those

courses were considered that demonstrated that the goals of the course had been achieved. A theoretical framework was established in chapter 2 based on the American Psychological Association's (1995) Learner-Centered Psychological Principles (APA LCP) that can help guide WBI development (see Table 1). I used this framework to organize the findings for the first research question. The findings are grouped under each of the six categories as identified and described in chapter 2. Some of the findings overlap between the principles, so they are featured where they seem particularly appropriate. An overview of all the findings can be seen in Table 15. I would suggest that this represents the beginning of a model for WBI based on the APA LCP. In this study five of the six instructors did not have a set of university or outside standards with which to develop and evaluate their online courses. Most accrediting bodies do not have such standards/guidelines, yet it is clear that creative instructors are bridging the gap between effective face-to-face classes and effective online classes.

The analysis of these courses adds to the experience of others to support or develop new models and theories. Merriam asserts that:

> The insights that form the basis of new theory can come from one's imagination, personal experience, the experiences of others, and existing theory. The trick in using existing theory as a source for new theory 'is to line up what one takes as theoretically possible or probable with what one is finding in the field' (Glaser and Strauss, 1967, p. 253). (p. 60)

Nature of the Learning Process and Construction of Knowledge

The American Psychological Association's Learner-Centered Psychological Principles (1995) define the "nature of the learning process" as being "most effective when it is an intentional process of constructing meaning from information and experience" (p. 6). I have chosen to combine a second, related principle, "Construction of knowledge," which

Table 15

Web-Based Courses in Higher Education: Creating Active Learning Environments—Findings

Finding	Number of courses
Nature of the Learning Process & Construction of Knowledge	
1. Active learning and constructivist learning theories were foundational to the courses	6
2. Courses were learner-centered rather than instructor-centered.	6
3. Instructors found many ways to address varied learning needs.	6
Context of Learning	
4. Pedagogy drove the technology.	6
5. Courses provided the necessary online resources for students often including original material on the course Web site such as hypertext glossaries and texts.	6
6. Instructors were cautious about providing outside links.	6
7. Instructors endeavored to meet student needs by regular and ongoing assessment and evaluation on lessons, activities, and course.	6
8. Good navigation systems were critical to keep students functioning in the course and to prevent them from becoming lost in cyberspace.	6
9. Students were often given Web-access to information on their scores and grade in the course.	3
Intrinsic Motivation to Learn & Effects of Motivation on Effort	
10. Online courses had authentic and active learning experiences that motivated students to work hard—often harder than in face-to-face courses.	6
11. Supportive and invigorating learning environments were created to motivate students and their learning.	6
12. Critical thinking and problem solving were promoted.	6
13. Simulations, games, and authentic activities were used to motivate students to work hard and to learn.	6
14. Course metaphor themes provided continuity and context for learners.	3

Table 15—*Continued*.

15. Many instructors provided grade-free practice activities, quizzes, and tests before having students do the real activities for grades.	3
16. Instructors gave prompt feedback to students often within 24 hours whenever possible.	6
17. Regular work and deadlines—at least suggested ones—helped students keep up in the course and avoid procrastination.	6
18. Redundancy was frequently part of the course design to provide enough practice in new and interesting ways.	4
Developmental Influences on Learning	
19. Whenever possible, students were given choices to get them engaged in the learning activities.	6
20. Instructors tried to connect content to students' lives as much as possible.	6
21. Flexible schedules and activities—such as asynchronous discussions—helped adult learners meet course requirements in spite of their work and family responsibilities.	5
22. Instructors were flexible to help meet learner needs.	6
23. Although students appreciated flexible courses, they still needed some structure.	6
Social Influences on Learning	
24. Courses had well-designed interactions between the learners and content, other learners, and instructors.	6
25. Student collaboration was encouraged online, and they were often given appropriate scaffolding on how to do it well.	5
26. Various forms of peer assessment were used to help students learn from each other.	5
27. Courses required all students to participate in all activities and discussion questions.	6
28. Instructors used cooperative learning activities online.	4

Table 15—*Continued.*

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Standards and Assessment	
29. High standards were communicated to the students who were provided with rich, supportive learning environments.	6
30. Courses included regular and ongoing student assessment and evaluation.	6
31. Instructors set high standards for content, pedagogy, and technology.	6
Higher Education Implications	
32. Course design, development, and delivery took more faculty time and effort than expected.	6
33. Most courses were developed through intensive team efforts.	4
34. Universities had difficulties relating well to online courses in marketing, registration, online resources, and support for faculty and students.	5
35. Most courses could not be scaled up because of the intense time required for instructor-student interactions.	4
Instructors indicated that:	
36. Simply converting existing face-to-face courses to online ones without rethinking the pedagogy and technology possibilities will not lead to effective online learning experiences.	5
37. Automatic courseware development software may limit innovation.	6
38. Students are not yet demanding online courses to the extent that many assume.	3

is described by the following statement: “The successful learner can link new information with existing knowledge in meaningful ways” (p. 7).

Active learning

Active learning and construction of knowledge learning theories were foundational to all the courses. Active learning was, in fact, one of the criteria for the Paul Allen Virtual Education Foundation (PAVEF) Online Award courses. The instructors found creative ways of addressing active learning theories with unique activities often in ways that many educators would not imagine were possible to do online. Two activities that were used in these courses the most and that had the highest effectiveness rating on the questionnaire with a mean of 4.5 were “Simulations” and “Individual Projects” on a scale of 1 for Not Effective and 5 for Very Effective. “Reading Assignments” had a mean of 4.0. “Cooperative Learning Activities” (a range of activities were included—see questionnaire in Appendix) had a mean of 3.33. This rating reflects the challenge of learning how to best facilitate these kinds of online experiences. These are only a sampling of a wide variety of strategies available to promote active online learning (Bonk & Reynolds, 1997; Bostock, 1997; Jonassen et al., 1997; Siegel & Kirkley, 1997).

Learner-centered

Courses were learner-centered rather than instructor-centered. Cox (“Taming the Electronic Frontier”) stated that this was the most valuable feature of his course. Instructors created learning environments that promoted student learning. It was not teacher centric with the professor giving lectures, and students passively listening.

Meyen's course—"Curriculum Development"—had streaming audio lectures with timed visuals, and at first glance could be thought to be teacher-centric. Yet he had 45 interactive, required but non-graded activities throughout the lectures to promote active learning, in addition to collaborative team projects and other active learning activities.

Instructors found ways to meet varied learning needs. Meyen started out with streaming audio lectures, but then added a written outline and notes to help visual learners. He is also planning on providing written transcripts of the lectures. In CalculusQuest™ students worked with both numbers and words, giving all students an opportunity to work in their comfort zone and thus learn better.

Context of Learning

In the APA LCPs (1995), context of learning is defined in this way: "Learning is influenced by environmental factors including culture, technology, and instructional practices." Creating rich online learning environments is important. Merickel ("Integration of the Disciplines," chapter 4) shares this John Dewey quote in his course: "We never educate directly, but indirectly by means of the environment. Whether we permit chance environments to do the work, or whether we design environments for the purpose makes a great deal of difference" (Vol. 4, p. 85). These six instructors were intentional in the way they designed online learning environments. The following findings emerged.

Pedagogy drove technology

First, the instructors emphasized that pedagogy drove the technology. None of them used technology just because it was available and was cutting edge. All wanted to

create learning environments that were friendly and accessible to students who only had basic computers and Internet connections. The instructors used a variety of ways to create diverse online learning environments using technology to implement good pedagogy. Nelson ("Murder") expressed the strong belief held by the instructors that "pedagogy should determine the technology" (Vol. 1, p. 237).

Original course materials

In addition to good teaching practices, the instructors posted original materials for the students at their course Web sites. In fact, only two of the courses used textbooks, and those were not used as the focal point for the instruction. Two of the courses had teams wrote their own hypertext course books, and the others wrote their own course materials and/or they posted published articles and other resources. A common student complaint that the instructors reported, however, was students got tired of sitting at their computers for so long and grew weary of having to do so much reading on the computer screen. Furthermore, several of the courses had extensive glossaries. CalculusQuest™ had a hypertext glossary that supported students while working in the lessons. When students clicked on unknown, hyper-linked words, a new window opened up with the word and its definition. Sometimes historical information or other background information was also included. Meyen commented that it is important to teach the language unique to the subject matter.

Instructors were careful about providing outside links in their courses for several reasons: Outside links can be unstable, students often feel compelled to explore each one even though they may be marked optional, and these links often encourage students to surf the Web and thus can be distracting to the learner.

Course flexibility

Many of the instructors indicated that they made in-course corrections based on regular and ongoing feedback from students. Nelson made many beneficial course changes to "Murder on the Internet" because of students' suggestions. All the instructors genuinely cared about their students and endeavored to develop a good online-learning experience for them. This also meant that they used assessment and evaluation to make course environment changes as needed and will be noted in the "Standards and Assessment" section.

Interactivity

Students were required to respond to the content as they worked in these courses. In some cases, automatic feedback was part of the interactive design. At other times, there were Web-based forms that allowed them to interact directly with the instructor and/or students at the moment they first encountered new information. This set up a perfect way to take advantage of the social influences on learning, which will be addressed in a later section.

When asked what the ideal number of students would be for an online course, the instructors in this study had a wide range of answers as seen in Table 16. Fuellen notes that there could be "about 5-6 per study group, and no more than 10 groups" (Vol. 5, p. 235). This would bring the number of students in a course up to 50-60. He quickly adds, however, that there should be "about 5-6 instructors" for this type of class with one instructor for each study group (Vol. 5, p. 235). Such a low student/instructor ratio is important for a course like BioComputing where small, intimate study groups are

clustered around a common curriculum and course structure. The groups then cross-pollinated through intergroup dialogs and by sharing group synthesis reports.

One professor gave a range of 15-20 as the ideal number of students for an online course. Since SPSS would not accept a number range, I entered the median knowing that there cannot be 17.5 students in any course. The 500 student course model would be dependent on having customized software that would provide prompt, automatic feedback to students individualizing and personalizing their learning experience. This would then give more time for the instructor to personally interact with the students.

Table 16

Ideal Number of Students for Online Courses

Value	Frequency	Percentage
5.00	1	16.7
17.50[a]	1	16.7
20.00	1	16.7
25.00	1	16.7
50.00	1	16.7
500.00	1	16.7
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Total	6	100.0

[a]This instructor gave a range of 15-20, but SPSS would not accept a range; therefore, I entered the mean of the two scores that were given.

Good navigation systems

Good navigation systems were important on the Web and were the product of careful research and development. Frustrated or lost students will not have good learning experiences, so testing was critical to the courses' navigational success. Tangen, technical designer for "Curriculum Development," emphasized the importance of pilot testing. "Try not to torture your students with a bad interface," he urged (Vol. 3, p. 197).

Some instructors questioned whether or not good instructional design and navigation systems can be developed with automatic courseware development software. It is now easy to post courses on the Web, but these programs seem to encourage professors to merely post their syllabi and course handouts on the Web without thinking about the new technological learning environment or how they might take advantage of innovative pedagogical opportunities. At least one instructor in this study expressed concern that many electronic correspondence courses were being posted with little or no thought given to them. Several were concerned with premature standardization and that the software companies would not keep up fast enough with technological developments, many of which could open up new vistas for learning.

Instructor roles and course value perceptions

As in face-to-face classrooms the instructor's role in an online course sets the tone for learning. The instructors were asked on the questionnaire to "Describe your primary function in the course." The following choices were given:

1 = Present facts and information and test students for mastery.

2 = Provide structure for students to construct their own knowledge.

3 = Guide students' process of learning and provide abundant resources.

The mean for the instructors' roles was 2.50 putting them halfway between number 2 and number 3. Since item number 1 is the description of more traditional roles in higher education, the mean shows these instructors have shifted away from the traditional pedagogical paradigm of lecture and test.

Instructors were also asked what made their courses valuable. Table 17 documents their responses. Their comments strongly suggest they value learner control of their educational experience, and they therefore set up environments to accomplish this.

Connections to the literature

There are many ways to develop a context for learning and to create an online instructional design that includes interactivity, good screen design, and other important considerations to help the learner (Gillani & Relan, 1997; Hedberg, Brown, & Arrighi, 1997; McCormack & Jones, 1998; McGreal, 1997; Reeves & Reeves, 1997; Ritchie & Hoffman, 1997). Feedback and teacher immediacy behaviors are important to student learning and success (Egan & Gibb, 1997).

Motivation

In this section I have combined two of the Learner-Centered Psychological Principles: Intrinsic Motivation to Learn and Effects of Motivation on Effort. Motivation is important in both face-to-face and online courses; but it is especially important in online courses where students have to be more self-disciplined and thus need more motivation.

In describing intrinsic motivation, the APA document (1995) suggests that it is stimulated by tasks of optimal novelty and difficulty, relevant and personal interests, and

Table 17

Instructors' Perceptions on Most Valuable Course Features

Instructor	Most Valuable Course Features
Terri Nelson "Murder on the Internet"	The students were actively participating at a time and place convenient to them. . .and all of their work was in the target language. Students made significant progress, but everyone wasn't expected to be learning the same language. Students made significant progress, but everyone wasn't expected to be learning the same things within a time frame constructed by the instructor. (Vol. 1, p. 2)
Richard Schori "CalculusQuest™"	It helped the students become more independent in their learning and to think more about how they go about learning. (Vol. 2, p. 2)
Ed Meyen "Curriculum Development"	The content richness of the course. The amount on interactions. My efforts to b e responsive and thorough in responding to student work. (Vol. 3, p. 2)
Mark Merickel "Integration of the Disciplines"	Simulations, multiple pathways to learning, good navigational strategies, cognitive flexibility, and a caring facilitator. (Vol. 4, p. 2)
Georg Fuellen "BioComputing"	Personal interaction small groups; volunteer activity + projects. (Vol. 5, p. 2)
Brad Cox "Taming the Electronic Frontier"	Learner centric. Not teacher centric. (Vol. 6, p. 2)

providing for personal choice and control. These courses addressed this principle in several remarkable ways.

Students of any age appreciate authentic learning activities and work very hard if they are interested in the topic. These courses had authentic and active learning experiences that motivated students to work hard—often harder than they would have worked in face-to-face classes. Nelson ("Murder") described her students: "If you engage students in a meaningful activity, they will spend hours doing it. They'll complain about the work, but they won't not do it!" (Vol. 1, p. 4).

The courses had supportive and invigorating learning environments that stimulated critical thinking and problem solving. There were a wide variety of simulations and authentic, online learning experiences from a whodunit mystery to simulated problem teaching experiences. CalculusQuest™ included Black Boxes and interactive activities with feedback while BioComputing included a Java-powered sequence analyzer because "prediction of protein structure from sequence is one of the most challenging tasks in today's computational biology" (Vol. 5, p. 72). This connection to a real-life need motivated the students. All these activities promoted critical thinking and problem solving, as well.

Half of the courses had course metaphor themes to motivate students by connecting course content and/or structure to familiar settings. These metaphors also helped organize the course structure (Harasim et al., 1995). Themes used included a soap opera murder mystery, mountain-climbing, and orienteering.

The effects of motivation on effort are critical for online learning where the learner is physically separated from the instructor and other students. The APA Learner-

Centered Principles (1995) identify this principle as the "acquisition of complex knowledge and skills requires extended learner effort and guided practice. Without learners' motivation to learn, the willingness to exert this effort is unlikely without coercion" (p. 8).

As mentioned earlier, online students often feel isolated and need prompt feedback from the instructor whether on personal email messages or submitted coursework. The instructors tried to give prompt feedback to students within 24 hours whenever possible. Merickel explains:

> If something sits there for more than 24 hours, the students are wondering where you are, why there's not a response, and they want to make sure that you have received their posting. But, providing a 24 hour response time is certainly a benefit to the learner. (Vol. 4, p. 44)

Regular work and deadlines—at least suggested ones—helped students keep up and not procrastinate. All courses had suggested deadlines for work, and some firm ones for certain projects and activities. Two courses had custom software that would not accept any scores after the due date. Schori describes the effect on student effort,

> The Gradebook is the thing that tells the student when they're supposed to be done and what they're supposed to do. I was amazed to see how effective [it was]. I can go into a class and say, "You need to turn in your homework next week," and I have students coming back to me the next week saying, "Gee, can I have a little bit more time?' They don't do that when it's the Gradebook telling them that you have to complete this quiz by this particular time. For some reason the Gradebook is a tremendous authority in that respect. (Vol. 2, p. 242)

Grade-free activities, quizzes, and tests were available in several of the courses to help students determine how well they were doing in the course. At the end of every lesson in Curriculum Development there was a grade-free 10-point quiz that students could take as many times as they wanted to. CalculusQuest™ had a similar feature with feedback.

Planned redundancy was part of several of the course designs. Certain types of information and skills can be mastered only with lots of repetition. Yet doing the same thing over and over again is boring for students. Instructors planned repetition in new and varied ways that maintained the students' attention and motivation.

Motivation is important in face-to-face courses but it is especially important in online courses since students are working in physical isolation away from the instructor and fellow students. Therefore, addressing motivation is important to the learners' success (Cornell & Martin, 1997; Duchastel, 1997).

Developmental Influences on Learning

"As individuals develop, there are different opportunities and constraints for learning," states the APA Learning-Centered Principles (1995, p. 9). This study deals with adult developmental learning principles. A number of findings emerged demonstrating ways these online courses met the needs of adults.

Several of the instructors mentioned that students need to be self-disciplined to be successful in this kind of education. Instructors mentioned that students are often not ready for this type of learning because they are accustomed to traditional courses. The good news is, however, that although students may be awkward at first, they learn how to do it better as they take additional online courses. Meyen comments, "It's really great to have a student take a second course and a third course because they become very efficient and very effective at online learning. This is new for them" (Vol. 3, p. 202).

Adult learners like to have choices. These courses gave students choices as often as possible to fully engage them in the learning activities. One important choice that most of the students were given was being able to choose when to "attend" class. They were

often given choices on which teams to join or what topic to choose for projects. Flexible schedules allowed adults to fit coursework around home and work duties. One way that courses addressed this issue was to have asynchronous discussions rather than live chat. Although, BioComputing had a 2-hour live chat once a week to prevent procrastination, all other components of the course were asynchronous. Equally important, instructors also tried to connect content to the students' lives, which is another strategy to help adults learn better. For example, "Taming the Electronic Frontier" had teams develop Web sites for real customers that they got to choose. BioComputing students learned new skills in an area that was already part of their work or study. "Integration of the Disciplines" had students solving authentic problems in their professional area.

Adult learners usually have many responsibilities beside going to school. Learning opportunities need to be available for them when they are ready to learn. These courses addressed this need very well. In addition, instructors tried to be flexible with students whenever possible to help meet the learners' needs. Even though students appreciated flexible courses, however, they wanted some structure. Schori noted that students both liked and did not like the Webbed environment. Instructors agreed that online learning was a new skill students need to develop.

Connections to the Literature

Adult learners are especially interested in online instruction because it fits into their busy lives better. "Lifelong learners—mature working adults who require continuing education—already comprise 44 percent of the student population. Even traditional students are expecting round-the-clock access," Everhart reports (1999, p. 14). Pressure is building for higher education to provide online instruction to keep students

learning throughout their lifetimes; therefore, new ways of teaching and learning need to be developed (Blustain et al., 1999; Boettcher, 1999; Denning, 1996; Doucette, 1997; Duderstadt, 1999; Farrington, 1999; Hawkins, 1999; Horgan, 1998; Katz, 1999; Marchese, 1998; Noam, 1996; Palattella, 1998; Pittinsky, 1999; Rowley et al., 1998; Sherritt & Basom, 1997; Talbott, 1999).

Social Influences on Learning

"Learning is influenced by social interactions, interpersonal relations, and communication with others," states the APA LCP (1995). That all six online courses addressed this principle is truly remarkable when many face-to-face courses still struggle with this psychological learning principle.

Interactions

Interactions were a key to the success of all of the courses. Each of them included all three types of interactions as defined by Moore and Kearsley (1996): learner-to-content, learner-to-learner, and instructor-to-learner. "Murder" is a dynamic example of how students interacted together to create new understandings of the target language and culture as well as to develop new language skills. "Integration of the Disciplines" is set up so students can respond to the instructor or to the other students when interacting with the content at any time. Students valued this ability. Interactions between students and faculty was highly valued by both groups. In fact, Meyen spent about 600 minutes per student in his course personally responding to their activities, email, and such. BioComputing students worked together in study groups, each with its own instructor. These intimate groupings facilitated better dialog in BioMOO where larger meetings may

not have been as effective. In addition, all the students participated in whole-course conversations through the class listservs.

Course instructors were asked on the questionnaire to rate the effectiveness of the three major types of interactions (Moore & Kearsley, 1996) as previously discussed. All were rated highly with both "Learner to content" and "Learner to learner" having means of 4.50. "Instructor to learner" interactions had a mean of 4.60. It is clear that interactions were highly valued in these courses.

Collaboration and group skills

Each of the courses had some type of collaboration that was a significant part of the course. For example, in CalculusQuest™ students were paired so they could collaborate on comparing, contrasting, defending, and amending their solutions together. Many of the courses had team projects where collaboration was necessary to produce a product or solve problems together. Cox specifically taught sociocentric skills that are necessary for successful group interactions and dynamics. He believed that such important life skills should not be left to chance, and that when groups work virtually, this guidance becomes even more necessary.

Peer assessment

Peer assessment is another way for students to learn from each other, and there were a variety of ways this was worked into the courses. Over half of the courses used some type of formal or informal peer assessment. For example, in "Integration of the Disciplines" students peer-reviewed other students' lessons. The most unique example is

in Cox's "Taming the Electronic Frontier" in which he applies a market-based type of peer assessment where students have to "sell" their portfolios to their peers.

Threaded discussion lists

Several of the instructors used threaded discussion lists on bulletin boards or with other software. Merickel applied the concept of social constructivism by using threaded discussions. He used the term "dynamic knowledge repositories" as described in chapter 7 (Vol. 4, pp. 23-24) to explain how students create new knowledge by interacting with each other in a way that promotes critical thinking, reflection, and problem solving. Because these messages were posted by topic in a place where students could access them at any time, they became repositories that became dynamic whenever a student added a new message.

Student engagement

Instructors noted students were actively engaged and participated in all course activities and questions. The instructors explained that all students were engaged in all the activities and discussions unlike in their face-to-face classes. This was one reason why they felt that students had good quality online learning experiences; students were not able to sit in the back of the room passively listening to class discussions or daydreaming about something completely outside of the class. Meyen notes that about two weeks into a course he typically gets the following message from a student: "You know, I've been doing this for 2 weeks and all of the sudden it dawned on me that I would never talk in class. And now, I'm sending you all of these comments and I'm responding and such. What a difference that makes!" (Vol. 3, p. 28).

Cooperative learning

Cooperative learning was often used in group or team projects . Even though typical cooperative learning verbiage was not present most of the time, instructors did try to set up cooperative conditions in the groups. After Cox set up conditions for groups to learn and practice sociometric and group dynamic skills, they worked on their projects. In addition to promoting social skills he addressed another of the cooperative learning components—individual accountability in the group. Cox described the impossibility of his being able to fully "observe" the groups in action so turned to peer assessment where each student in the group grades every other member on a Web-based form. The compilation of the scores became the student's individual grade. The same full-project grade was given to each of the students in the group.

Connections to the literature

Online interactions provide environments for knowledge to be socially constructed (Cornell & Martin, 1997). Interactions can be structured in various ways to promote learning. Some well-researched instructional methods such as cooperative learning and collaboration can also be done online. Several authors discuss the importance and strategies of implementing cooperative and collaborative learning online (Althauser & Matuga, 1998; Bonk & Reynolds, 1997; Campbell, 1998; Chickering & Ehrmann, 1997; Harasim, 1993, 1997; Harasim et al., 1995; Palloff & Pratt, 1999; Riel, 1996). Alle comments that "today, security lies in what you know how to do, what you can learn to do, and how well you can access knowledge through collaboration with others" (1997, p. 4). Collaboration is now a life-skill goal.

Standards and Assessment

Standards and assessment are concerns in higher education particularly about online instruction. High standards were communicated to the students in these courses; but they were also provided with rich, supportive learning environments to help them meet those standards. Student needs and success were important to the instructors; therefore, they had ways of assessing the students' learning experiences and of evaluating their own success in making effective instructional and navigational designs. Some courses had learning assessments plus lesson evaluations at the end of each lesson. Many of the courses included regular and ongoing student assessment and evaluation. Instructors set high standards for content, pedagogy, and technology.

In addition, students want to know where they stand in their courses, but this is especially true in online courses because it is so easy for them to feel isolated. Therefore they ask—and sometimes demand—fast feedback and information on their standing. Students need to know if the instructor actually received their assignment and if so, how they did on it. Knowing this, several of the instructors developed ways to provide students with their current scores and grades by posting name-coded gradebooks.

Evaluation and assessment of constructivist learning has unique challenges for higher education (Jonassen, 1991; Reeves & Okey, 1996), especially when done online (Astin et al., 1996; McLean, 1996).

Summary

Without the use of a set of guidelines, these six courses were developed and delivered largely in agreement with the APA principles reviewed in this study. It appears that research-based instructional strategies can be creatively embedded in WBI.

Research Question 2:

Research Question 2 asked: What are the implications of new delivery models for higher education? If higher education wants to be a significant force in online education, it would be well for them to learn more about what makes effective WBI. Are there things that administrators could do to ensure that students have successful learning experiences?

Development

Course design and development were important to the instructors in this study. They believed that careful development was an integral prerequisite to having a successful online course.

Developing effective online instruction is a huge time-consuming responsibility. Without exception these course instructors said that course design, development, and delivery took more time than expected. It took Cox 5 years to develop and maintain the course infrastructure. Meyen found that it took him 40 hours on average to develop the content and format for each lesson. This did not include the 16 hours for each lesson that the technical designer also spent.

Of the six courses in this study only two were not developed by a team, and one of the lone designers says he could not and would not do it alone again. Nelson asserts that teamwork as well as "collaboration has been a key to success" in the "Murder on the Internet" course (Vol. 1, p. 256).

Most of the instructors did not get the kind of institutional support that was desired. As Merickel reflected, "You just have to put in a tremendous amount of work and a tremendous amount of time in a culture that did not value it" (Vol. 4, p. 35).

Two of the instructors noted that successful scalability was either a goal or was already possible for their courses. It all depended upon course pedagogy and instructional design. Most of the other instructors, however, were very sure that scalability would not be possible or desirable for their courses. The reason for this was the intensive time instructors spent on interactions with students due to the instructional design.

Connections to the Literature

Class size, designing learning communities with effective interactions, instructional strategies, and responding quickly to students are important issues for online instructors (Berge, 1996; Bork, 1998; Chizmar et al., 1999; Harasim, 1993; Kearsley et al., 1995; Palloff & Pratt, 1999). Further, in order to develop effective online instruction, administration and faculty need to work together (Farrington, 1999; Hardy & Boaz, 1997; Marchese, 1998). Farrington (1999) clarifies the situation of higher education administration, online instruction, and instructors:

> Exploiting the power of the World Wide Web in teaching is not necessarily simple or inexpensive. Faculty will need substantial help in terms of staff support and equipment. Most importantly, faculty will have to pay far more attention to innovation in teaching than has been common in the past, and administrations will have to reward them for it. (p. 90)

The PAVEF Outstanding Online Course Award judges were even more adamant than Farrington that the future of online instruction is dreary at best without full administrative support:

> Many of the better courses were the product of team efforts that brought together faculty, serving only as content experts, with instructional designers, programmers, editors and the like. The days of the lone teacher who authors and owns all their own course materials are clearly numbered. And institutions that cannot marshal the will and resources to support strong development teams and infrastructure will soon be left behind. (Paul Allen Virtual Education Foundation, 1998)

Recommendations

Based on the findings of this study, I have several recommendations for those involved in designing, developing, and delivering Web-based instruction in higher education. The first set of recommendations deals with online instruction itself. The second set addresses implications for higher education.

Recommendations for Web-based Instruction

Recommendations regarding course designers, developers, and instructors:

1. *Create active learning WBI*. Students who are actively engaged in constructing their own knowledge will learn better than those who do not.

2. *Create WBI that is based on effective, innovative pedagogy*. The thing that sets apart these award-winning online courses from so many others is innovative pedagogy rather than cutting-edge technology. Keep focused on the learners.

3. *Create WBI that motivates learners*. Instructors cannot count on charisma to keep students' attention as can be done more easily in the physical classroom. Because online students are isolated physically and emotionally—at least in the beginning—motivational strategies need to be integrated into instruction to keep students engaged.

4. *Create virtual learning communities in online courses to enhance learning*. This study showed that even in courses of diverse subjects virtual learning communities were not only possible, but beneficial. Social construction of knowledge is critical to learners.

5. *Create high quality courses—nothing less*. Communicate the standards to the students and then create an environment where all can reach those goals.

6. *Take calculated risks in WBI course design based on learning theories and effective pedagogy*. We are just beginning to learn of the unique learning possibilities on the Web.

7. *Research new ways of using the Web for instruction*. Many instructors expressed how little is known about exemplary Web pedagogy. We need to continue to explore possibilities and study results.

Recommendations for Higher Education Administrators

1. *Support faculty who take calculated risks in WBI course design based on learning theories and effective pedagogy*. Doing so will help faculty make new WBI discoveries and innovations.

2. *Recognize thoughtful development of innovative WBI as a scholarly activity and provide other incentives*. Until administration recognizes this activity as scholarly, the quality of WBI as a whole will not improve as quickly as it should. Faculty need administrative support.

3. *Recognize that most effective online courses have quality interactions built into them so are not scalable*. Administrators are prone to think that WBI can fill the university with students from only a few online courses.

4. *Create support departments for the development of WBI*. Not all instructors are willing to teach themselves what they need to know for innovative WBI development. Therefore, WBI support departments could have instructional and technical designers to help the faculty. They could provide professional development courses for interested faculty to learn both technical skills and Web pedagogy and to make necessary technologies available to WBI faculty.

5. *Support collaboration of faculty teams for WBI design, development, and instruction with members both in and beyond the individual university*. By working together in unique collaborations, all will benefit.

6. *Provide necessary marketing for courses, smooth out glitches in registration for distance students, and provide regular student services online*. All these are needed to provide distant learners the support they need to function well.

7. *Be cautious of automatic course development software*. Such software could tend to keep courses at a mediocre level because faculty are satisfied with the ease of making courses that fit the "stand and deliver" instructional paradigm. Train faculty in innovative Web pedagogy, so they can build more creative and effective courses even within the limitations of these programs.

Reflections

As I worked with this outstanding group of online educators I was impressed again and again that the components necessary for success are a vision for Web-based instruction, a willingness to learn, a commitment to students, and perseverance to carry out the vision. These six courses have demonstrated what is possible in online learning and instruction, and as several of the instructors emphasized, we are just at the beginning of learning what can be done. As technology continues to develop so will the new possibilities for online education; yet, pedagogy must always drive the technology as these courses demonstrate so well.

This study had its challenges and its surprises. It was a challenge for me to find out what I needed to know without infringing on the busy instructors. I had promised them that this process would not take much of their time. I tried to live by that in order to

have as many of the courses in the study as possible. I was able to find out what I needed by becoming a detective. The surprises included how supportive the instructors were even in spite of their hectic schedules.

One of my goals in this study was to see whether or not active learning environments could be created for higher education. It was confirmed beyond any doubt that not only can it be done, but it should be done. There is so much that we need to learn yet about WBI, but these instructors have shown ways to create dynamic learning with socially constructed knowledge. The potential is enormous if educators are willing to explore and experiment based on sound learning theories and instructional strategies. Kearsley (1998), one of the PAVEF Outstanding Online Award judges, concludes after evaluating all the courses in the competition:

> But the most important overall impact of online courses is the emphasis they place on critical thinking and discourse. The one thing that happens in all online courses, regardless of the discipline or grade level, is that students communicate a lot more with each other and with the instructor. They discuss ideas, analyze, evaluate, argue, debate, and question. Online education redirects learning towards a constructivist and experiential mode on a large scale. This is a significant contribution of technology to improving our educational system. (p. 5)

APPENDIX A

INSTRUMENTS

APPENDIX B

LETTERS

REFERENCE LIST

Alavi, M. (1994). Computer-mediated collaborative learning: An empirical evaluation. *MIS Quarterly, 18*(2), 159-174.

Alle, V. (1997). The knowledge evolution: Expanding organizational intelligence. Boston, MA: Butterworth-Heinemann.

Althauser, R., & Matuga, J. M. (1998). On the pedagogy of electronic instruction. In C. J. B. K. S. King (Ed.), *Electronic collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse* (pp. 183-208). Mahway, NJ: Lawrence Erlbaum.

American Psychological Association. (1995). *Learner-centered psychological principles: A framework for school redesign and reform* (Report No. ED 411 493). Washington, D.C.: American Psychological Association.

Ames, C. A. (1990). Motivation: What teachers need to know. *Teachers College Record, 91*(3), 409-422. Retrieved from: EBSCOhost on-line database (EBSCOhost, AN 9705111791).

Archer, J., & Scevak, J. J. (1998). Enhancing students' motivation to learn: Achievement goals in university classrooms. *Educational Psychology, 18*(2), 205-224. Retrieved from EBSCOhost on-line database (EBSCOhost, AN 790176).

Astin, A. W., Banta, T. W., Cross, K. P., El-Khawas, E., Ewell, P. T., Hutchings, P., Marchese, T. J., McClenney, K. M., Mentkowski, M., Miller, M. A., Moran, E. T., & Wright, B. D. (1996, July 25). AAAHE assessment forum: 9 principles for good practice for assessing student learning. American Association for Higher Education. Retrieved August 2, 1999 from the World Wide Web: http://www.aahe.org/principl.htm

Bazillion, F. J., & Braun, C. (1998, April). Teaching on the Web and in the studio classroom. *Syllabus,* 37-39.

Belland, J. C. (1991). Developing connoisseurship in educational technology. In D. Hlynka and J. C. Belland (Ed.), *Paradigms regained: The uses of illuminative, semiotic and post-modern criticism as modes of inquiry in educational technology*. Englewood Cliffs, NJ: Educational Technology Publications.

Berge, Z. L. (1996). Where interaction intersects time. *The Journal of Academic Media Librarianship*. Retrieved January 3, 1999 from the World Wide Web: http://wings.buffalo.edu/publications/mcjml/v4n1/berge.html

Betz, J. A. (1996-1997). Construction cooperative learning systems in engineering technology. *Journal of Educational Technology Systems, 25*(2), 97-108.

Billington, D. D. (1988). Ego development and adult education: The effects of intellectual stimulation, motivation, gender, time, and traditional versus self-directed learning programs. *Dissertation Abstracts International, 49*(07A), 1665-2058.

Billington, D. D. (1998). The adult learner in higher education and the workplace: Seven characteristics of highly effective adult learning programs. *New Horizons*. Retrieved August 11, 1998 from the World Wide Web: http://www.newhorizons.org/article_billington1.html

Billson, J. M. (1994). Group process in the college classroom: Building relationships for learning. *Collaborative learning: A sourcebook for higher education* (Vol. II, pp. 21-42). University Park, PA: National Center on Postsecondary Teaching, Learning, & Assessment.

Black, J. B., & McClintock, R. O. (1996). An interpretation construction approach to constructivist design. In B. G. Wilson (Ed.), *Constructivist learning environments: Case studies in instructional design* (pp. 25-31). Englewood Cliffs, NJ: Educational Technology Publications.

Blustain, H., Goldstein, P., & Lozier, G. (1999). Assessing the new competitive landscape. In R. N. Katz and Associates (Ed.), *Dancing with the devil: Information technology and the new competition in higher education* (pp. 51-72). San Francisco: Jossey-Bass.

Boettcher, J. V. (1999, June 8, 1999). 21st century teaching and learning patterns: What will we see? *Syllabus, 12*.

Bonk, C. J., & Cunningham, D. J. (1998). Searching for learner-centered, constructivist, and sociocultural components of collaborative educational learning tools. In C. J. B. K. S. King (Ed.), *Electronic collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse* (pp. 25-50). Mahwah, NJ: Lawrence Erlbaum.

Bonk, C. J., & Reynolds, T. H. (1997). Learner-centered Web instruction for higher-order thinking, teamwork, and apprenticeship. In B. Khan (Ed.), *Web-based instruction* (pp. 167-178). Englewood Cliffs, NJ: Educational Technology Publications.

Bonwell, C. C., & Eison, J. A. (1991). *Active learning: Creating excitement in the classroom*. Washington, DC: The George Washington University, School of Education and Human Development.

Bork, A. (1998, December 15). Global distance learning institutions with highly interactive multimedia learning units concept. University of California. Retrieved August 1, 1999 from the World Wide Web: http://www.ics.uci.edu/~bork/concept.html

Bork, A., & Britton, D. R., Jr. (1998, June). The Web is not yet suitable for learning. *Internet Watch,* 115-116.

Borkman, T. (1996, December 17, 1996). Case studies of two poorly functioning teams. George Mason University and VirtualSchool. Retrieved July 13, 1999 from the World Wide Web:http://www.virtualschool.edu/98c/Soci305/Soci305Thomasina.html

Bostock, S. J. (1997). Designing Web-based instruction for active learning. In B. Khan (Ed.), *Web-based instruction* (pp. 225-230). Englewood Cliffs, NJ: Educational Technology Publications.

Breen, R., & Lindsay, R. (1999). Academic research and student motivation. *Studies in Higher Education, 24*(1), 75-94. Retrieved from: EBSCOhost on-line database (EBSCOhost, AN 1838849).

Brooks, D. W. (1997). Web-teaching: A guide to designing interactive teaching for the World Wide Web. New York: Plenum Press.

Brooks, J. G., & Brooks, M. G. (1993). *In search of understanding: The case for constructivist classrooms*. Alexandria, VA: Association for Supervision and Curriculum Development.

Burgos, M. (1998). *Online instruction: Ed Meyen talks about the benefits of online instruction.* WWW4Teachers. Retrieved July 1, 1999 from the World Wide Web: http://www.4teachers.org/keynotes/meyen/

Burns, A. C., & Gentry, J. W. (1998). Motivating students to engage in experiential learning: A tension-to-learn theory. *Simulation & Gaming, 29*(2), 133-152. Retrieved from: EBSCOhost on-line database (EBSCOhost, AN 747057).

Butler, J. A. (1998). Staff development. NWREL. Retrieved September 10, 1998 from the World Wide Web:http://www.nwrel.org/scpd/sirs/6/cu12.html

Campbell, K. (1998). The Web: Design for active learning. Retrieved August 21, 1998 from the World Wide Web:http://www.atl.ualberta.ca/presentations/activelearn/activel.html

Chickering, A. W., & Ehrmann, S. C. (1997). Implementing the seven principles: Technology as lever. *American Association for Higher Education Bulletin*. Retrieved August 2, 1999 from the World Wide Web: http://www.aahe.org/technology/ehrmann.htm

Chickering, A. W., & Gamson, Z. F. (1987). 7 Principles for good practice in undergraduate education. *The Wingspread Journal, 9*(2), Insert.

Chizmar, J. F., Walbert, M. S., & Hurd, S. (1999). Web-based learning environments guided by principles of good teaching practice. *Journal of Economic Education, 30*(3), 248-265. Retrieved from: EBSCOhost on-line database (EBSCOhost, AN 1992415).

Cornell, R., & Martin, B. L. (1997). The role of motivation in Web-based instruction. In B. H. Khan (Ed.), *Web-based instruction* (pp. 93-100). Englewood Cliffs, NJ: Educational Technology Publications.

Cox, B. (1998a, March 27, 1998). Plan for a new university. Retrieved February 9, 1999 from the World Wide Web: http://virtualschool.edu/heu/index.html

Cox, B. (1998b, May 7, 1998). Coordination technology in higher education. VirtualEducation. Retrieved September 28, 1998 from the World Wide Web: http://www.virtualschool.edu/nsf/CTinHigherEd.html

Cramton, C. D. (1999). Learning through the ages: What adult development theory brings to management classes. *Journal of Management Education, 23*(4), 437-444. Retrieved from: EBSCOhost on-line database (EBSCOhost, AN 2050502).

Cross, K. P. (1998, 1998). *What do we know about students' learning and how do we know it?* Paper presented at the American Association for Higher Education National Conference.

Dede, C. (1996). The evolution of distance education: Emerging technologies and distributed learning. *The American Journal of Distance Education, 10*(2), 4-36.

Denning, P. J. (1996). Business designs for the new university. *Educom Review, 31*(6), 21-30.

Denning, P. J. (1999, May/June). Teaching as a social process. Retrieved August 8, 1999 from the World Wide Web:: http://www.educause.edu/ir/library/html/erm9932.html

Dodge, B. (1998, December 2, 1998). Schools, skills and scaffolding on the Web. Retrieved December 9, 1998 from the World Wide Web: http://edweb.sdsu.edu/people/BDodge/scaffolding.html

Doucette, D. (1997, February 15). *So what do community colleges do when Microsoft and Disney deliver high-quality, accredited, higher education and training to the businesses and homes of most Americans?* Paper presented at the meeting of the International Conference for Chairs, Deans, and Other Organizational Leaders, Reno, NV.

Driscoll, M. (1998). Web-based training: Using technology to design adult learning experiences. San Francisco, CA: Jossey-Bass/Pfeiffer.

Driscoll, M. P. (1994). *Psychology of learning for instruction*. Boston, MA: Allyn and Bacon.

Duchastel, P. (1997). A motivational framework for Web-based instruction. In B. Khan (Ed.), *Web-based instruction* (pp. 179-184). Englewood Cliffs, NJ: Educational Technology Publications.

Duderstadt, J. J. (1999). Can colleges and universities survive in the information age? In R. N. Katz and Associates (Ed.), *Dancing with the devil: Information technology and the new competition in higher education* (pp. 1-26). San Francisco: Jossey-Bass.

Dunlap, J. C. (1998). *Developing Web-based performance support systems to encourage lifelong learning in the workplace.* Paper presented at the WebNet Conference, Orlando, FL.

Dunlap, J. C., & Grabinger, R. S. (1996). Rich environments for active learning in the higher education classroom. In B. G. Wilson (Ed.), *Constructivist learning environments: Case studies in instructional design* (pp. 65-82). Englewood Cliffs, NJ: Educational Technology Publications.

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*(2), 256-273.

Dwyer, D., Barbieri, K., & Doerr, H. M. (1995). *Creating a virtual classroom for interactive education on the web*. Paper presented at the meeting of the Third International World Wide Web Conference 95 Proceedings, Darmstadt, Germany. Retrieved September 22, a998 from the World Wide Web: http://www.igd.fhg.de/www/www95/proceedings/papers/62/ctc.virtual.class/ctc.virtual.class.html

Dynes, S., Cooper, R., Trudel, N., & Guglietti, C. (1998). *Computers: More effective at feedback than your average presenter?* Paper presented at the WebNet Conference, Orlando, FL.

Egan, M. W., & Gibb, G. S. (1997). Student-centered instruction for the design of telecourses. In T. E. Cyrs (Ed.), *Teaching and learning at a distance: What it takes to effectively design, deliver, and evaluate programs* (pp. 33-39). San Francisco, CA: Jossey-Bass Publishers.

Eisner, E. W. (1991). *The enlightened eye: Qualitative inquiry and the enhancement of educational practice*. New York: Macmillan Publishing Company.

Ells, R. (1999). Webagogy. UW Computing & Communications. Retrieved August 2, 1999 from the World Wide Web: http://staff.washington.edu/rells/webagogy/printfile.shtml

Everhart, R. L. (1999). Creating virtual communities. *Syllabus: New Directions in Educational Technology, 12*(8), 12-16.

Farrington, G. C. (1999). The new technologies and the future of residential undergraduate education. In R. N. K. a. Associates (Ed.), *Dancing with the devil: Information technology and the new competition in higher education* (pp. 73-94). San Francisco: Jossey-Bass Publishers.

Fraenkel, J. R., & Wallen, N. E. (1993). *How to design and evaluate research in education*. (2nd ed.). New York: McGraw-Hill.

Fridley, L. P. (1997). Case study of two well-functioning teams. George Mason University and VirtualSchool. Retrieved July 13, 1999 from the World Wide Web:http://www.virtualschool.edu/98c/Soci305/Soci305Fridley.html

Galbraith, M. W. (1991). The adult learning transactional process. In M. W. Galbraith (Ed.), *Facilitating adult learning: A transactional process* (pp. 1-32). Malabar, FL: Krieger Publishing Company.

Garrison, D. R. (1997). Self-directed learning: Toward a comprehensive model. *Adult Education Quarterly, 48*(1), 18-34. Retrieved from: EBSCOhost on-line database (EBSCOhost, AN 1486).

Gillani, B. B., & Relan, A. (1997). Incorporating interactivity and multimedia into Web-based instruction. In B. Khan (Ed.), *Web-based instruction* (pp. 231-237). Englewood Cliffs, NJ: Educational Technology Publications.

Grabowski, B., Koszalka, T., & McCarthy, M. (1998, July 30). *Web-based learning environment strategies for classroom teachers*. Paper presented at a meeting of the Internet Society '98 Conference, Geneva, Switzerland. Retrieved November 1, 1998 from the World Wide Web:http://info.isoc.org/inet98/proceedings/4e/4e_3.htm

Grabowski, B. L. (1995). Generative learning: Past, present, and future. In D. Maeder (Ed.), *Teaching & learning models for on-line courses* (pp. 149-210). Los Angeles, CA: Academic Publishing.

Graves, W. H. (1999). Developing and using technology as a strategic asset. In R. N. Katz and Associates (Ed.), *Dancing with the devil: Information technology and the new competition in higher education* (pp. 95-118). San Francisco: Jossey-Bass Publishers.

Grow, G. O. (1991). Teaching learners to be self-directed. *Adult Education Quarterly, 41*(3), 125-149.

Harapnuik, D. (1998). *Inquisitivism or "The HHHMMM??? What does this button do?" approach to learning*. Paper presented at the WebNet Conference, Orlando, FL.

Harasim, L. (1993). Collaborating in cyberspace: Using computer conferences as a group learning environment. *Interactive learning environments, 3*(2), 119-130.

Harasim, L. M. (1997). The potential of the Web: Interacting in hyperspace. International University Consortium and Institute for Distance Education. Retrieved December 10, 1998 from the World Wide Web:http://www.umuc.edu/ide/potentialweb97/harasim.html

Harasim, L., Hiltz, S. R., Teles, L., & Turoff, M. (1995). *Learning networks: A field guide to teaching and learning online*. (3rd ed.). Cambridge, MA: The MIT Press.

Hardy, D. W., & Boaz, M. H. (1997). Learner development: Beyond the technology. In T. E. Cyrs (Ed.), *Teaching and learning at a distance: What it takes to effectively design, deliver, and evaluate programs* (pp. 41-48). San Francisco, CA: Jossey-Bass Publishers.

Harju, B. L., & Eppler, M. A. (1997). Achievement motivation, flow and irrational beliefs in traditional and nontraditional college students. *Journal of Instructional Psychology, 24*(3), 147-158.

Harmin, M. (1994). *Inspiring active learning: A handbook for teachers*. Alexandria, VA: Association for Supervision and Curriculum Development.

Hawkins, B. L. (1999). Distributed learning and institutional restructuring. *Educom Review, 34,* 12-19.

Hedberg, J., Brown, C., & Arrighi, M. (1997). Interactive multimedia and Web-based learning: Similarities and differences. In B. Khan (Ed.), *Web-Based Instruction* (pp. 47-58). Englewood Cliffs, NJ: Educational Technology Publications.

Herring, M. C. (1997). Design and training for implementation of constructivist-based distance learning environments. *Dissertation Abstracts International, 58*(07A), 2610-2773.

Hiltz, S. R., & Turoff, M. (1993). *The network nation: Human communication via computer*. Cambridge, MA: MIT Press.

Hoepfl, M. C. (1997). Choosing qualitative research: A primer for technology education researchers. *Journal of Technology Education, 9*(1).

Horgan, B. H. (1998). Transforming higher education using information technology: First steps. *Horizon*. Retrieved October 2, 1998 from the World Wide Web: http://horizon.unc.edu/TS/vision/1998-01.asp

Houle, C. O. (1961). *The inquiring mind*. Madison: University of Wisconsin Press.

Hsu, Y., Boysen, J. P., Yarger, D., & Chen, C. (1998). *The development of an exploratory simulation for constructivist learning: An example of Java application*. Paper presented at the WebNet Conference, Orlando, FL.

Hudspeth, D. (1997). Testing learner outcomes in Web-based instruction. In B. H. Khan (Ed.), *Web-based instruction* (pp. 353-356). Englewood Cliffs, NJ: Educational Technology Publications.

Jensen, E. (1998). *Teaching with the brain in mind*. Alexandria, VA: Association for Supervision and Curriculum Development.

Johnson, D. W., Johnson, R. T., & Holubec, E. J. (1994). *Cooperative learning in the classroom*. Alexandria, VA: Association of Supervision and Curriculum Development.

Johnson, D. W., Johnson, R. T., & Smith, K. A. (1991). *Active learning: Cooperation in the college classroom*. Edina, MN: Interaction Book Company.

Jonassen, D. H. (1991). Evaluating constructivistic learning. *Educational Technology, 39*(9), 28-33.

Jonassen, D. H., Dyer, D., Peters, K., Robinson, T., Harvey, D., King, M., & Loughner, P. (1997). Cognitive flexibility hypertexts on the Web: Engaging learners in meaning making. In B. H. Khan (Ed.), *Web-based instruction* (pp. 119-133). Englewood Cliffs, NJ: Educational Technology Publications.

Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). *Learning with technology: A constructivist perspective*. Upper Saddle River, NJ: Prentice Hall.

Katz, R. N. (1999). Competitive strategies for higher education in the information age. In R. N. Katz and Associates (Ed.), *Dancing with the devil: Information technology and the new competition in higher education* (pp. 27-50). San Francisco: Jossey-Bass Publishers.

Kearsley, G. (1994). Explorations in learning & instruction: The theory into practice database. George Washington University. Retrieved November 29, 1998 from the World Wide Web: http://www.gwu.edu/~tip/index.html

Kearsley, G. (1998). Online education: New paradigms for learning and teaching. *Horizon*: *The Technology Source*. Retrieved October 2, 1998 from the World Wide Web: http://horizon.unc.edu/TS/vision/1998-08.asp

Kearsley, G., Lynch, W., & Wizer, D. (1995). The effectiveness and impact of online learning in graduate education. *Educational Technology, 35*(6), 37-42.

Keller, J. M. (1987, October). Strategies for stimulating the motivation to learn. *Performance & Instruction,* 1-7.

King, S. J. (1997). *Nailing Jello to the wall*. VirtualSchool. Retrieved July 13, 1999 from the World Wide Web: http://www.virtualschool.edu/sking/practicum/final.html.

Knowles, J. S., Holton, I., E. F., & Swanson, R. A. (1998). *The adult learner: The definitive classic in adult education and human resource development* (5th ed.). Houston, TX: Gulf Publishing Company.

Knox, E. L. S. (1997, August). The pedagogy of Web site design. *Asynchronous Learning Networks Magazine, (1)2*. Retrieved August 28, 1999 from the World Wide Web: http://www.aln.org/alnweb/magazine/issue2/knox.htm

Kubota, K. (1991). Developing an alternative learning environment: A constructivist view. *Dissertation Abstracts International, 53*(01A), 0056-0401.

Lee, V. S. (1999). Creating a blueprint for the constructivist classroom. *National Teaching & Learning Forum, 8*(4). Retrieved August 29, 1999 from the World Wide Web:http://www.ntlf.com/html/pi/9905/blue_1.htm

Lefrere, P. (1997). Teaching in hyperspace .*The Potential of the Web*. Retrieved December 10, 1998 from the World Wide Web: http://www.umuc.edu/ide/potentialweb97/lefrere.html

Levinson, D. J. (1986). A conception of adult development. *American Psychologist, 41*(1), 3-13.

Lin, X., Bransford, J. D., Hmelo, C. E., Kantor, R. J., Hickey, D. T., Secules, T., Petrosino, A. J., & Goldman, S. R. (1996). Instructional design and development of learning communities: An invitation to dialogue. In B. G. Wilson (Ed.), *Constructivist learning environments: Case studies in instructional design* (pp. 203-220). Englewood Cliffs, NJ: Educational Technology Publications.

Lucas, R. (1998, June 1998). An ecology of distance learning. *Syllabus,* 14-22.

Marchese, T. (1998). Not-so-distant competitors: How new providers are remaking the postsecondary marketplace. *Journal for American Association for Higher Education*. Retrieved December 8, 1998 from the World Wide Web: http://www.aahe.org/bulletin/bull_1may98.htm

Martin, B. L. (1987, June). Aesthetics and media: Implications for the design of instruction. *Educational Technology, 26,* 15-21.

Masie, E. (1998). The Masie Center. Retrieved January 4, 1999 from the World Wide Web: http://www.masie.com/

McCormack, C., & Jones, D. (1998). *Building a Web-based education system*. New York: John Wiley & Sons

McGrath, B. (1998). Partners in learning: Twelve ways technology changes the teacher-student relationship. *T.H.E. Journal, 25*(9), 58-62. Retrieved from: EBSCOhost on-line database (EBSCOhost, AN 473450.)

McGreal, R. (1997). The Internet: A learning environment. In T. E. Cyrs (Ed.), *Teaching and learning at a distance: What it takes to effectively design, deliver, and evaluate programs* (pp. 67-74). San Francisco, CA: Jossey-Bass Publishers.

McLean, R. S. (1996). *Assessing course assignments submitted as Web pages*. Paper presented at the INET '96 Conference, Montreal, Canada. Retrieved August 21, 1998 from the World Wide Web:http://info.isoc.org/isoc/whatis/conferences/inet/96/proceedings/c7/c7_4.htm

McManus, T. F. (1998). *Individualizing Web based hypermedia learning environments*. Paper presented at the WebNet Conference, Orlando, FL.

Merriam, S. B. (1988). *Case study research in education: A qualitative approach*. San Francisco, CA: Jossey-Bass.

Meyen, E. L., Lian, C. H. T., & Tangen, P. (1997a). Developing on-line instruction: One model. *Focus on Autism and other Developmental Disabilities, 12*(3), 159-165. Retrieved October 8, 1998 from the World Wide Web: http://busboy.sped.ukans.edu/~emeyen/elmtree/paper1/paper1.htm

Meyen, E. L., Lian, C. H. T., & Tangen, P. (1997b). Teaching on-line courses. *Focus on Autism and other Developmental Disabilities, 12*(3), 166-117. Retrieved October 8, 1998 from the World Wide Web: http://busboy.sped.ukans.edu/~emeyen/elmtree/paper2/paper2.htm

Meyen, E. L., Lian, C. H. T., & Tangen, P. (1998b). *Developing on-line instruction: Partnership between instructors and technical developers*. Manuscript submitted for publication. Retrieved October 8, 1998 from the World Wide Web: http://busboy.sped.ukans.edu/~emeyen/elmtree/paper4/paper4.htm

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Thousand Oaks, CA: Sage Publications.

Miller, E. L. (1997, May 5, 1997). *Case study of a well functioning group in LRNG572—Taming the electronic frontier*. George Mason University and VirtualSchool. Retrieved July 13, 1999 from the World Wide Web:http://www.virtualschool.edu/98c/Soci305/Soci305Miller.html

Mo-Yee, L., & Greene, G. J. (1999). A social constructivist framework for integrating cross-cultural issues in teaching clinical social work. *Journal of Social Work Education, 35*(1), 21-382. 21-382. Retrieved from EBSCOhost on-line database (EBSCOhost, AN 1538186)

Moore, M. G., & Kearsley, G. (1996). *Distance education: A systems view*. Belmont, CA: Wadsworth Publishing Company.

Nelson, T. J, & Oliver, W. (in press). Murder on the Internet. *CALICO, 16*(Special Issue).

Noam, E. (1996). On the future of the university. *Educom Review, 31*(4), 38-41.

Noble, D. F. (1998a). Digital diploma mills: The automation of higher education. *First Monday*. Retrieved December 1, 1998 from the World Wide Web: http://www.firstmonday.dk/issues/issue3_1/noble/index.html

Noble, D. F. (1998b). Digital diploma mills, part II: The coming battle over online instruction. The University of Western Ontario, Faculty Association. Retrieved August 2, 1999 from the World Wide Web:http://www.uwo.ca/uwofa/articles/di_dip_2.html

Oliver, R., Herrington, J., & Omari, A. (1996). Creating effective instructional materials for the World Wide Web. AusWeb97. Retrieved September 14, 1998 from the World Wide Web: http://www.scu.edu.au/sponsored/ausweb/ausweb96/educn/oliver/

Palattella, J. (1998, July/August). The British are coming, the British are coming: A lesson for American educators. *University Business,* 24-30.

Palloff, R. M., & Pratt, K. (1999). *Building learning communities in cyberspace: Effective strategies for the online classroom*. San Francisco: Jossey-Bass.

Palmer, P. J. (1998). *The courage to teach*. San Francisco, CA: Jossey-Bass.

Parker, D., & Rossner-Merrill, V. (1998). *Socialization of distance education: The Web as enabler*. Paper presented at the WebNet Conference, Orlando, FL.

Patton, M. Q. (1990). *Qualitative evaluation and research methods* (2nd ed.). Newbury Park, CA: Sage Publications.

Paul Allen Virtual Education Foundation. (1998). The Virtual Education Foundation: Online course award winners Paul Allen Virtual Education Foundation. Retrieved October 2, 1998 from the World Wide Web: http://www.paulallen.com/foundations/education/virtual_awards.asp

Peck, M. S. (1988). *The different drum: Community-making and peace*. New York: Simon & Schuster.

Pittinsky, M. (1999). Studying today to envision tomorrow the future of enterprise academic computing systems. Retrieved August 8, 1999 from the World Wide Web: http://www.educause.edu/ir/library/html/erm9934.html

Potter, D. J. (1998, June 24, 1998). Evaluation methods used in Web-based instruction and the online course, "Taming the Electronic Frontier." Retrieved September 21, 1998 from the World Wide Web: http://mason.gmu.edu/~dpotter1/1djp_611.html

Reeves, T. C., & Okey, J. R. (1996). Alternative assessment for constructivist learning environments. In B. G. Wilson (Ed.), *Constructivist learning environments: Case studies in instructional design* (pp. 191-202). Englewood Cliffs, NJ: Educational Technology Publications.

Reeves, T. C., & Reeves, P. M. (1997). Effective dimensions of interactive learning on the World Wide Web. In B. Khan (Ed.), *Web-based instruction* (pp. 59-66). Englewood Cliffs, NJ: Educational Technology Publications.

Repman, J., & Logan, S. (1996). Interactions at a distance: Possible barriers and collaborative solutions. *TechTrends, 41*(6), 36-38.

Riel, M. (1996). The Internet: A land to settle rather than an ocean to surf and a new "place" for school reform through community development. Global SchoolNet Foundation. Retrieved November 24, 1998 from the World Wide Web: http://www.gsn.org/teach/articles/netasplace.html

Ritchie, D. C., & Hoffman, B. (1997). Incorporating instructional design principles with the World Wide Web. In B. H. Khan (Ed.), *Web-based instruction* (pp. 135-138). Englewood Cliffs, NJ: Educational Technology Publications.

Rowley, D. J., Lujan, H. D., & Dolence, M. G. (1998). Strategic choices for the academy: How demand for lifelong learning will re-create higher education. San Francisco, CA: Jossey-Bass Publishers.

Savery, J. R., & Duffy, T. M. (1996). Problem based learning: An instructional model and its constructivist framework. In B. G. Wilson (Ed.), *Constructivist learning environments: Case studies in instructional design* (pp. 135-148). Englewood Cliffs, NJ: Educational Technology Publications.

Sharan, Y., & Sharan, S. (1992). *Expanding cooperative learning through group investigation*. New York: Teachers College Press.

Sherritt, C., & Basom, M. (1997). *Using the Internet for higher education* (Report No. ED 407 546). Laramie, WY: University of Wyoming.

Sherry, L. (1996). Issues in distance learning. *International Journal of Distance Education, 1*(4), 337-365.

Sherry, L., & Wilson, B. (1997). Transformative communication as a stimulus to Web innovations. In B. Khan (Ed.), *Web-based instruction* (pp. 67-73). Englewood Cliffs, NJ: Educational Technology Publications.

Shotsberger, P. G. (1997). Emerging roles for instructors and learners in the Web-based instruction classroom. In B. H. Khan (Ed.), *Web-based instruction* (pp. 101-106). Englewood Cliffs, NJ: Educational Technology Publications.

Siegel, M. A., & Kirkley, S. (1997). Moving toward the digital learning environment: The future of Web-based instruction. In B. H. Khan (Ed.), *Web-based instruction* (pp. 263-270). Englewood Cliffs, NJ: Educational Technology Publications.

Simonson, M. R. (1997). Evaluating teaching and learning at a distance. In T. E. Cyrs (Ed.), *Teaching and learning at a distance: What it takes to effectively design, deliver, and evaluate programs* (pp. 87-94). San Francisco, CA: Jossey-Bass Publishers.

Spector, J. M. (1996). Creativity and constructivity in learning environments. *Educational Media International, 33*(2), 55-59.

Spiro, R. J., Feltovich, P. J., Jacobson, M. J., & Coulson, R. L. (1992a). Cognitive flexibility, constructivism, and hyptertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. In T. M. Duffy & D. H. Jonassen (Ed.), *Constructivism and the technology of instruction: A conversation* (pp. pp. 57-75). Hillsdale, NJ: Lawrence Erlbaum.

Spiro, R. J., Feltovich, P. J., Jacobson, M. J., & Coulson, R. L. (1992b). Knowledge representation, content specification, and the development of skill in situation-specific knowledge assembly: Some constructivist issues as they relate to cognitive flexibility theory and hypertext. In T. M. Duffy & D. H. Jonassen (Ed.), *Constructivism and the technology of instruction: A conversation* (pp. pp. 122-128). Hillsdale, NJ: Lawrence Erlbaum.

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. Newbury Park, CA: Sage Publishers.

Talbott, S. (1999, March/April). Who's killing higher education? *Educom Review, 34,* 26-33. Retrieved August 8, 1999 from the World Wide Web: http://www.educause.edu/ir/library/html/erm99024.html

Torraco, R. J. (1997). Theory building research methods. In I. R. A. Swanson & E. F. Holton (Ed.), *Human resource development research handbook* (pp. 114-137). San Francisco: Berrett-Koehler.

Trinkle, D. A. (1999,). Distance education: A means to an end, no more, no less. *The Chronicle of Higher Education, 45,* A60.

Vella, J. (1995). Training through dialogue: Promoting effective learning and change with adults. San Francisco: Jossey-Bass.

Vygotsky, L. (1986). *Thought and language*. Cambridge, MA: The MIT Press.

Wagner, E. D. (1997). Interactivity: From agents to outcomes. In T. E. Cyrs (Ed.), *Teaching and learning at a distance: What it takes to effectively design, deliver, and evaluate programs* (pp. 19-26). San Francisco, CA: Jossey-Bass Publishers.

White, L. F. (1998). Motivating students to become more responsible for learning. *College Student Journal, 32*(2), 190-197. Retrieved from EBSCOhost on-line database (EBSCOhost, AN 759257).

William Graves: On the emerging knowledge economy. *Educom Review, 33*(6), 32-38.

Williams, V., & Peters, K. (1997). Faculty incentives for the preparation of Web-based instruction. In B. H. Khan (Ed.), *Web-based instruction* (pp. 107-110). Englewood Cliffs, New Jersey: Educational Technology Publications.

Wilson, B. G. (1995). Metaphors for instruction: Why we talk about learning environments. *Educational Technology, 35*(5), 25-30.

Wilson, B. G. (Ed.). (1996). *Constructivist learning environments: Case studies in instructional design*. Englewood Cliffs, NJ: Educational Technology Publications.

Wolcott, L. L. (1996). Distant, but not distanced: A learner-centered approach to distance education. *TechTrends, 41*(5), 23-27.

Young, A. J. (1997). I think, therefore I'm motivated: The relations among cognitive strategy use, motivational orientation and classroom perceptions over time. *Learning & Individual Differences, 9*(3), 249-284. Retrieved from: EBSCOhost on-line database (EBSCOhost, AN 9711171632).

Yuen, S. C. Y. (1998). *Web-based performance support systems (WBPSS)*. Paper presented at the WebNet Conference, Orlando, FL.

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Andrews University	Ph.D.	Leadership, Focus on Educational Technology	December, 1999
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San Jose State University	B. A.	Liberal Studies	August, 1986

Employment History

Pacific Union Conference ATIE Director	La Selva Beach California	January 1992- present
San Jose State University Contract Instructor	San Jose California	Spring Semester, 1998
La Sierra University Adjunct Professor	Riverside California	June 1995-present
Virgil Hauselt Memorial Christian School Gr. 9-10—English, Computers Grades 7-10—Girls' P.E., Home Ec Library, K-8 Computers	Santa Cruz California	July 1989-1992
Gilroy Adventist School Teacher—grades 1-4	Gilroy California	1986-1989
Murphy Adventist School Team Teacher—grades 5-9 Supervising teacher for the Education Department, Southern College	Murphy North Carolina	1981-1984
Oasis Palms SDA School Team Teacher—grades 1-8 Homeroom—grades 3-5	Indio California	1978-1980

Certification

Professional Credential, North American Division, General Conference of Seventh-day Adventist with the following secondary endorsements: Computer Science, English, History, and Home Ec. Also, Elementary with the following junior academy endorsements: Business Education, General Science, Mathematics, Music, and Religion

Honors

Richard B. Lewis Outstanding Graduate Award 1995, Instructional Technology, San Jose State University
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Graduated with Distinction (1986); Presidential Scholar, 1985; Dean's Scholar, 1986
Supervising Teacher of the Year Award, 1984, joint recipient with husband, Gary; Department of Education, Southern College, Tennessee