THE INFLUENCE OF DEVELOPING A WEB-BASED COURSE ON UNIVERSITY PROFESSOR CLASSROOM INSTRUCTIONAL TECHNIQUES AS MEASURED BY THE MTQ

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by
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The undersigned, appointed by the Dean of the Graduate School, have examined the dissertation entitled

THE INFLUENCE OF DEVELOPING A WEB-BASED COURSE ON UNIVERSITY PROFESSOR CLASSROOM INSTRUCTIONAL TECHNIQUES AS MEASURED BY THE MTQ

Presented by Douglas Dean Hawley

A candidate for the degree of Doctor of Education

And hereby certify that in their opinion it is worthy of acceptance.

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Of course, I must first thank Dr. Messner for hours of reading, re-reading, encouragement and support. His advice and insight have been invaluable. I would also like to thank members of my committee for all of their assistance throughout this process.

Looking back further, this dissertation and my path of learning would never have been possible without my parents exemplifying a love of lifelong learning themselves. I thank them for encouraging me to question and think. I also am in deep gratitude to Carolyn Phelps for providing me room (and board) on nights like these, when I am away from home, writing. It is impossible to understate how she, Gary and my parents have positively affected my life.

I often reflect on the first July that I spent in Columbia. As the time to leave home approached, two of our three vehicles became inoperable. In order to be punctual, I set out in the only working vehicle, leaving Kathryn, my wife, home to pick up the pieces without transportation. Many times throughout this doctoral experience, it seems that I have rushed off in a flash leaving Kathryn to pick up the pieces of our lives. When multiple priorities competed for my time and energy, she always was the one that gave. I could never have endured without her unwavering love and support.

My daughters, Darell and Phelps, have also given up a lot without even knowing it sometimes. Their pleas of “When are you coming home, Dad” were always heard, and I thank them for their patience and tolerance. It is to Kathryn, Darell and Phelps that I dedicate this final product.

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ABSTRACT

The purpose of this study was to update the teacher questionnaire used in a national survey of educators for use on the World Wide Web (Weiss, 1978) and investigate how the web-based course development process influenced full-time Computer Science (CS) and Information Systems (IS) instructors' classroom instructional methods. The 12 independent variables included demographics; tenure status, faculty rank, total years teaching, gender, teaching within a private or public institution, teaching within a college or university and teaching within a two year or four year institution. Additionally, independent variables included experience with web-based courses. These variables were "currently developing", "have developed", "number of developed", "time since developed first web-based course" and "willing to develop a web-based course". The study consisted of 17 dependent variables that described instructional techniques; lecture, discussion, student reports, library work, students at chalkboard, individual assignments, manipulatives, televised instruction, computer assisted instruction, tests, simulations, field trips, guest speakers, teacher demonstrations, amount of time teacher spent with entire class, amount of time teacher spent with small groups and amount of time teacher spent supervising individuals.

The population in this study included all full-time CS and IS instructors, regardless of rank, at all 2 year and 4 year, public and independent, higher education

degree granting institutions in Missouri. The entire population (N=413) was surveyed yielding a self-selected sample of 244 subjects, for a 59% rate of return.

The findings confirmed that the Modified Teacher Questionnaire (MTQ) was a reliable instrument for collecting all instructional techniques, excluding lecture and televised instruction. Additionally, MANOVA tests, ANOVA tests, and discriminant analyses were used to determine that the following variables significantly affected instructional techniques; gender, teaching within a college or university, teaching within a two year or four year institution and currently developing a web-based course.

The findings led to the formulation of several conclusions. First, this study substantiated research done by Freiberg and Driscoll (2000) indicating that when looking at CS and IS faculty members, "one to many" instructional paradigms continued to prevail at higher education institutions. Furthermore, faculty members who were male and faculty members who taught at universities were more dependent on these traditional teaching techniques than their female and collegiate faculty member counterparts. Second, even though a large percentage of faculty members had some experience developing web-based courses, few faculty members have a great deal of experience. Third, past web-based course design experience had little influence on classroom instructional methods. Only current web-based course development had any significant effect on instructional techniques. This study illustrated a "return to center" affect on instructional techniques for faculty who develop web-based courses.

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CHAPTER 1

INTRODUCTION TO THE STUDY

Web-based courses and programs have become a major focus for many colleges and universities worldwide (Peterson's Distance Learning, 2004). Many educators believe that web-based course development allows a faculty member to expand his or her approach to content delivery (Gillani, 2000). Research has shown that web-based courses can be successful by utilizing a variety of delivery mechanisms such as discussion, collaboration, and self-reflection (Berge, 1997). The question remains, however, if instructors who develop web-based courses actually use a more varied approach to teaching, even within their traditional classroom-based courses? The purpose of this study was to investigate how web-based course development by a faculty member influenced his or her instructional techniques even in traditional classroom-based environments.

In 1998, the Higher Education Act of 1965 was amended establishing distance education as a primary focus for the U.S. Department of Education (Higher Education Amendments, 1998). Since that time, enrollment in distance education, as well as enrollment in web-based programs has risen. According to the National Center for Educational Statistics, during the 2000-2001 academic year, there were 3,077,000 enrollments at two and four year higher education institutions nation-wide (Waits & Lewis, 2003) as compared to 753,640 in 1994-1995 (Lewis, Alexander, & Farris, 1997). This increase was due not only to the ability to reach students that were previously unreachable, but also because web-based course design provided a medium to the instructor that can potentially enhance student involvement and learning (Brooks, 1997;

Bruffee, 1999). Technology may attract new students, and add a measure of convenience, but if technology does not enhance and deepen learning, then it has little value (Weigel, 2002).

This chapter will provide a brief discussion about the potential benefits of developing a web-based course. Nonaka and Takeuchi's (1995) knowledge spiral supports these benefits and is utilized as the conceptual underpinning to this study. A problem statement will be given, a purpose for the study will be formulated and research questions will be presented to guide the study. Limitations will be identified and key terms will be identified. Finally, a summary will be provided.

Developing Web-Based Courses

Although an enormous amount of information exists about how to develop and teach a web-based course, doing so is a relatively new experience for many teachers. Technology revolutionizes how we think about learning, working and teaching (Draves, 2000). For the purposes of this study, instructional techniques and methods were defined as those basic behaviors used to convey content during the instructional process (Wilen, Isher, Hutchison, & Kindsvatter, 2000). "By developing web-based courses, faculty can create an interactive learning environment that changes the tired old paradigm of instruction from one of 'shoveling knowledge' at the students to one of guiding students through collaborative learning experiences" (Santoro, in email to Williams & Peters, 1997). Smith and Caris (2001) stated that a successful instructor teaching a web-based course must shift from a content provider to a content facilitator. One question that remained to a great degree unanswered was "Does creating new web-based learning environments enhance a teacher's instructional method in general"? Predicting how

technology will ultimately influence education and create new learning environments is impossible, but determining how teaching methods were influenced by interaction with this technology was the focus of this study.

Conceptual Underpinnings for the Study

The interaction between student and teacher involves a process of knowledge transfer (Cleeremans, 1993). Teaching is a social knowledge creation process (Bruffee, 1999) therefore including a process of converting certain skills held by the teacher into knowledge for incorporation by the student (Nonaka & Takeuchi, 1995). By focusing on the tacit to explicit knowledge conversion process, teaching can be viewed as an externalization process as defined by Nonaka and Takeuchi (1995).

Likewise, developing a web-based course, as a specific teaching task, includes a process by which tacit knowledge is transformed into explicit. Web-based course development involves the transformation from tacit knowledge about traditional teaching strategies and student learning into new, innovative and explicit approaches involving the same principles, applied to considerably new and different learning environments. Knowledge transformation and creation indicates that teaching, along with the development of a web-based course, involves the knowledge spiral as defined by Nonaka and Takeuchi (1995). In the sections that follow, a concise explanation of the knowledge spiral will first be given, followed by a description of how the knowledge spiral related to this study.

Knowledge Spiral

Nonaka and Takeuchi (1995) outlined four knowledge conversion modes. Each mode involved the interaction between tacit and explicit knowledge. Tacit knowledge is

that knowledge which is context-specific, personal and difficult to convey while explicit knowledge is easy to convey, describe and communicate. Both developing a web-based course and teaching a traditional classroom-based course involves each of these four modes of knowledge creation. Each is described below.

Socialization describes a knowledge transformation from tacit to tacit within the organization. "Since tacit knowledge held by individuals is the basis of organizational knowledge creation, it seems natural to start the process [of knowledge creation] by focusing on tacit knowledge, which is the rich, untapped source of new knowledge" (Nonaka & Takeuchi, 1995, p. 85). From this context, the organization was considered the college or university learning community. New knowledge is created from this context by observing another party using knowledge that is personal and difficult to espouse. The socialization phase of the knowledge spiral was related to this study as provided by a typical mentorship model where someone with experience models behaviors to someone with little experience. Experiential learning strategies that focus on apprenticeships or internships are examples of socialization.

Externalization was a focal point of this study. Externalization involves taking knowledge that is tacit and making it explicit. This particular knowledge conversion mode was pivotal as it involved creating an explicit learning environment; in this case a web-based learning environment. This explicit environment was derived from the tacit knowledge the instructor had about teaching and learning. This study focused on the externalization phase in two ways. First, externalization was identified as the actual creation of a new web-based course. Second, externalization was identified and measured as teaching techniques used in traditional classroom-based courses.

Combination describes how new knowledge is created due to the transfer from explicit knowledge into another person's explicit knowledge. Unlike socialization, combination typically involves formal communication channels, such as meetings and conversations. At colleges and universities, when considering web-based course development, combination examples included the use of email, telephone and chat collaboration sessions.

Internalization involves transforming explicit knowledge into tacit knowledge. Once explicit knowledge is gained, it becomes integrated into the social environment at the college or university. Nonaka and Takeuchi (1995) closely align internalization with "learning by doing" (p. 69). Examples at colleges and universities included students engaged in laboratory experiences or homework assignments. "When experiences through socialization, externalization, and combination are internalized into individuals' tacit knowledge bases in the form of shared mental models or technical know-how, they become valuable assets" (Nonaka & Takeuchi, 1995, p. 69).

Relationship of Knowledge Spiral to this Study

Consider the following example:

> *In order to teach a course on the fundamentals of Computer Science, a new teacher sits in on a course taught by an experienced professor. This knowledge transfer process is considered socialization. The experienced professor's tacit knowledge is transferred, in part, to the new teacher as tacit knowledge. This new teacher later develops a web-based course on the fundamentals of Computer Science. The teacher's tacit knowledge about the subject is made explicit for consideration by*

students who will be taking the web-based course. As the students discuss the material with other students and the teacher, combination is taking place, transferring one person's explicit knowledge to another person's explicit knowledge. Finally, the students become engaged in activities developed by the instructor as part of the web-based course development process, through the use of worksheets, assignments and other activities. These activities contribute to the students' tacit knowledge internalization.

This study utilized Nonaka and Takeuchi's (1995) knowledge creation spiral. The four modes of knowledge creation which comprised the knowledge spiral provided focus and insight to this study. In particular, this study focused on the externalization phase within the knowledge creation spiral (see Figure 1). Externalization was used in two distinct ways. First, externalization was identified as the frequency of web-based course development and the time that had elapsed since the development of the first web-based course. Second, externalization was alternatively identified as teaching a traditional classroom-based course. Specifically, teaching techniques within traditional classroom-based courses were monitored. By identifying externalization in these two ways, this study took snapshots of the knowledge spiral only during externalization.

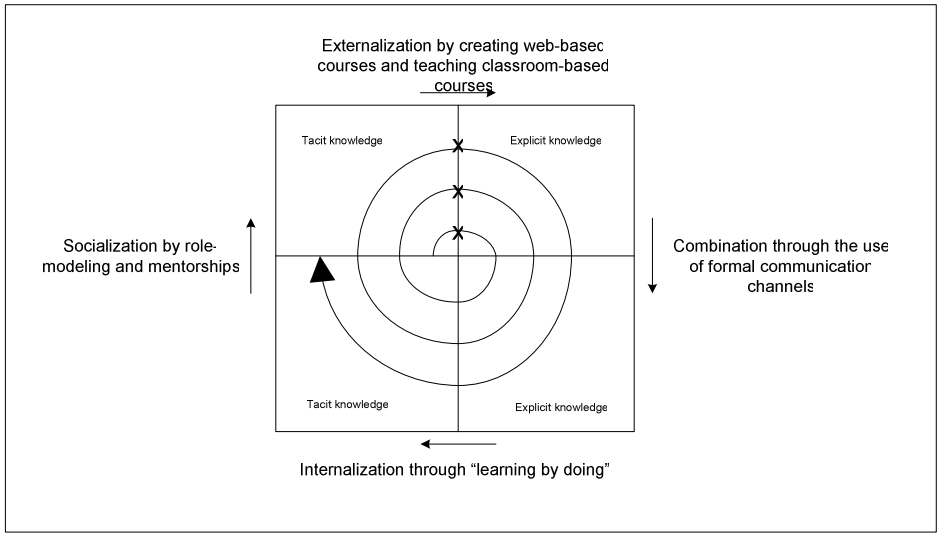

Figure 1. A description of externalization as related to the knowledge creation spiral and this study (adapted from Nonaka & Takeuchi, 1995).

Statement of the Problem

In order to promote student learning, teachers must use a variety of instructional techniques that actively engage students (Hargreaves, 2003; Bruffee, 1999; Katz & Henry, 1993; Meyers & Jones, 1993; Raths, Wassermann, Jonas, & Rothstein, 1986; Hills, 1979). Additionally, lecture has come under attack as being an inferior instructional technique (Freiberg & Driscoll, 2000; Bruffee, 1999; Salomon, 1992; Leonard, Fallon, & von Arx, 1972). Yet, the age-old lecture-based instructional method continues to be the predominate method used at colleges and universities (Freiberg & Driscoll, 2000). Conversely, recent research suggests that successful web-based courses utilize innovative delivery mechanisms and instructional techniques (The Power of the Internet, 2000). In order to be successful, web-based instructors must move away from a teacher-centered model (Blythe, 2001), foster web-based collaboration (Bruffee, 1999), and refocus learning on the student and not the classroom (The Power of the Internet, 2000; McCombs & Whisler, 1997).

Although web-based course delivery is touted as a method of diversifying instructional techniques (Salomon, 1992), little research has been done that investigates this externalization process (Berge & Mrozowski, 2001). Therefore, it has been only assumed that web-based course development will diversify an instructor's teaching methods. Even as the educational community spends enormous time and money on web-based courses, there is a lack of information as to how the process of developing a web-based course might expand an instructor's instructional techniques, even within their traditional, classroom-based courses. In fact, there is little information identifying the factors that influence instructional techniques when viewed as a composite of various techniques. The instructional techniques that make up the composite view include lecture, class discussion, computer-assisted instruction, and simulation, among others. The factors that affect this composite view include total years teaching, private school or public school, two year school or four year school, college or university, gender, faculty rank, and tenure status or non-tenure status.

Purpose of the Study

The purpose of this study is to respond to a lack of information and investigate how the interaction with web-based course development influences instructional techniques even in traditional classroom-based environments. In order to accomplish this primary purpose, this study also surveyed the status of current teaching methods within traditional classroom-based courses. Furthermore, the externalization of web-based instructional techniques was a focal point of this analysis.

By focusing on a potential instructional benefit, this study informed college and university policy related to the institutional importance of web-based teaching. This

information can notify campus policy-makers about the benefits of web-based instruction as not attracting a new group of students, but instead requiring a shift in current teaching methods.

Research Questions

The following research questions and null hypotheses were developed in order to guide the study.

Research Question 1

What classroom instructional techniques are reportedly used by Computer Science (CS) and Information Systems (IS) college and university faculty members in the state of Missouri?

Research Question 2

Are there relationships or differences among, and between, CS and IS college and university faculty member classroom instructional techniques when grouped by total years teaching, private school or public school, 2 year school or 4 year school, college or university, gender, faculty rank, or tenure status or non-tenure status?

Research Question 3

Do CS and IS faculty members in Missouri who have developed web-based courses and CS and IS faculty members in Missouri who have not developed web-based courses utilize different classroom instructional techniques?

Research Question 4

Does the faculty member's amount of experience in web-based course development influence his or her classroom instructional techniques?

Sub research question 4.1. Among those faculty members who have developed a web-based course, does the number of web-based courses developed influence a faculty member's classroom instructional techniques?

Sub research question 4.2. Among those faculty members who have developed a web-based course, does the amount of time passed since the faculty member first developed a web-based course, in years, influence the faculty member's classroom instructional techniques?

Sub research question 4.3. Among those faculty members who have developed a web-based course, do those who are currently developing a web-based course and those who are not currently developing a web-based course utilize different classroom instructional techniques?

Research Question 5

Among those faculty members who have not developed a web-based course, does willingness to develop a web-based course influence classroom instructional techniques?

Research Hypotheses

H_o1. There are no statistically significant relationships or differences among, and between, CS and IS college and university faculty member classroom instructional techniques when grouped by total years teaching, private school or public school, 2 year school or 4 year school, college or university, gender, faculty rank, or tenure status or non-tenure status.

H_o2. There is no significant difference in classroom instructional techniques between faculty members who have developed web-based courses and those who have not.

H_o3. A faculty member's amount of experience in web-based course development has no significant influence on his or her classroom instructional techniques.

H_o4. Among those faculty members who have not developed a web-based course, the willingness of the faculty member to develop a web-based course does not significantly influence instructional techniques.

Limitations

1. Results are limited by the degree to which the Modified Teacher Questionnaire (MTQ) (Weiss, 1978) is reliable and valid.
2. Results are limited by the degree to which all participants had access to the World Wide Web.
3. Results are limited by the degree to which all participants understood and answered the questions in the MTQ honestly.
4. Results of this study only describe participants involved in this study and cannot characterize a general population due to the fact that the data were self-reported and the sample was self-selected.
5. This study used an instrument that limited reported instructional techniques to those contained in the MTQ.
6. The MTQ only comprised one section of questions from the original instrument. The findings in this study are therefore restricted to only those contained within this section.

Definition of Key Terms

A specific and unambiguous vocabulary was needed to communicate information pertinent to this study. In order to facilitate the understanding of key vocabulary used in this study, the following terms were defined.

Combination. The reconfiguring process occurring when existing explicit knowledge was extrapolated into another system of explicit knowledge whereby creating new knowledge (Nonaka & Takeuchi, 1995). In this study, the combination process was considered the transfer from explicit knowledge to explicit knowledge through collaboration or other formal educational communication channels.

Explicit knowledge. Knowledge that was easy to convey, describe and communicate. Explicit knowledge is codified and systematic (Nonaka & Takeuchi, 1995).

Externalization. The process of transferring tacit knowledge to explicit knowledge making it codified, quantifiable and systematic (Nonaka & Takeuchi, 1995). In this study, the externalization process was considered in two areas. First, web-based course development was considered externalization. Second, the actual teaching of a classroom based course was viewed as having an externalization component.

Instructional method. Smith and Ragan (1993) defined instruction as "the delivery of information and activities that facilitate learners' attainment of intended, specific learning goals" (p. 2). The method of such instruction is a term attributed to those specific teaching behaviors that have the purpose of achieving this content delivery (Fenstermacher, 1992). For the purposes of this study, instructional methods were synonymous with instructional techniques.

Instructional Technique. Again, by defining instruction as "the delivery of information and activities that facilitate learners' attainment of intended, specific learning goals" (Smith & Ragan, 1993, p. 2), instructional techniques are those basic behaviors used to convey content during the instructional process (Wilen, Isher, Hutchison, & Kindsvatter, 2000). For the purposes of this study, instructional techniques were synonymous with instructional methods.

Internalization. Internalization was considered the process of transferring explicit knowledge that is quantifiable and systematic into tacit knowledge (Nonaka & Takeuchi, 1995). This study considered the internalization process as relating to transforming explicit knowledge developed by the instructor as a hands on activity or assignment into the student's tacit knowledge.

Knowledge spiral. The knowledge spiral was defined by Nonaka and Takeuchi (1995) as the organizational process of knowledge creation. This creation process was realized through methodical and continuous progress from socialization to externalization, from externalization to combination, from combination to internalization, and from internalization back to socialization (see Figure One on page seven). Each of the four knowledge creation modes is defined in this section.

Web-based course. A web-based course is a course that is primarily instructed through the use of web-based instruction as defined by Khan (1997). "Web-based instruction (WBI) is a hypermedia-based instructional program which utilizes the attributes and resources of the World Wide Web to create a meaningful learning environment where learning is fostered and supported" (p. 6).

Web-based course development. This study defines web-based course development as web-based course creation.

Classroom-based course. A classroom-based course is a course where the instructor and all students enrolled in the course meet regularly on campus in a specific building and room. Classroom-based courses may include a significant technology component.

Socialization. Socialization occurred when individual tacit knowledge was transferred directly to another individual's tacit knowledge (Nonaka & Takeuchi, 1995). Socialization was acknowledged in this study as typically provided by a mentorship model, where someone with experience modeled behaviors to someone with little experience.

Tacit knowledge. Tacit knowledge was knowledge which is context-specific, personal and difficult to convey (Nonaka & Takeuchi, 1995).

Summary

In 1998, the Higher Education Act Amendments were signed into law establishing the Web-Based Education Commission (Higher Education Amendments, 1998). These amendments also established distance education as a major focus for the U.S. Department of Education. The focus on distance education using the World Wide Web (shortened to the "web" later in this document) as a delivery mechanism has created an opportunity for teachers to re-think how courses are taught and what mechanisms can best enhance instruction (Weigel, 2002). This study was founded on the conceptual underpinnings conceived by Nonaka and Takeuchi (1995) regarding the knowledge creation spiral. The purpose of this study was to explore how the interaction with web-based course

development influenced instructional techniques even in traditional classroom-based environments. The study should inform college and university policy regarding web-based course instruction by examining a key, yet often overlooked benefit of web-based instruction; the shift it requires in teaching methods. Chapter One also included a statement of the problem relating to this study, research questions and hypotheses, the limitations of the study and definitions of key terms.

Chapter Two will provide a literature review related to web-based instruction and its influence on teaching methods. Historical context of the web will be given as it related to teaching and instruction. Pressures that schools and teachers face with regard to web-based course design and how instructional methods differed will also be addressed. Chapter Three will provide the methodology used in this study. A description of the sample, the instrumentation used, data collection and analysis procedures will be discussed in Chapter Three. The fourth chapter will present the results of the data analysis, while Chapter Five will summarize the entire study and present conclusions, implications and recommendations for further study.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

In Chapter One, several central themes regarding this study were introduced. First, as part of the introduction, federal pressures that push colleges and universities to develop web-based courses were identified. Second, in the problem statement, Chapter One made the case that successful web-based courses utilize innovative instructional delivery mechanisms, foster web-based collaboration and focus learning on the student and not the classroom. Third, externalization as it related to new knowledge creation was addressed and defined as creating new web-based courses and teaching. Chapter Two will provide a context for each of these themes relating each to current literature.

In response to these identified themes, this literature review will focus on four areas related to web-based course development. First, general historical perspectives will be provided relating the web and teaching. Second, facilitating conditions and pressures faced by colleges and universities will be considered from the standpoint of how they encourage colleges, universities and faculty members to provide web-based courses and programs. Third, attention will be given to web-based teaching methods. Specifically, the discussion will revolve around how web-based teaching methods differed from those found in traditional classroom-based courses. Particular consideration will be given to interaction due to the importance it plays in successfully designed web-based courses (Moller, 1998). Fourth, the externalization of classroom teaching methods and web-based teaching methods will be addressed as each related to this study. Externalization will be related to this study as to how knowledge gained from externalizing a web-based course

influences later externalization in a traditional, classroom-based course. Finally, a chapter summary will be provided.

Historical Perspectives of the World Wide Web and Teaching

Many people hold a misconception that the web and the Internet are synonymous (Grauer & Barber, 2002). However, the Internet was founded as Arpanet in 1967 while the web was conceived at CERN (Conseil European pour la Recherche Nucléaire) in 1990 (Gillies & Cailliau, 2000). The web is an infrastructure that enables users and educators to transfer data in the form of text, graphics and multimedia over another data channel known as the Internet (Berners-Lee, 1999).

Many educators understood that the web had great potential for education even at the time of its introduction in 1990 (Leu & Leu, 1999). The web did not start experiencing tremendous growth, however, until 1993 due to the development of Mosaic, the first user-friendly, free web browser (Gillies & Cailliau, 2000). Invented by the later developers of Netscape, Marc Andreessen and Eric Bena, Mosaic introduced many educators to the benefits of the web. Beating industry to the technology, up until 1996, much growth of the web was in the realm of education. Not until this time did business become interested (Berners-Lee, 1999; Crossman, 1997). By 1996 and 1997, the capabilities of the web had become widely known and applied in education, as well as in business (Crossman, 1997).

Today, the web has become ubiquitous on college and university campuses worldwide (Leonard, 2000). Many universities and colleges see the web as a way to build programs that are delivered in a distance education format (Lewis, Alexander, & Farris, 1997). Fifty-six percent of all two and four year, Title IV eligible, degree granting higher

education institutions offered distance education courses during the 2000-2001 academic year. Within the remaining sixty four percent, twelve percent indicated that they planned to offer distance education programs within three years of that time (Waits & Lewis, 2003). In fact, distance education has become a primary focus for the U.S. Department of Education (Higher Education Amendments, 1998). These trends have caused many colleges and universities to explore the challenges and benefits that the web as a teaching tool offers (Lewis, Alexander, & Farris, 1997). In the next section, these challenges, viewed as facilitating conditions for web-based instruction and pressures to offer web-based programs will be addressed.

Facilitating Conditions and Pressures

As access to the web became more and more ubiquitous, educators realized that they could reach students that were previously unreachable (Leu & Leu, 1999). This new opportunity became a major thrust at many colleges and universities (Weigel, 2002). However, many other colleges that were defined by their missions as residential colleges were uninterested in this new benefit (Lewis, Alexander, & Farris, 1997). Others noted the web as a tool not only to reach students who were geographically distant, but as an educational tool itself (Paris, 2000). "[The web] will bring together the best work of countless teachers and authors for everyone to share. Teachers will be able to draw on this material, and students will have the opportunity to explore it interactively" (Gates, 1995, p. 185).

As interest in the web has grown, colleges, universities and faculty members have been under pressure to develop web-based courses and programs (Quitadamo, Ian, & Brown, 2001). In fact, the federal government now expects higher education institutions

to provide technology and web-based course design as a professional development tool for its faculty members (The Power of the Internet, 2000; Higher Education Amendments, 1998).

In 1999, Ely identified eight facilitating conditions for the innovation of educational programs and technology. Ensminger and Surry (2002) analyzed the importance of these facilitating conditions as perceived by faculty who developed online degree programs. Each was found to be important and will be discussed in turn.

First, in order to facilitate innovation, there was dissatisfaction with the status quo. Second, the faculty and the students needed the required knowledge and skills to use the product effectively. Third, adequate resources had to be available. Fourth, adequate time also had to be available. Fifth, rewards and incentives had to be present in order to motivate developers to innovate. Sixth, key stakeholders had to participate in the planning and design of the product. Seventh, users and developers needed to perceive that there was commitment by leadership. Eighth, leaders had to support developers and users in successful implementation (Ely, 1999).

Within these eight facilitating conditions, Ensminger and Surry (2002) found that adequate resources were perceived by the faculty as the most important when developing online degree programs. Also perceived as highly important was dissatisfaction with the status quo, and required knowledge and skills of involved parties.

As more and more innovations have been developed and the web has become used to deploy multiple courses and programs, today's students demand greater control over how they receive instruction (Peat, 2001). These courses and programs should be taught meeting these new expectations about how course content is delivered (Peat,

2001). Additionally, students place less emphasis on having a "home" campus and are more likely to attend more than one college or university before graduating (Mendenhall, from an interview cited in Carnevale, 2000). These pressures forced colleges and universities to re-examine how best to use the web as a course delivery mechanism (Carnevale, 2000).

In the next section, a discussion is provided as to how web-based teaching methods differed from those found in traditional classroom-based courses. Particular attention is given to interaction as a requisite to successfully designed web-based courses.

Web-Based Vs. Traditional Classroom-Based Teaching Methods

In a traditional teaching methods study dating over a century, Cuban (1993) found that teaching methods generally fell somewhere between teacher-centered and student-centered methodology. Cuban found that at the teacher-centered side of the spectrum, teachers talked more than students, instruction occurred most often with the entire class, use of class time was determined exclusively by the teacher, the textbook was used to guide instruction and the classroom was fashioned in a traditional row based arrangement. Conversely, at the student-centered end of the spectrum, the students talked as much or more than the teacher, group discussion was central to instruction, students partially controlled classroom behavior, instructional materials were determined partially by the students and the classroom was fashioned in order to facilitate small group discussion.

The methods that Cuban (1993) classified as student-centered, included interactive instructional techniques that add value to traditional teacher-centered techniques and increase learning (Bruffee, 1999; Heterick & Twigg, 1999; Young &

Young, 1999). The literature is quite clear. When teachers use a variety of teaching techniques, namely those that engage the students interactively, learning increases substantially (Davis, 1993; Meyers, 1993).

The consensus in literature that interaction is important to learning is neither new nor controversial (Sims & Sims, 1995) and has roots in learning theory (McGilly, 1994). Although this study is not directly focused on learning theory and no attempt has been made to perform an exhaustive literature review on different theories of learning, it is important to understand why both interaction and the use of a variety of teaching techniques is critical. Wooldridge (1995) identified numerous models of learning and the implications they had for university and colleges. These implications were categorized under "faculty development", "classroom research", "student orientation" and "hiring new faculty" (p. 60-63) . Modification of instructional design and delivery was addressed under the "faculty development" (p. 60) category. Instructional designs that utilize student-centered techniques were found to be congruent with students' cognitive learning styles. This focus on student-centered instructional strategies along with increasing diversity and interaction in the classroom was echoed by Brown and Campione (1994) as a response to accounting for various student learning styles and practices. The next subsection discusses the value of incorporating interactive teaching strategies into the classroom and the danger of a lecture-only format.

Interaction

The lecture format of teaching treats all students as if they were the same; consisting of the same academic background, having identical learning styles and the same interest and motivation in the subject matter (Twigg, 2002). Additionally, lecture

alone is considered by many to have little educational value (Christopher, 2003; Felder, 1997). As indicted earlier in Chapter One, lecture is the predominate method used at colleges and universities (Freiberg & Driscoll, 2000) even though it has come under attack as being an inferior instructional technique (Freiberg & Driscoll, 2000; Bruffee, 1999; Salomon, 1992; Leonard, Fallon, & von Arx, 1972).

The literature has responded to this phenomenon by providing numerous valuable teaching methods. (Freire, 1971; Pagliaro, 1979; Belenkey et al., 1986; Hilligoss, 1992). Methods that allow students to interact, or partially control the class content (Smith, 1996), increase learning because they make the learner play an active role in knowledge construction (Bruffee, 1999; Defresne, et. al., 1999). These interactive methods also provide the instructor with valuable feedback about student learning (Smith, 1996), assist students with different learning styles and abilities by providing diversity in content delivery (Entwistle, 1981), and maintain student interest and motivation (Stodt, 1987).

Similarly, the value of instructional interaction is also demonstrated in the literature for web-based courses. This interaction was, in fact, found to be critical for a web-based course's success (Moller, 1998). Web-based course interaction is discussed in the next section.

Web-based Teaching Methods

These foundational teaching strategies provided the foundational instructional knowledge for newer web-based teaching strategies (Grasha & Yangarber-Hicks, 2000). As indicated in Chapter One, the enrollment numbers at two and four year higher education institutions rose from 753,640 in 1994-1995 (Lewis, Alexander, & Farris, 1997) to 3,077,000 in 2000-2001 (Waits & Lewis, 2003). The literature has responded to

this extremely high adoption rate in interest and course offerings, with numerous articles and books on how to effectively teach an on-line course. As a result, Relan and Gillani (1997) found seven areas where web-based teaching methods diverged from their classroom-based counterpart.

First, learning in a web-based course took place outside of a physical boundary and in an asynchronous manner. When learning was not confined to a classroom, the student had more opportunity and flexibility to approach the material at a time that was appropriate to the student.

Second, experiential learning was more easily accommodated. Instructors could integrate real-world scenarios into the learning process and allow students to learn "vicariously" (p. 44) by experiencing professional photographs, logs and documented interactions among the participants.

Third, social interaction could become more connected. Cooperative learning activities could be conducted by students who were geographically distant. Students could interact with peers, mentors and experts in order to solve problems via the web.

Fourth, the course content sources could become more diverse. Instead of relying on the textbook and teacher for the predominate source of material, the student could dynamically access materials that vary in style, legitimacy and depth. This level of control that the learner gained was an important distinction between web-based and traditional classroom-based courses.

The fifth and the most specific to the web was the cognitive advantage of the hypertext format of content management (Jonassen, Myers, & McKillop, 1996). This

presentational type allowed the learner to follow a line of thought on his or her own timeline and incorporate the material at a natural learner-based pace.

Sixth, web-based teaching methods promoted the concept of quality distance education. When geography was not a hindrance, students were empowered by the large course selection offered on numerous topics.

Seventh, students were given more choice as to how to interpret and display their understanding. For example, content could be digested and presented in not only text and graphics but also through any multimedia format.

Most differences outlined by Relan and Gillani (1997) moved away from a teacher centered model as defined by Cuban (1993) and granted the learners more access and control over their own learning. Jiang (1998) echoed this comparison and purported that students showed higher levels of achievement in online learning when interaction was emphasized. This interaction was critical to the web-based course's success (Moller, 1998).

Web-Based Interaction

Literature related to the methods used in web-based teaching revolved around how to encourage interaction (Greer, 2000). A web-based learning environment can and should incorporate many varying resources, encourage collaboration and incorporate multiple activities (Bi, 2000; Sherry & Wilson, 1997). When discussing interaction, the literature distinguished between content interaction and social interaction (Liaw and Huang, 2000). Liaw and Huang considered content interaction as dynamic control of information while social interaction entailed questioning, answering, discussion, debate

or negotiation with or without face-to-face communication between both learners and instructors.

Additionally, research showed that the web as an interactive instructional tool provided four educational enhancements to traditional teaching (Jonassen, 1994). Each of the four enhancements will be considered from the standpoint of content or social interaction. First, the web provided various media format combinations. This indicated that students could interact with various materials and multiple formats. Not only could the student learn from a text and an instructor, but instead from several content types. This type of interaction illustrated content interaction as the learner manipulated the information provided. Second, due to the hypermedia design, the web provided a non-linear approach to learning. This approach allowed the student to interact with the material at his or her own pace and follow paths that were not sequential and preplanned, but instead dynamic and non-consecutive. Again, due to the fact that this enhancement allowed the student to manipulate the information offered, this enhancement was considered content interaction. Third, the media provided educational interaction communication channels. Students were able to interact with their peers in both synchronous and asynchronous formats. This enhancement exemplified social interaction. Fourth, the web provided integration of each of the above three principles into a coherent structure. With the three previous principles providing the learner with a greater degree of control over how the content is presented, uniformity and integration was essential. Finally, this enhancement was considered as a content interaction as it allowed the learner to explore the content within the structure given.

The research also classified the interaction, whether social or content, as asynchronous or synchronous (Swan, et. al., 2000). Asynchronous interaction occurred when the learner controlled the pace of the interaction. The pace for synchronous interaction was controlled by the group or instructor involved in the communication. A web-based course may contain each component (Berge, 1997). First, asynchronous interaction was achieved in a web-based course when the learner interacted with the content, other learners, or the instructor individually (Moller, 1998) through e-mail, list servers, newsgroups or guest books (Liaw & Huang, 2000). This involved both content and social interaction. Synchronous interaction on the other hand, involved chat sessions or conference sessions that occurred in real time. This interaction type was typically considered by the literature to include social interaction and not content interaction. Synchronous interaction was also typically considered less effective in web-based courses than asynchronous interaction (Berge, 1999).

The next section describes how the literature has approached the subject of teaching methods as a process of externalization. The literature was also examined as to how Nonaka and Takeuchi (1995) arrived at their functional and organizational definition.

Externalization

Externalization was defined by Nonaka and Takeuchi (1995) as the transforming of tacit knowledge into explicit knowledge. Tacit knowledge, as defined by Nonaka and Takeuchi was central to the concept of externalization. From its epistemic roots, tacit knowledge has been considered as implicit knowledge (Reber, 1993), intrinsic knowledge (Goldman, 1997) and personal knowledge (Polanyi, 1958). The concept of complex

knowledge relating to awareness dates back to the late 1950's and into the 1960's (Reber, 1993). During this time, much of the literature points out disputes in methodologies used to study this difficult to measure concept (Brewer, 1974). By the middle 1970's tacit knowledge acquisition was described primarily as a "situation-neutral process whereby complex information about any stimulus environment may be acquired largely independently of the subjects' awareness of either the process of acquisition or the knowledge base ultimately acquired" (Reber, 1993). By the middle 1980s the literature emphasized mental models (Johnson-Laird, 1983). Nonaka and Takeuchi (1995) utilized the work of Johnson-Laird (1983) as a foundation to their model of externalization.

This study measured externalization in the following manner. The development of a web-based course was viewed as a process of externalization. Then externalization was viewed again, later in the knowledge creation spiral as teaching a classroom-based course. Unfortunately, there was little found in the literature as to how the process of externalizing by developing a web-based course affected classroom-based instructional methods and techniques.

In a comprehensive journal article review about distance education, Berge and Mrozowski (2001) categorized the research done between 1990 and 1999 using Sherry's (1996) ten distance education research issues. One category, "design issues" (p. 6), accounted for an enormous amount of research devoted to web-based course development (Berge & Mrozowski, 2001). However, externalization as measured by this study would have been categorized as "redefining roles of key participants" (p. 6). This category accounted for less than nine percent of the articles involved in the study. Additionally, this broad category accounted for teachers, students and site facilitators.

The category was also defined broadly enough to include all training programs and issues related to familiarization of these defined participants to distance education (Berge & Mrozowski, 2001; Sherry, 1996). In fact, no research was found that considered how web-based course development affects an instructor's teaching methods or techniques.

Summary

Chapter Two provided a review of related literature. This literature review focused on four areas related to web-based course development. First, historical perspectives were given as they related to the web and teaching. Second, the pressures that colleges, universities and faculty members faced along with facilitating conditions that were present were discussed. These conditions and pressures were considered from the standpoint of how they encouraged colleges, universities and faculty members to provide web-based courses and programs. Third, attention was given to web-based teaching methods. Specifically, the discussion revolved around how web-based teaching methods differed from those found in traditional classroom-based courses. Particular consideration was given to interaction. Interaction was stressed due to the fact that research found it to be essential in successfully designed web-based courses. Fourth, the externalization of web-based teaching methods was addressed as it related to this study. Externalization was related to this study as to how knowledge gained from externalizing a web-based course influenced later externalization in a traditional, classroom-based course. Little research was found as to how developing a web-based course redefines roles for educators, and no research was found that measured how developing a web-based course affected classroom-based instructional methods.

Chapter Three will provide details about the methodology used in this study. Chapter Three will include a purpose, research questions, research design, data collection and instrumentation and data analysis techniques. A chapter summary will also be provided.

CHAPTER THREE

METHODOLOGY

The benefits of using the web as an educational tool have been recognized since the web was introduced in the early 1990's (Leu & Leu, 1999). However, one driving force of web-based course and program development is not the educational benefit, but instead the new customers that it can attract from geographically remote locations (Lewis, Alexander, & Farris, 1997). By focusing on providing courses to students far away, as opposed to focusing on the educational benefits of the web, many colleges and universities whose attention is on residential studies, de-emphasize its importance on campus (Lewis, Alexander, & Farris, 1997). A review of related literature suggested that successful web-based instructional methods moved away from a teacher centered model as defined in Chapter Two and granted the learners more access and control over their own learning. There was a lack of information, however, as to how the development of a web-based course affected the externalization of knowledge, shown in an instructor's traditional classroom-based course.

This chapter will outline the methods used to study how web-based course development influences classroom instructional techniques. The chapter is organized in the following manner. First, conceptual underpinnings will be given. Second, the purpose of the study is provided. Third, research questions and hypotheses will be presented. Fourth, the population and sample, research design, instrumentation and data collection and analysis will be discussed. Finally, a chapter summary will be provided.

Conceptual Underpinnings

This study used Nonaka and Takeuchi (1995) as a lens to organize the analysis and view the results. In this study, the focus of web-based course development was on the process of new knowledge creation. Nonaka and Takeuchi (1995) organized the new organizational knowledge creation process through the introduction of the knowledge spiral. This knowledge spiral was divided into four knowledge creation phases. This study related the four phases to processes used in a learning community such as a college or university. Please see Figure One on page seven.

The phase of socialization referred to the transformation of knowledge from tacit to tacit within the organization. Following socialization, externalization entailed taking knowledge that was tacit and making it explicit. In the teacher-student setting, externalization involves the transfer of the teacher's tacit knowledge into explicit knowledge that the students can grasp. Externalization was the focus of this study in the following ways. Both developing a web-based course and teaching a classroom-based course involved externalization. Therefore, externalization was used both in the independent and dependent variables in this study. Next, combination involved the conversion of knowledge from explicit to explicit within the organization. Finally, internalization followed combination and described the transformation from explicit to tacit knowledge.

These four knowledge creation modes which comprised the knowledge spiral, especially the mode of externalization provided a lens through which to view this study. Based on these conceptual underpinnings, the study was framed in an appropriate manner.

Purpose of the Study

The purpose of this study was to respond to a lack of information and investigate whether or not the web-based course developing process influenced a faculty member's classroom instructional methods. Furthermore, the externalization of both web-based instructional methods and classroom-based instructional methods was a focal point of this analysis.

Research Questions

The following research questions and null hypotheses were developed in order to guide the study.

Research Question 1

What classroom instructional techniques are reportedly used by Computer Science (CS) and Information Systems (IS) college and university faculty members in the state of Missouri?

Research Question 2

Are there relationships or differences among, and between, CS and IS college and university faculty member classroom instructional techniques when grouped by total years teaching, private school or public school, 2 year school or 4 year school, college or university, gender, faculty rank, or tenure status or non-tenure status?

Research Question 3

Do CS and IS faculty members in Missouri who have developed web-based courses and CS and IS faculty members in Missouri who have not developed web-based courses utilize different classroom instructional techniques?

Research Question 4

Does the faculty member's amount of experience in web-based course development influence his or her classroom instructional techniques?

Sub research question 4.1. Among those faculty members who have developed a web-based course, does the number of web-based courses developed influence a faculty member's classroom instructional techniques?

Sub research question 4.2. Among those faculty members who have developed a web-based course, does the amount of time passed since the faculty member first developed a web-based course, in years, influence the faculty member's classroom instructional techniques?

Sub research question 4.3. Among those faculty members who have developed a web-based course, do those who are currently developing a web-based course and those who are not currently developing a web-based course utilize different classroom instructional techniques?

Research Question 5

Among those faculty members who have not developed a web-based course, does willingness to develop a web-based course influence classroom instructional techniques?

Research Hypotheses

H_o1. There are no statistically significant relationships or differences among, and between, CS and IS college and university faculty member classroom instructional techniques when grouped by total years teaching, private school or public school, 2 year school or 4 year school, college or university, gender, faculty rank, or tenure status or non-tenure status.

H_o2. There is no significant difference in classroom instructional techniques between faculty members who have developed web-based courses and those who have not.

H_o3. A faculty member's amount of experience in web-based course development has no significant influence on his or her classroom instructional techniques.

H_o4. Among those faculty members who have not developed a web-based course, the willingness of the faculty member to develop a web-based course does not significantly influence instructional techniques.

Population and Sample

The population in this study included all full-time CS and IS instructors, regardless of rank, at all 2 year and 4 year, public and independent, higher education degree granting institutions in Missouri (see Appendix D). The Missouri Coordinating Board for Higher Education (CBHE) identified 24 public institutions and 50 independent institutions (CBHE, 2004). Upon IRB approval, each institution on the list maintained by the CBHE was contacted to determine whether or not the college or university offered a program in CS or IS. Those schools who did not offer such programs were removed from the study. All faculty members who teach full time within CS or IS programs were sent an email (see Appendix C) that described the study, along with a clickable hyperlink that directed them to the on-line statement of informed consent (see Appendix B) and corresponding study instrument. The sample collected was a self-selected sample as defined by Vogt (1999) consisting of all data collected from the instrument.

Research Design

Quantitative research was defined as research evaluated numerically (Vogt, 1999). de Vaus (1995) indicated that surveys have distinguishing quantitative features in the form of data collection and analysis. Data collection from surveys is characterized by discrete, structured variables resulting from direct questions. Survey analysis was used to describe the characteristics of the consequential variable results. Both independent and dependent variables including demographic data may be collected effectively through the use of well-written survey instruments (Alreck & Settle, 1995). In order to help the researcher determine if a sample is representative of the population, attribute questions can also be incorporated (Ury, 2003).

Additionally, use of a survey instrument indicates a non-experimental design (Mertler & Vannatta, 2002) while use of the survey in a one-time fashion indicates a cross-sectional design. More specifically, this study is considered a case study in that data was gathered from only one group, CS and IS professors in Missouri, at a specified time (Vogt, 1999). Therefore, this study was considered a non-experimental, quantitative, cross-sectional case study survey research design.

Instrumentation

The instrument used in this survey was developed by The Research Triangle Institute for the National Science Foundation Survey of Science, Mathematics, and Social Studies Education (Weiss, 1978). Portions of the instrument that were unrelated were eliminated from this study.

Preliminary drafts of the instrument were sent to the Association of State Supervisors of Mathematics, the Council of State Science Supervisors, and the Council of

State Social Studies Specialists along with 18 consultant firms with expertise in education. The questionnaire was revised based on feedback from these groups and reviewed by the Committee on Evaluation and Information Systems within the Council of Chief State School Officers. The instrument was field tested and further refined based on the tests. Each item within the instrument was tested for reliability through the use of a reliability instrument. Reliability was measured as to how closely the respondents answered identically on the reliability instrument. The item used in this study with the lowest reliability was found to be 78 percent reliable resulting in "quite reasonable" (Weiss, 1978, p. 164) items reported on the questionnaire. The modified instrument, lacking items that were unrelated to this study was generated in HTML for use by web respondents.

Advantages of using the web to perform surveys include improved response rates, greater accuracy in the data collection process and real-time error detection and correction capabilities (Solomon, 2001). These advantages make web-based surveys attractive in certain scenarios. However, specific concerns must also be addressed.

The greatest concern related to web-based surveys is coverage bias (Kay & Johnson, 1999; Crawford, Couper & Lamias, 2001). This bias is a result of large numbers of participants that do not have sufficient access to the Internet. However, coverage bias introduced by web-based surveys is of little concern when the population is defined within college students or faculty in the United States, Canada or Western Europe (Solomon, 2001). Additionally, participant comfort level with the web must also be considered when conducting a web-based survey (Dillman, Tortora & Bowker, 2001). Therefore, a web-based survey would be considered appropriate when the population was

defined as all full-time CS and IS instructors, regardless of rank, at all 2 year and 4 year, public and independent higher education institutions in Missouri.

Solomon (2001) also cautions that because the web is such a public place, care should be taken that respondents are indeed those present in the sample. This study addressed the concern in the following manner. The initial email message included a clickable hyperlink that the respondent used to access the informed consent page and subsequent survey. This hyperlink included a different randomly generated key for each respondent. This key was used to authenticate that the respondent filling out the survey arrived at the location by way of the email message. This key, however, was not used to identify the respondent individually.

Specifically, the instrument used in this survey included three sections. The first section was designed to collect demographic data including tenure status, faculty rank, total years teaching, gender, private or public institution, college or university and 2 year or 4 year institution. Additionally, section one asked respondents whether or not they are currently developing a web-based course and if they have developed a web-based course in the past. If the respondent indicated that he or she had developed at least one web-based course the active survey page prompted the respondent to indicate how many web-based courses he or she had developed and how many months had passed since he or she developed their first web-based course. If the respondent indicated that he or she had not developed at least one web-based course, the active survey prompted the respondent to indicate whether he or she would be willing to develop a web-based course. The second section asked the respondent to select one of their classroom-based courses and indicate how often he or she used a number of specified instructional techniques in that class.

These techniques include lecture, discussion, student reports, library work, students working at the chalkboard, individual assignments, manipulatives, televised instruction, computer assisted instruction, tests, simulations, field trips, guest speakers or teacher demonstrations. The third section asked the respondent to consider the last class meeting of the class described in section two and indicate how much time in class was spent with the teacher working with the entire class as a whole, the teacher working with small groups of students and the teacher supervising students working individually. A printed copy of the instrument may be found in Appendix A.

Data Collection and Analysis

Survey data was collected electronically in order to minimize the risk of entry error and imported into a useable Statistical Package for the Social Sciences (SPSS) version 12.0 application format. Values for each variable were extracted using SPSS.

Variables

The 12 independent variables included demographics; tenure status, faculty rank, total years teaching, gender, private or public institution, college or university and two year or four year institution. Additionally, independent variables included “currently developing”, “have developed”, “number of developed courses”, “time since developed” and “willing to develop”. The study consisted of 17 dependent variables including lecture, discussion, student reports, library work, students at chalkboard, individual assignments, manipulatives, televised instruction, computer assisted instruction, tests, simulations, field trips, guest speakers, teacher demonstrations, teacher with entire class, teacher with small groups and teacher supervising individuals. See Table One and Table Two.

Table 1
Identification of Independent Variables Contained in the MTQ

Variable Name	Scale
Faculty rank	Ordinal
Tenure status	Nominal
Gender	Nominal
Private or public	Nominal
College or University	Nominal
Two year or four year	Nominal
Total years teaching	Ratio
Currently developing	Nominal
Have developed	Nominal
Number of developed courses	Ratio
Time since developed	Ratio
Willing to develop	Nominal

Table 2
Identification of Dependent Variables Contained in the MTQ

Variable Name	Scale
Lecture	Likert (1-5)
Discussion	Likert (1-5)
Student reports	Likert (1-5)
Library work	Likert (1-5)
Students at chalkboard	Likert (1-5)
Individual assignments	Likert (1-5)
Manipulatives	Likert (1-5)
Televised instruction	Likert (1-5)
Computer assisted instruction	Likert (1-5)
Tests	Likert (1-5)
Simulations	Likert (1-5)
Field trips	Likert (1-5)
Guest speakers	Likert (1-5)
Teacher demonstrations	Likert (1-5)
Teacher with entire class	Ratio
Teacher with small groups	Ratio
Teacher supervising individuals	Ratio

Statistical Tests Performed

Descriptive statistical analyses were performed for all independent and dependent variables. When dependent variables are likely to be correlated, a one-way multivariate analysis of variance (MANOVA) can be used to control for inter-correlations among dependent variables (Mertler & Vanatta, 2002). Therefore, statistically significant

differences between and among each group were computed using a one way MANOVA for each of the independent variables.

Additionally, a discriminant analysis is closely related to a MANOVA as the discriminant analysis is considered the reverse process of the MANOVA. While the MANOVA utilizes the independent variable as a grouping strategy and dependent variables as predictors, the discriminant analysis uses the dependent variables as grouping variables, and the independent variables as predictors (Tabachnick & Fidell, 1996). The discriminant analysis is typically done with two purposes in mind. The first purpose is to effectively show differences among groups after a MANOVA has been performed. The second purpose is to categorize subjects based on a collection of measures (Stevens, 1992). This study utilized a discriminant analysis for research questions four through five. The purpose of the discriminant analysis was to classify subjects by independent variables. Meaningful names were provided for the resulting discriminant functions. For a summary of research questions, along with the resulting type of analyses performed, see Table 3.

Table 3
Summary of analyses used by research questions

Research question	Analysis type	Grouping variable for MANOVA
1	%	None
2	MANOVA	Demographics
3	MANOVA	Have developed
4	MANOVA/Discriminant Analysis	See sub-questions
4.1	MANOVA/Discriminant Analysis	Number of developed courses
4.2	MANOVA/Discriminant Analysis	Time since developed
4.3	MANOVA/Discriminant Analysis	Currently developing
5	MANOVA/Discriminant Analysis	Willing to develop

Summary

Chapter Three described the methodology used in this study. An introduction was provided along with conceptual underpinnings that guide this study. The study's purpose was summarized and research questions were provided. The population included all full-time CS and IS instructors, regardless of rank, at all 2 year and 4 year, public and independent, higher education institutions in Missouri. The research design was described as a non-experimental, quantitative, cross-sectional case study survey research design. The background of the instrument was also provided. The instrument had been developed by The Research Triangle Institute for the National Science Foundation Survey of Science, Mathematics, and Social Studies Education (Weiss, 1978) and was updated for use as a web-accessible instrument. Data collection and analysis was provided including descriptions of variables and statistical methods for analysis. Externalization of instructional techniques were measured by inspecting survey responses obtained by the MTQ (Weiss, 1978). Independent variables included demographics and descriptors of an instructor's experience in developing web-based courses. Seventeen dependent variables were used to describe classroom-based instructional techniques. These techniques were considered though statistical analyses including descriptives, MANOVAs, and discriminant analyses.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

Distance education has been a major focus for the U.S. Department of Education since 1998 (Higher Education Amendments, 1998). By utilizing the web as a rich content delivery mechanism, teachers have an opportunity to re-think how courses are taught and which mechanisms can best enhance instruction (Weigel, 2002). This study utilized Nonaka and Takeuchi's (1995) knowledge creation spiral as a lens to examine how teachers externalize their experience with the web as a content delivery mechanism. The study's purpose was to explore how the interaction with web-based course development influenced instructional techniques even in traditional classroom-based environments. Additionally, this study sought to update the Modified Teacher Questionnaire (MTQ) developed by Weiss (1978) for use on-line and to identify current trends in teaching methods. The study should inform college and university policy regarding web-based course instruction by examining a key, yet often overlooked benefit of web-based instruction; the shift it requires in teaching methods.

Review of Research Design

This study utilized a non-experimental, cross-sectional, case study design to investigate five research questions identified previously. This study was non-experimental because it utilized a survey instrument (Mertler & Vannatta, 2002) and was a cross-sectional case study because data was gathered in a one-time fashion from only Computer Science (CS) and Information Systems (IS) professors (Vogt, 1999). Once collected, data were examined using appropriate quantitative methodologies (Hutcheson & Sofroniou, 1999; Williams, 1992; Nunnally, 1978; Cohen, 1969).

Population and Sample

The population included in this project consisted of 413 full-time CS and IS faculty members employed at 32 public and 50 private two year and four year higher education institutions in the state of Missouri as listed on the Coordinating Board for Higher Education's website (Coordinating Board for Higher Education, 2004). Each of the 413 participants were sent an electronic mail on April 27th, 2004 (see Appendix C) and directed to the web-based informed consent statement and subsequent instrument (see Appendix A). On April 29th, 2004, May 4th, 2004, and August 19th, 2004, follow-up messages were sent (see Appendix C) redirecting participants who hadn't completed the survey back to the web-based informed consent statement and instrument. This method of selecting participants produced a non-probability sample where subjects were self-selected based on their willingness to participate in the study (Patton, 1997).

No data were rejected due to lack of informed consent because all respondents had to acknowledge informed consent electronically before being directed to the survey instrument. Results were collected electronically providing 244 useable surveys, for a 59% return rate.

Schwalbe (2002) contended that a sample size of 68 represents the population with 90% certainty, while for 95% certainty, 384 respondents are needed. Therefore, with a return rate of 244 respondents, this sample represented the population with a certainty between 90-95% (Schwalbe).

Some literature suggested that the size of the entire sample collected is less important than the number of values present in each variable. More specifically, both Draper and Smith (1981) and Hutcheson & Sofroniou (1999) indicated that each variable

should contain between five and ten values for regression analysis. In this study, the variable containing the smallest number of responses was "number of months since first web-based course was developed" with 95 responses. This number was significantly lower than the total of 244 because only those respondents who indicated that they had developed at least one web-course were asked to indicate the "number of months since first web-based course was developed."

Additionally, when using a MANOVA or discriminant analysis with 12 independent variables, 240 responses is a large enough sample to provide the robustness needed to account for univariate and multivariate normality (Mertler & Vannatta, 2002). Therefore, this study, with a return rate of 59%, or 244 useable responses was deemed adequate for the statistical analyses performed.

Statistical Analyses

The data collected from this survey were analyzed. The results of analyses were described within five sub-sections. The first section addressed reliability and internal consistency tests performed and responded to research question one. This section reported descriptive measures represented by demographic values and emphasized the classroom instructional techniques CS and IS faculty members in Missouri currently use according to the MTQ. The second section explored research question two by examining the independent variables from a demographic standpoint and examined relationships and differences between groups of faculty members. The third section reports on research questions three and four by looking at the influence of web-based course development experience (IV) on classroom instructional techniques (DV). The fourth and final section looks at research question five. Section four considers the willingness to develop a web-

based course as an independent variable influencing the faculty member's classroom instructional techniques. This last section described how a faculty member's predisposition to developing a web-based course might influence his or her instructional techniques.

Section I – Reliability and Descriptive Measures - Research Question One

Before any consideration was given to findings within the data, two reliability tests were performed. These reliability tests were described first, followed by descriptive measures that address research question one. Research question one was given as "What classroom instructional techniques are reportedly used by Computer Science (CS) and Information Systems (IS) college and university faculty members in the state of Missouri?"

Internal reliability of the MTQ was tested using a Cronbach alpha (Cronbach, 1951) and an item-total analysis (Cronk, 1999). DeVellis (1991) recommended that a Cronbach alpha correlation below 0.60 was unacceptable; 0.60-0.65 undesirable; 0.65-0.70 minimally acceptable; 0.70-0.80 respectable; 0.80-0.90 very good; and if much above 0.90 excellent. The MTQ Cronbach alpha analysis results using Devellis (1991) recommendations were found to minimally acceptable at $\alpha = 0.68$ (see Table 4).

Table 4
Cronbach Alpha Recommendations (DeVellis, 1991).

α	Recommendation
0.90	Excellent
0.80-0.90	Very Good
0.70-0.80	Respectable
0.65-0.70	Minimally Acceptable
0.60-0.65	Undesirable
below 0.60	Unacceptable

In order to confirm internal consistency results an item-total analysis was also run. Cronk (1999) asserted that when any items have correlations less than 0.3, the least correlated items should be removed until all items are correlated with the total at greater than 0.3. Cronk further indicated that "when all remaining correlations are greater than 0.3, the remaining items in the scale are considered to be the items that are internally consistent. Two MTQ items had item-total analysis correlations less than 0.3. First, lecture was correlated at 0.170. It was removed and items were re-tested. Second, televised instruction was correlated at 0.198. Televised instruction was also removed. The remaining items were all found to be internally consistent with correlations greater than 0.3 (see Table 5).

Table 5
Item-Total Correlations for Included Instructional Techniques

Variable	N	Correlation with Item-Total
Discussion	238	0.463
Student Reports	239	0.426
Library Work	235	0.350
Chalkboard Work	239	0.359
Individual Assignments	235	0.484
Manipulatives	236	0.567
Computer Assisted Instruction	234	0.526
Tests or Quizzes	238	0.428
Simulations	239	0.544
Guest Speakers	239	0.359
Field Trips	238	0.423
Demonstrations	234	0.619

After lecture and televised instruction scales were removed, a second Cronbach alpha internal reliability test was run. Again, the results for the MTQ Cronbach alpha analysis using Devellis (1991) recommendations were found to minimally acceptable. Once lecture and televised instruction were removed, alpha improved by only 0.01, or $\alpha = 0.69$.

Descriptive data were calculated and analyzed with regard to demographics, experience developing web-based courses, and instructional techniques. This section will provide both narrative and tables in order to illustrate details of reported frequencies by each variable. The variables highlighted in the following narrative were faculty rank, tenure status, gender, private or public institution, college or university, two year or four year institution, years teaching, currently developing a web-based course, have developed a web-based course, number of developed web-based courses, months since developed first web-based course, willingness to develop a web-based course, along with 17 variables describing instructional techniques. These 17 variables were lecture, discussion, student reports, library work, chalkboard work, individual assignments, manipulatives, televised instruction, computer-assisted instruction, tests or quizzes, simulations, guest speakers, field trips, demonstrations, time with entire class, time with groups and time with individuals. Note also that lecture and televised instruction indicators are included in the frequency tables and narrative below in order to illustrate the frequency of survey responses, but no further inferences will be drawn concerning lecture and televised instruction.

Faculty rank. Respondents were somewhat uniform with regard to rank and tenure status. The rank with least representation was Associate Professor, while the greatest representation was both Assistant Professor and Professor (see Table 6).

Table 6
Frequency of Responses – Faculty Rank

Variable	N	%
Instructor	53	21.7
Assistant Professor	69	28.3
Associate Professor	47	19.3
Professor	69	28.3
Sub - Total	238	97.5
Missing	6	2.5
Total	244	100.0

Tenure status. Tenured and non-tenured faculty members were represented equally. Faculty appointments appeared to be stable as both faculty rank and tenure status were evenly distributed. (see Table 7).

Table 7
Frequency of Responses – Tenure Status

Variable	N	%
Tenure	122	50.0
Non-tenure	119	48.8
Sub - Total	241	98.8
Missing	3	1.2
Total	244	100.0

Gender. Males accounted for nearly two-thirds of the respondents (see Table 8). Females represented a surprisingly high portion of the sample, considering that in 1999 fewer than 20% of the graduates from Computer Science research departments in the United States were female (Margolis, 2002).

Table 8
Frequency of Responses – Gender

Variable	N	%
Male	160	65.6
Female	84	34.4
Total	244	100.0

Institution type. Representative of the population, faculty members at public, four year universities accounted for over 70% of the respondents. Fewer than 20% of respondents reported that they were employed at a two year institution (see Table 9).

Table 9
Frequency of Responses –Institution Type

Variable	N	%
Private	50	20.5
Public	194	79.5
Total	244	100.0
College	64	26.2
University	173	70.9
Sub - Total	237	97.1
Missing	7	2.9
Total	244	100.0
Two Year	42	17.2
Four Year	200	82.0
Sub - Total	242	99.2
Missing	2	0.8
Total	244	100.0

Years teaching. Faculty members reported a wide range of teaching experience. However, reported values indicated that the sample consisted of a relatively young faculty (see Table 10).

Table 10
Frequency of Responses – Years Teaching

Years Teaching	N	%
1-9	98	40.2
10-19	65	26.6
20-29	49	20.1
30 or more	28	11.5
Sub - Total	240	98.4
Missing	4	1.6
Total	244	100.0

Web - based course experience. Approximately one-third of all respondents reported that they were "currently in the process of developing a web-based course" at the time of completing the survey and over 40% reported that they had "developed at least one web-based course in the past" (see Appendix A and Table 11).

Although a large number of the sample indicated some experience with web-based course development, most respondents indicated that this experience was new, or that their level of experience was small. Of those respondents who answered "yes" to "Have you developed at least one web-based course in the past?," nearly two-thirds had developed only 0-1 web-based course. About 20% had developed 2-4 web-based courses, and less than 10% had developed 5 or more web-based courses (see Table 11).

Respondents indicated moderate distribution of responses when questioned about the number of months since the first web-based course was developed. A large number of values are reported missing due to the fact that only those respondents who indicated that they had developed at least one web-course were asked about the number of months since the first web-based course was developed. Therefore, 141 respondents were not presented this question (see Table 11).

Table 11

Frequency of Responses – Web – Based Course Experience

Variable	N	%
Currently Developing a Web Course		
Yes	78	32.0
No	165	67.6
Sub - Total	243	99.6
Missing	1	0.4
Total	244	100.0
Have Developed a Web Course		
Yes	103	42.2
No	132	54.1
Sub - Total	235	96.3
Missing	9	3.7
Total	244	100.0
Number of Developed Web Courses		
0-1	160	65.6
2-4	52	21.3
5 or More	16	6.6
Total	228	93.4
Missing	16	6.6
Total	244	100.0
Months Since Developed First Web Course		
0-12 Months	18	7.4
13-24 Months	22	9.0
25-36 Months	18	7.4
37-48 Months	17	7.0
More than 48 Months	20	8.2
Sub - Total	95	38.9
Missing	149	61.1
Total	244	100.0

Willingness to develop a web-course. A large percentage of faculty members who had never developed a web-based course were willing to do so. A substantial number of values are reported missing due to the fact that only those respondents who indicated that they had not developed at least one web-course were asked about their willingness to develop a web-based course. Therefore, 112 respondents were not presented this question. (see Appendix A and Table 12).

Table 12
Frequency of Responses – Willing to Develop a Web Course

Variable	N	%
Yes	72	29.5
No	33	13.5
Sub - Total	105	43.0
Missing	139	57.0
Total	244	100.0

Instructional techniques. Respondents indicated the amount of use for the following instructional techniques; lecture, discussion, student reports or projects, library work, students working at the chalkboard, individual assignments, manipulative or laboratory materials, televised instruction, computer-assisted instruction, tests or quizzes, simulations, field trips, guest speakers, and teacher demonstrations. Lecture was reportedly used more frequently than any other method with over 90% of respondents using lecture "just about daily" or "at least once a week." This high frequency of reported use may account for lecture being uncorrelated with the other indicators and therefore an unreliable indicator of instructional techniques. Discussion was the second most-frequently used instructional technique with three-fourths of respondents using discussion "just about daily" or "at least once a week." Field trips were used less frequently than any other reported technique with under 3% of respondents using field trips "just about daily" or "at least once a week" (see Appendix A and Tables 13-15).

Table 13

Frequency of Responses – Regularity of Instructional Techniques, Part 1

	Lecture		Discussion		Student Reports		Library Work		Chalkboard Work		Individual Assignments		Manipulatives	
Frequency	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Never	3	1.2	9	3.7	10	4.1	77	31.6	140	57.4	10	4.1	63	25.8
Less than once a month	1	0.4	17	7.0	50	20.5	93	38.1	56	23.0	18	7.4	31	12.7
At least once a month	6	2.5	29	11.9	92	37.7	49	20.1	30	12.3	63	25.8	35	14.3
At least once a week	100	41.0	87	35.7	73	29.9	15	6.1	11	4.5	104	42.6	62	25.4
Just about daily	129	52.9	96	39.3	14	5.7	1	0.4	2	0.8	40	16.4	45	18.4
Sub – Total	239	98.0	238	97.5	239	98.0	235	96.3	239	98.0	235	96.3	236	96.7
Missing	5	2.0	6	2.5	5	2.0	9	3.7	5	2.0	9	3.7	8	3.3
Total	244	100.0	244	100.0	244	100.0	244	100.0	244	100.0	244	100.0	244	100.0

Table 14

Frequency of Responses – Regularity of Instructional Techniques, Part 2

	Televised Instruction		Computer Assisted Instruction		Tests or Quizzes		Simulations		Guest Speakers		Field Trips		Demonstrations	
Frequency	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Never	196	80.3	83	34.0	10	4.1	130	53.3	115	47.1	192	78.7	32	13.1
Less than once a month	29	11.9	38	15.6	49	20.1	53	21.7	113	46.3	39	16.0	39	16.0
At least once a month	6	2.5	28	11.5	126	51.6	35	14.3	9	3.7	6	2.5	54	22.1
At least once a week	3	1.2	49	20.1	49	20.1	16	6.6	2	0.8	1	0.4	68	27.9
Just about daily	3	1.2	36	14.8	4	1.6	5	2.0	0	0.0	0	0.0	41	16.8
Total	237	97.1	234	95.9	238	97.5	239	98.0	239	98.0	238	97.5	234	95.9
System	7	2.9	10	4.1	6	2.5	5	2.0	5	2.0	6	2.5	10	4.1
Total	244	100.0	244	100.0	244	100.0	244	100.0	244	100.0	244	100.0	244	100.0

Table 15

Regularity of Instructional Techniques Used Almost Daily, Ranked by N

Variable	N	%
Lecture	129	52.9
Discussion	96	39.3
Manipulatives	45	18.4
Demonstrations	41	16.8
Individual Assignments	40	16.4
Computer Assisted Instruction	36	14.8
Student Reports	14	5.7
Simulations	5	2.0
Tests or Quizzes	4	1.6
Televised Instruction	3	1.2
Chalkboard Work	2	0.8
Library Work	1	0.4
Guest Speakers	0	0.0
Field Trips	0	0.0

Additionally, data were analyzed regarding the amount of time (as a percent of class-time) the teacher spent working with the entire class as a group, the amount of time (as a percent of class-time) the teacher spent working with small groups of students, and amount of time (as a percent of class-time) the teacher spent supervising students working on individual activities. Of these three categories, faculty members indicated that they spend a great deal of time with the entire class and little time with small groups or individual students (see Table 16 and Figure 2).

Table 16

Frequency of Responses –Amount of Teacher Attention as a Percent of Class Time

Variable	Time with Entire Class		Time with Groups		Time with Individuals	
	N	%	N	%	N	%
0% - 25%	15	6.1	115	47.1	112	45.9
26% - 50%	25	10.2	20	8.2	20	8.2
51% - 75%	32	13.1	3	1.2	3	1.2
76% - 100%	69	28.3	3	1.2	6	2.5
Sub - Total	141	57.8	141	57.8	141	57.8
Missing	103	42.2	103	42.2	103	42.2
Total	244	100.0	244	100.0	244	100.0

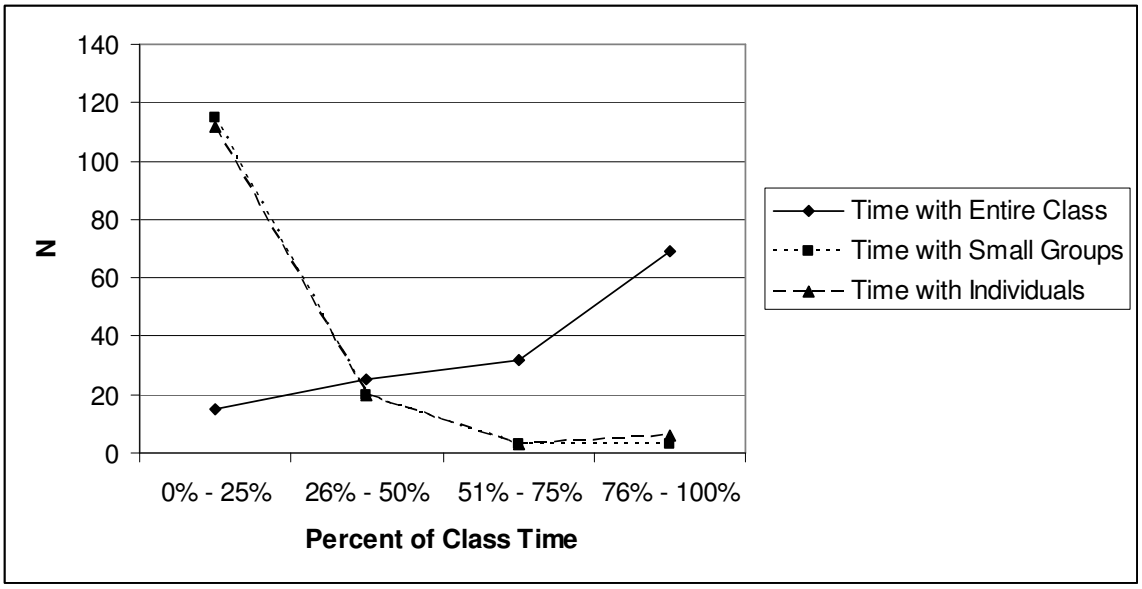

Figure 2. The number of respondents who reported how much of their time was spent with the entire class, with small groups or with individuals during their most recent class.

To summarize this section, reliability tests were described first, followed by descriptive measures that addressed research question one. Cronbach alpha analysis indicated that the MTQ items were minimally acceptable (Devellis, 1991). Item-total analysis (Cronk, 1999) indicated that lecture and televised instruction were not correlated with the total. Both were removed. Each of the remaining items was considered acceptably correlated with the total.

After reliability tests were discussed, descriptive measures were addressed. This sample indicated that faculty appointments appeared to be stable as both faculty rank and tenure status were evenly distributed. However, a relatively young and largely male faculty was represented. Most of these faculty members taught at public, four year universities.

Lecture was the instructional technique reportedly used more frequently than any other method, and faculty members indicated that they spend a great deal of time with the entire class and little time with small groups or individual students. As for experience in web-based course development, a large number of the sample indicated some, but a small amount of experience. Those faculty members with no experience developing a web-based course were willing to do so.

Section II – Demographics and Instructional Techniques - Research Question Two

This section reports on the analysis of the effects demographic independent variables had on a group of dependent variables. Research question two relied on demographic data and was given as "Are there relationships or differences among, and between, CS and IS college and university faculty member classroom instructional techniques when grouped by total years teaching, private school or public school, 2 year school or 4 year school, college or university, gender, faculty rank, or tenure status or non-tenure status?"

This section was divided into three distinct sub-sections. The first sub-section identified the dependent and independent variables used to answer research question two. The second sub-section provided results from the multivariate analysis of variance (MANOVA) and subsequent analysis of variance (ANOVA) tests conducted. Mertler & Vannatta (2002) asserted that when dependent variables are correlated, a MANOVA can be used to control for inter-correlations among dependent variables. Therefore, statistically significant differences between and among each group were computed using a one way MANOVA for each of the independent variables. ANOVA tests were then conducted for those variables in which the MANOVA revealed significance. The third

and final sub-section gave the results for the discriminant analysis tests conducted. A descriptive discriminant analysis was performed in order to identify uncorrelated linear combinations (Stevens, 1992). This discriminant analysis utilized the dependent variables as grouping variables, and the independent variables as predictors (Tabachnick & Fidell, 1996).

Dependent and Independent Variables

The dependent variables were identified as discussion, student reports, library work, students at chalkboard, individual assignments, manipulatives, computer assisted instruction, tests, simulations, field trips, guest speakers, teacher demonstrations, time spent with entire class, time spent with small groups, and time spent supervising individuals. These variables were used in order to answer research question two (see Table 17).

Table 17
Dependent Variables – Research Question Two

Variable Name	Scale
Discussion	Likert (1-5)
Student reports	Likert (1-5)
Library work	Likert (1-5)
Students at chalkboard	Likert (1-5)
Individual assignments	Likert (1-5)
Manipulatives	Likert (1-5)
Computer assisted instruction	Likert (1-5)
Tests	Likert (1-5)
Simulations	Likert (1-5)
Field trips	Likert (1-5)
Guest speakers	Likert (1-5)
Teacher demonstrations	Likert (1-5)
Teacher with entire class	Ratio
Teacher with small groups	Ratio
Teacher supervising individuals	Ratio

The independent variables were total years teaching, private school or public school, 2 year school or 4 year school, college or university, gender, faculty rank, and tenure status. These variables were also used in order to answer research question two (see Table 18).

Table 18
Independent Variables – Research Question Two

Variable Name	Scale
Faculty rank	Ordinal
Tenure status	Nominal
Gender	Nominal
Private or public	Nominal
College or University	Nominal
Two year or four year	Nominal
Total years teaching	Ratio

MANOVA and ANOVA Tests Performed

MANOVA tests were conducted in order to determine which independent variables significantly affected the combined dependent variable. Once these independent variables were identified, separate ANOVA tests were done to further describe how the independent variables affected the dependent variable. This sub-section provides details of the MANOVA and ANOVA tests performed.

MANOVA results showed that two year or four year institution (Wilk's Λ=.70, $F(15, 119) = 3.35$, p=.000), college or university (Wilk's Λ=.75, $F(15, 115) = 2.61$, p=.002), and gender (Wilk's Λ=.79, $F(15, 119) = 2.08$, p=.015) significantly affected the combined dependent variable of discussion, student reports, library work, students at chalkboard, individual assignments, manipulatives, computer assisted instruction, tests, simulations, field trips, guest speakers, teacher demonstrations, time spent with entire class, time spent with small groups, and time spent supervising individuals. Univariate

ANOVA tests were conducted on two year or four year institution, college or university and gender as follow-up examinations. The results of these ANOVA tests follow.

Two year or four year institution. ANOVA results indicated that discussion ($F(1, 133) = 4.03$, $p = .047$)), student reports (($F(1, 133) = 6.14$, $p = .015$)), chalkboard work (($F(1, 133) = 5.42$, $p = .021$)), individual assignments (($F(1, 133) = 6.47$, $p = .012$)), manipulatives (($F(1, 133) = 33.73$, $p = .000$)), computer-assisted instruction (($F(1, 133) = 18.3$, $p = .000$)), simulations (($F(1, 133) = 4.09$, $p = .045$)), teacher demonstrations (($F(1, 133) = 11.0$, $p = .001$)), time spent with entire class (($F(1, 133) = 10.93$, $p = .001$)) and time spent supervising individuals (($F(1, 133) = 7.13$, $p = .009$)) significantly differed for two year or four year institution. Library work (($F(1, 133) = .33$, $p = .568$)), tests or quizzes (($F(1, 133) = 1.64$, $p = .202$)), guest speakers (($F(1, 133) = .319$, $p = .573$)), field trips (($F(1, 133) = 1.56$, $p = .215$)) and time spent with small groups (($F(1, 133) = 1.13$, $p = .289$)) did not significantly differ for two year or four year institution. After ANOVA tests were run to determine significance for individual techniques for two year or four year institution, post-hoc *t*-tests were conducted on significant factors in order to further isolate mean scores (see Table 19).

Table 19
Significantly Different Mean Scores for Techniques by Two Year or Four Year Institution

	Two Year Institution			Four Year Institution			
Technique	N	Mean	σ	N	Mean	σ	*p*
Discussion	42	4.26	1.149	195	3.98	1.048	.047*
Student Reports	42	3.48	1.042	196	3.05	0.916	.015*
Chalkboard Work	42	1.76	0.850	196	1.64	0.943	.021*
Individual Assignments	42	3.98	0.924	192	3.55	0.996	.012*
Manipulatives	42	4.07	1.276	193	2.74	1.438	.000*
Computer Assisted Instruction	42	3.52	1.311	191	2.45	1.489	.000*
Simulations	42	2.07	1.237	196	1.74	1.007	.045*
Demonstrations	40	3.85	1.051	193	3.07	1.303	.001*
Time With Entire Class	30	2.57	0.971	111	3.24	1.020	.001*
Time With Individuals	30	1.63	0.850	111	1.23	0.656	.009*

* *p <= .05*

These analyses revealed that faculty members who taught at two year institutions used significantly more discussion, student reports, chalkboard work, individual assignments, manipulatives, computer assisted instruction, simulations and demonstrations during class than their counterparts at four year institutions. Additionally, faculty members who taught at two year institutions spent significantly more time in class working with individuals than faculty members at four year institutions. Conversely, faculty members who taught at four year institutions spent significantly more time with the entire class as a group than their four year institution counterparts.

College or university. ANOVA results indicated that discussion (($F(1, 129) = 5.42, p = .021$)), student reports (($F(1, 129) = 8.08, p = .005$)), chalkboard work (($F(1, 129) = 4.13, p = .044$)) , individual assignments (($F(1, 129) = 7.84, p = .006$)), manipulatives (($F(1, 129) = 24.82, p = .000$)), computer-assisted instruction (($F(1, 129) = 13.56, p = .000$)), simulations (($F(1, 129) = 4.00, p = .047$)), field trips (($F(1, 129) = 6.85, p = .010$), teacher demonstrations (($F(1, 129) = 14.77, p = .000$)) and time spent with entire class (($F(1, 129) = 7.37, p = .008$)) significantly differed for college or university. Library work (($F(1, 129) = .29, p = .592$)), tests or quizzes (($F(1, 129) = 2.21, p = .139$)), guest speakers (($F(1, 129) = 1.38, p = .243$), time spent with small groups (($F(1, 129) = .861, p = .355$)) and time spent supervising individuals (($F(1, 129) = 1.97, p = .163$)) did not significantly differ for college or university. After ANOVA tests were run to determine significance for individual techniques for college or university, post-hoc *t*-tests were conducted on significant factors in order to further isolate mean scores (see Table 20).

Table 20

Significantly Different Mean Scores for Techniques by College or University

	College			University			
Technique	N	Mean	σ	N	Mean	σ	*p*
Discussion	63	4.27	1.139	168	3.97	1.023	.021*
Student Reports	63	3.44	0.980	169	3.02	0.909	.005*
Chalkboard Work	63	1.79	0.986	169	1.59	0.896	.044*
Individual Assignments	62	3.90	0.987	166	3.51	0.989	.006*
Manipulatives	63	3.76	1.388	167	2.69	1.447	.000*
Computer Assisted Instruction	63	3.25	1.402	164	2.43	1.495	.000*
Simulations	63	2.11	1.138	169	1.67	0.997	.047*
Field Trips	63	1.41	0.638	168	1.16	0.428	.010*
Demonstrations	61	3.75	1.027	166	3.02	1.319	.000*
Time With Entire Class	44	2.75	1.014	93	3.25	1.028	.008*

* *p* <= .05

These analyses revealed that faculty members who taught at colleges used significantly more discussion, student reports, chalkboard work, individual assignments, manipulatives, computer assisted instruction, simulations, field trips and demonstrations during class than their counterparts at universities. Conversely, faculty members who taught at universities spent significantly more time with the entire class as a group than their college faculty counterparts.

Gender. Student reports (($F(1, 133) = 8.36$, $p = .004$)), individual assignments (($F(1, 133) = 8.22$, $p = .005$)), manipulatives (($F(1, 133) = 6.63$, $p = .011$)), simulations (($F(1, 133) = 4.11$, $p = .045$)), time spent with entire class (($F(1, 133) = 19.34$, $p = .000$)) and time spent supervising individuals (($F(1, 133) = 5.93$, $p = .016$)) significantly differed for gender. Discussion ($F(1, 133) = .2$, $p = .657$)), library work (($F(1, 133) = .02$, $p = .892$)), chalkboard work (($F(1, 133) = 1.64$, $p = .203$)), computer-assisted instruction (($F(1, 133) = 2.94$, $p = .089$)), tests or quizzes (($F(1, 133) = 2.89$, $p = .091$)), guest speakers (($F(1, 133) = .101$, $p = .751$)), field trips (($F(1, 133) = 2.18$, $p = .142$)), teacher demonstrations (($F(1, 133) = 2.86$, $p = .093$) and time spent with small groups (($F(1, 133)$

= 2.46, p = .119)) did not significantly differ for gender. After ANOVA tests were run to determine significance for individual techniques for gender, post-hoc *t*-tests were conducted on significant factors in order to further isolate mean scores (see Table 21).

Table 21
Significantly Different Mean Scores for Techniques by Gender

	Male			Female			
Technique	N	Mean	σ	N	Mean	σ	*p*
Student Reports	160	3.01	0.945	79	3.37	0.922	.004
Individual Assignments	159	3.48	0.999	76	3.92	0.920	.005
Manipulatives	157	2.75	1.432	79	3.44	1.517	.011
Simulations	160	1.77	1.047	79	1.86	1.071	.045
Time With Entire Class	90	3.39	0.956	51	2.59	1.004	.000
Time With Individuals	90	1.21	0.609	51	1.49	0.857	.016

Note: p <= .05

These analyses revealed that female faculty members used significantly more student reports, individual assignments, manipulatives and simulations during class than their male counterparts. Additionally, female faculty members spent significantly more time in class working with individuals than male faculty members. Conversely, male faculty members spent significantly more time with the entire class as a group than female faculty members.

Discriminant Analyses Performed

Discriminant analyses were conducted to further describe the significant differences found in the MANOVA tests conducted. These descriptive discriminant analyses were done to determine if discussion, student reports or projects, library work, students working at the chalkboard, individual assignments, manipulative or laboratory materials, computer-assisted instruction, tests or quizzes, simulations, field trips, guest speakers, teacher demonstrations, time spent with entire class, time spent with small groups, and time spent supervising individuals could predict two year or four year

institution, college or university or gender. Three functions were generated, and each was found to be significant.

Function One, Hands-On Instructional Techniques. The first function, $\Lambda = .75$, $\chi^2(2, N = 132) = 37.69$, $p = .000$, indicated that the function of predictors significantly differentiated between faculty members who taught at a two year or four year institution. This function yielded 24.8% of the variability explained by two year or four year institution. Two variables were entered into the function: Manipulative or laboratory materials and computer-assisted instruction, respectively. The variables of discussion, student reports or projects, library work, students working at the chalkboard, individual assignments, tests or quizzes, simulations, field trips, guest speakers, teacher demonstrations, time spent with entire class, time spent with small groups, and time spent supervising individuals were excluded. The function was labeled *Hands-On Instructional Techniques*. Two year (coded as 1) or four year (coded as 2) institution could be predicted and was equal to 2.179 – 0.074 (MANIPULATIVES) – 0.052 (COMPUTER ASSISTED INSTRUCTION), when manipulatives and computer assisted instruction were coded as 1=Never, 2=Less than once a month, 3=At least once a month, 4=At least once a week, 5=Just about daily. Figure 3 shows a graphic representation of group membership means.

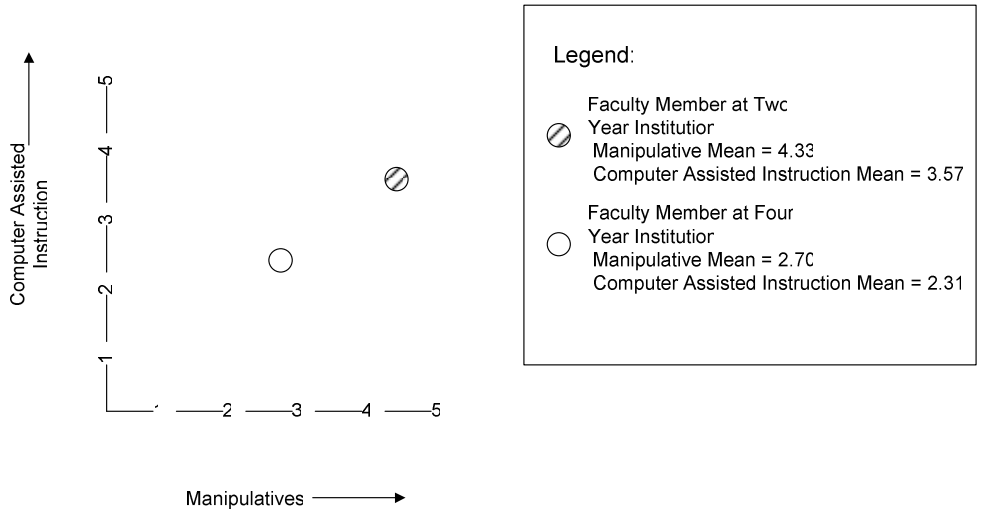

Figure 3. A representation of group membership means for manipulatives and computer assisted instruction for faculty members at two year and four year institutions.

Classification results showed that the original grouped cases were classified with 73.0% overall accuracy. Accuracy for each group was 73.8% for faculty at a two year institution and only 26.2% for faculty at a four year institution. The cross validated results supported original accuracy levels with 73.0% overall correctly classified. Group means for *Hands-On Instructional Techniques* indicated that faculty members who teach at a two year institution had a function mean of 1.068, while those faculty members who teach at a four year institution had a function mean of -0.305 (see Table 22 and Figure 4).

Table 22
Centroid Coefficients – Two Year or Four Year Institution

	Centroid Coefficient
Two Year Institution	1.068
Four Year Institution	-0.305

Figure 4. A representation of centroid coefficients for faculty members who taught at four year institutions and faculty members who taught at two year institutions.

Table 23 shows the correlation coefficients and standardized function coefficients. These results indicated that those faculty members who used manipulatives and computer-assisted instruction most frequently were likely teaching at a two year institution.

Table 23
Correlation Coefficients and Standardized Function Coefficients – Two Year or Four Year Institution

	Correlation Coefficients with Discriminant Function	Standardized Function Coefficients
Manipulatives	0.876	0.779
Computer Assisted Instruction	0.645	0.492

Function Two, Hands-On Instructional Techniques. The second function, $\Lambda = .80$, $\chi^2(2, N = 128) = 27.91$, $p = .000$ indicated that the function of predictors significantly differentiated between faculty members who taught at a college or university. This function yielded 19.6% of the variability explained by college or university. Two variables were entered into the function: Manipulative or laboratory materials and computer-assisted instruction, respectively. The variables of discussion, student reports or projects, library work, students working at the chalkboard, individual assignments, tests or quizzes, simulations, field trips, guest speakers, teacher demonstrations, time spent with entire class, time spent with small groups, and time spent supervising individuals were excluded. The function was labeled *Hands-On Instructional Techniques*. College

(coded as 1) or university (coded as 2) could be predicted and was equal to 2.1 – 0.080 (MANIPULATIVES) – 0.052 (COMPUTER ASSISTED INSTRUCTION), when manipulatives and computer assisted instruction were coded as 1=Never, 2=Less than once a month, 3=At least once a month, 4=At least once a week, 5=Just about daily. Figure 5 shows a graphic representation of group membership means.

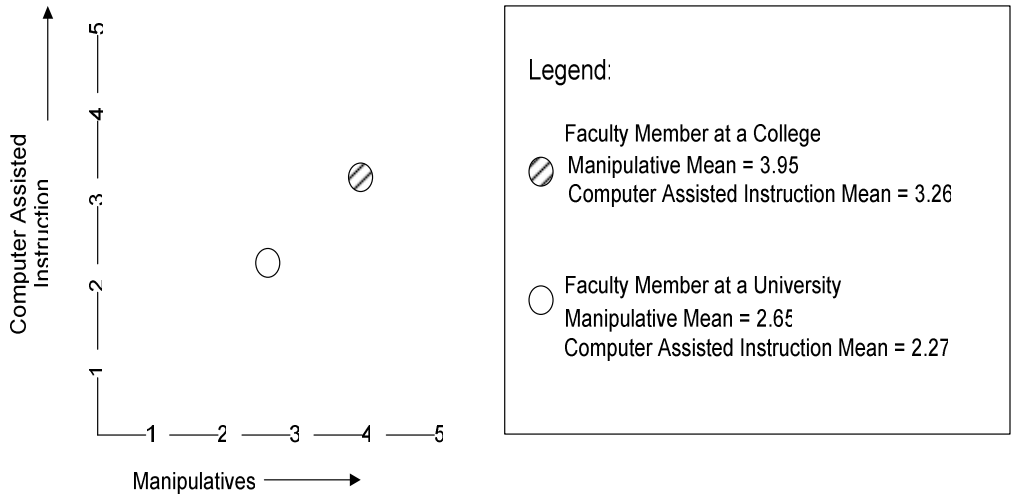

Figure 5. A representation of group membership means for manipulatives and computer assisted instruction for faculty members at colleges and universities.

Classification results showed that the original grouped cases were classified with 68.0% overall accuracy. Accuracy for each group was 68.3% for faculty at a college and only 31.7% for faculty at a university. The cross validated results supported original accuracy levels with 68.0% overall correctly classified. Group means for *Hands-On Instructional Techniques* indicated that faculty members who taught at a college had a function mean of 0.701, while those faculty members who taught at a university had a function mean of -0.342 (see Table 24 and Figure 6).

Table 24
Centroid Coefficients – College or University

	Centroid Coefficient
College	0.701
University	-0.342

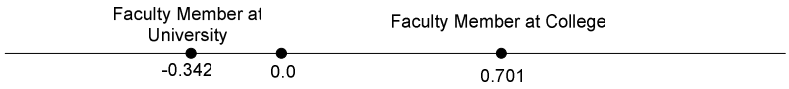

Figure 6. A representation of centroid coefficients for faculty members who taught at colleges and faculty members who taught at universities.

Table 25 shows the correlation coefficients and standardized function coefficients. These results indicated that those faculty members who used manipulatives and computer-assisted instruction most frequently were likely teaching at a college.

Table 25
Correlation Coefficients and Standardized Function Coefficients – College or University

	Correlation Coefficients with Discriminant Function	Standardized Function Coefficients
Manipulatives	0.889	0.776
Computer Assisted Instruction	0.657	0.472

Function Three, Collectivized Instruction. The third function, $\Lambda = .84$, $\chi^2(2, N = 132) = 22.32$, $p = .000$, indicated that the function of predictors significantly differentiated between male and female faculty members. This function yielded only 15.5% of the variability explained by gender. Two variables were entered into the function: Time spent with entire class and student reports or projects, respectively. The variables of discussion, library work, students working at the chalkboard, individual assignments, manipulative or laboratory materials, computer-assisted instruction, tests or quizzes, simulations, field trips, guest speakers, teacher demonstrations, time spent with small groups, and time spent supervising individuals were excluded. The function was

labeled *Collectivized Instruction* to explain differences in how men and women instruct individuals collectively. Gender, when male is coded as 1, and female is coded as 2, could be predicted and was equal to 1.534 – .152 (TIME WITH ENTIRE CLASS) + 0.093 (STUDENT REPORTS), when time with entire class was coded as 1 = 0%-25%, 2 = 26%-50%, 3 = 51%-75% and 4=76%-100%, and student reports was coded as 1=Never, 2=Less than once a month, 3=At least once a month, 4=At least once a week, 5=Just about daily. Figure 7 shows a graphic representation of group membership means.

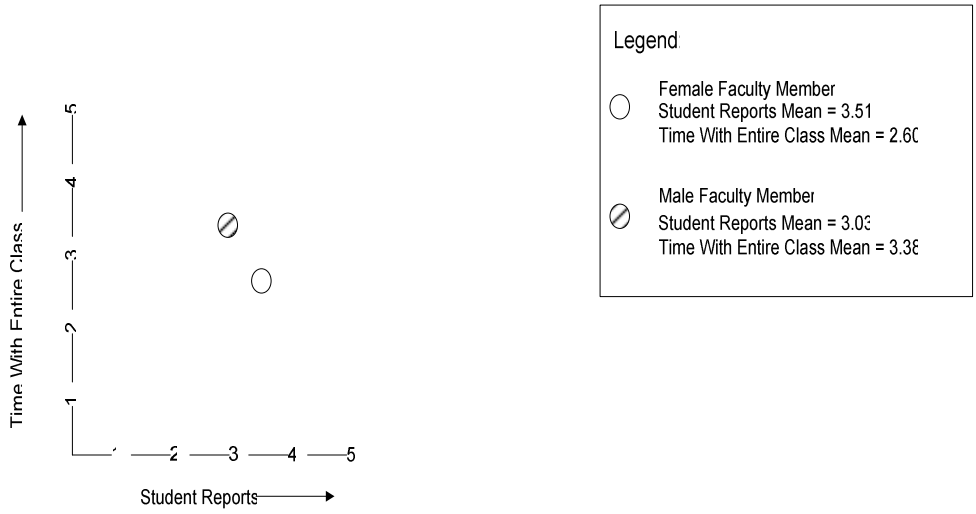

Figure 7. A representation of mean scores for student reports and time with entire class for male and female faculty members.

Classification results showed that the original grouped cases were classified with 68.8% overall accuracy. Accuracy for each group was 71.1% for male faculty and only 28.9% for female faculty. The cross validated results supported original accuracy levels with 68.8.0% overall correctly classified. Group means for *Collectivized Instruction* indicated that male faculty members had a function mean of 0.311, while female faculty members had a function mean of -0.583 (see Table 26 and Figure 8).

Table 26
Centroid Coefficients – Gender

	Centroid Coefficient
Male	0.311
Female	-0.583

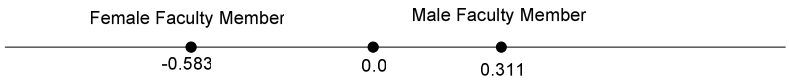

Figure 8. A representation of centroid coefficients for female and male faculty members.

Table 27 shows the correlation coefficients and standardized function coefficients. These results indicated that those faculty members who spent a great deal of time with the entire class as a whole and used student reports or projects least frequently were likely male. These findings support the previous findings obtained from the MANOVA and ANOVA tests detailed earlier in this section.

Table 27
Correlation Coefficients and Standardized Function Coefficients – Gender

	Correlation Coefficients with Discriminant Function	Standardized Function Coefficients
Student Reports	-0.584	-0.464
Time Spent with Entire Class	0.888	0.820

Section III – Development and Techniques – Research Questions Three and Four

Section three describes the analysis of the effects of web-based course development on instructional techniques. First, this section describes the variables outlined in the section. Then, the MANOVA and ANOVA tests conducted are described. Finally, the discriminant analysis test performed is discussed. Research questions three

and four related a number a number of independent and dependant variables (see Tables 30 and 31) and are restated below.

Research Question 3. Do CS and IS faculty members in Missouri who have developed web-based courses and CS and IS faculty members in Missouri who have not developed web-based courses utilize different classroom instructional techniques?

Research Question 4. Does the faculty member's amount of experience in web-based course development influence his or her classroom instructional techniques?

Sub research question 4.1. Among those faculty members who have developed a web-based course, does the number of web-based courses developed influence a faculty member's classroom instructional techniques?

Sub research question 4.2. Among those faculty members who have developed a web-based course, does the amount of time passed since the faculty member first developed a web-based course, in years, influence the faculty member's classroom instructional techniques?

Sub research question 4.3. Among those faculty members who have developed a web-based course, do those who are currently developing a web-based course and those who are not currently developing a web-based course utilize different classroom instructional techniques?

Research questions three and four were considered through the use of the following independent variables; currently developing a web-based course, have developed a web-based course, number of developed web-based courses and time since developed first web-based course (see Table 28).

Table 28
Independent Variables – Research Questions Three and Four

Variable Name	Scale
Currently developing a web course	Nominal
Have developed a web course	Nominal
Number of developed courses	Ratio
Time since developed first web course	Ratio

Instructional techniques were measured by the following group of dependent variables; discussion, student reports, library work, students at chalkboard, individual assignments, manipulatives, computer assisted instruction, tests, simulations, field trips, guest speakers, teacher demonstrations, time spent with entire class, time spent with small groups, and time spent supervising individuals (see Table 29).

Table 29
Dependent Variables – Research Questions Three and Four

Variable Name	Scale
Discussion	Likert (1-5)
Student reports	Likert (1-5)
Library work	Likert (1-5)
Students at chalkboard	Likert (1-5)
Individual assignments	Likert (1-5)
Manipulatives	Likert (1-5)
Computer assisted instruction	Likert (1-5)
Tests	Likert (1-5)
Simulations	Likert (1-5)
Field trips	Likert (1-5)
Guest speakers	Likert (1-5)
Teacher demonstrations	Likert (1-5)
Teacher with entire class	Ratio
Teacher with small groups	Ratio
Teacher supervising individuals	Ratio

MANOVA and ANOVA Tests Performed

Statistically significant differences between and among each group were computed using a one way MANOVA for each of the independent variables. A descriptive discriminant analysis as defined by Stevens (1992) was performed as well.

MANOVA results showed that currently developing a web-based course (Wilk's Λ=.79, $F(15, 118) = 2.04$, p=.018) was the only variable that significantly affected the combined dependent variable of discussion, student reports, library work, students at chalkboard, individual assignments, manipulatives, computer assisted instruction, tests, simulations, field trips, guest speakers, teacher demonstrations, time spent with entire class, time spent with small groups, and time spent supervising individuals. ANOVA tests and a discriminant analysis were preformed only on this variable. A discussion of each test follows.

Univariate ANOVA tests were conducted on currently developing a web-based course as follow-up examinations. The results of these ANOVA tests indicated that individual assignments ($F(1, 133) = 9.98$, $p = .002$)), manipulatives ($F(1, 133) = 12.34$, $p = .001$)), field trips ($F(1, 133) = 5.42$, $p = .021$)) and demonstrations ($F(1, 133) = 14.89$, $p = .000$)) significantly differed for currently developing a web-based course. Discussion ($F(1, 133) = 2.56$, $p = .112$)), student reports ($F(1, 133) = 1.74$, $p = .190$)), library work ($F(1, 133) = 1.50$, $p = .223$)), chalkboard work ($F(1, 133) = .09$, $p = .771$)), computer-assisted instruction ($F(1, 133) = .24$, $p = .627$)), tests or quizzes ($F(1, 133) = 1.52$, $p = .220$)), simulations ($F(1, 133) = .22$, $p = .644$)), guest speakers ($F(1, 133) = .01$, $p = .926$)), time with entire class ($F(1, 133) = 2.71$, $p = .102$)), time with groups ($F(1, 133) = .22$, $p = .642$)) and time with individuals ($F(1, 133) = 3.06$, $p = .083$)) did not significantly differ for currently developing a web-based course. After ANOVA tests were run to determine significance for individual techniques for currently developing a web-based course, *t*-tests were conducted on significant factors in order to further isolate mean scores (see Table 30).

Table 30
Significantly Different Mean Scores for Techniques by Faculty who are Currently Developing a Web-Based Course

Technique	Currently Developing a Web Course			Not Currently Developing a Web Course		
	N	Mean	σ	N	Mean	σ
Individual Assignments	74	3.88	0.921	160	3.50	1.009
Manipulatives	73	3.59	1.363	162	2.70	1.475
Field Trips	74	1.36	0.587	163	1.16	0.443
Demonstrations	74	3.64	1.278	159	2.99	1.255

These analyses revealed that faculty members who were developing a web-based course used several techniques during class significantly more than faculty members who were not currently developing a web-based course. These techniques were individual assignments, manipulatives, field trips and demonstrations.

Discriminant Analysis Performed

A discriminant analysis was conducted to further describe the significant differences found in the MANOVA tests conducted. This descriptive discriminant analysis was done to determine if discussion, student reports or projects, library work, students working at the chalkboard, individual assignments, manipulative or laboratory materials, computer-assisted instruction, tests or quizzes, simulations, field trips, guest speakers, teacher demonstrations, time spent with entire class, time spent with small groups, and time spent supervising individuals could predict whether or not the faculty member was currently developing a web-based course. One function was generated, and was found to be significant.

The function, $\Lambda = .86$, $\chi^2(2, N = 131) = 19.21$, $p = .000$, indicated that the function of predictors significantly differentiated between faculty members were currently developing a web-based course. This function yielded 13.6% of the variability

explained by currently developing a web-based course. Two variables were entered into the function: Individual assignments and teacher demonstrations, respectively. The variables of discussion, student reports or projects, library work, students working at the chalkboard, manipulative or laboratory materials, computer-assisted instruction, tests or quizzes, simulations, field trips, guest speakers, time spent with entire class, time spent with small groups, and time spent supervising individuals were excluded. The function was labeled *Evinced Externalization* to point out how both individual assignments and teacher demonstrations are examples of externalization for the teacher. Currently developing a web-based course (coded as 1) or not currently developing a web-based course (coded as 2) could be predicted and was equal to 2.124 – 0.074(TEACHER DEMONSTRATIONS) – 0.056(INDIVIDUAL ASSIGNMENTS), when teacher demonstrations and individual assignments were coded as 1=Never, 2=Less than once a month, 3=At least once a month, 4=At least once a week, 5=Just about daily. Figure 9 shows a graphic representation of group membership means.

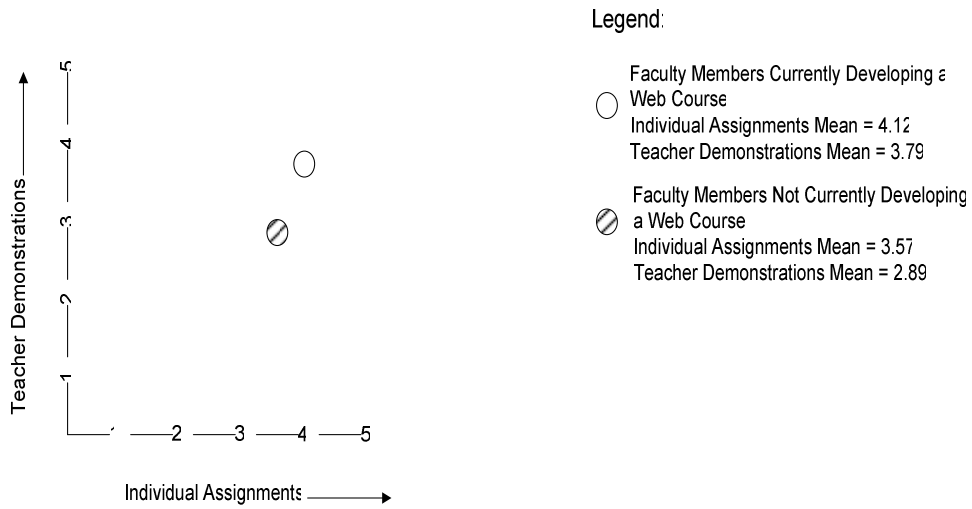

Figure 9. A representation of mean scores for teacher demonstrations and individual assignments faculty members who are currently developing a web course and faculty members who are not currently developing a web course.

Classification results showed that the original grouped cases were classified with 66.5% overall accuracy. Accuracy for each group was 58.9% for faculty who were currently developing a web-based course and 41.1% for faculty who were not currently developing a web-based course. The cross validated results supported original accuracy levels with 66.5% overall correctly classified. Group means for *Evinced Externalization* indicated that faculty members who were currently developing a web-based course had a function mean of 0.574, while those faculty members who were not currently developing a web-based course had a function mean of -0.271 (see Table 31 and Figure 10).

Table 31
Centroid Coefficients – Currently Developing a Web Course

	Centroid Coefficient
Yes	0.574
No	-0.271

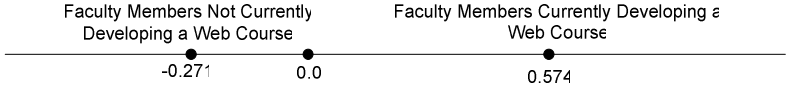

Figure 10. A representation of centroid coefficients for faculty members who were currently developing a web course and faculty members who were not currently developing a web course.

Table 32 shows the correlation coefficients and standardized function coefficients. These results indicated that those faculty members who used individual assignments and teacher demonstrations most frequently were likely developing a web-based course. These findings support the previous findings obtained from the MANOVA and ANOVA tests detailed earlier in this section.

Table 32
Correlation Coefficients and Standardized Function Coefficients – Faculty who are Developing a Web-Based Course

	Correlation Coefficients with Discriminant Function	Standardized Function Coefficients
Individual Assignments	0.692	0.546
Teacher Demonstrations	0.845	0.737

Section IV – Willingness and Instructional Techniques – Research Question Five

Section four describes the examination of the effects of a faculty member's willingness to develop a web-based course on instructional techniques. Research question five was stated as "Among those faculty members who have not developed a web-based course, does willingness to develop a web-based course influence classroom instructional techniques?"

A faculty member's willingness was only considered if the faculty member indicated that he or she had not developed any web-based courses in the past. Instructional techniques were again measured by the following group of dependent variables; discussion, student reports, library work, students at chalkboard, individual assignments, manipulatives, computer assisted instruction, tests, simulations, field trips,

guest speakers, teacher demonstrations, time spent with entire class, time spent with small groups, and time spent supervising individuals. Statistically significant differences between and among each group were computed using a one way MANOVA for the independent variable, defined as willingness to develop a web-based course.

MANOVA and ANOVA Tests Performed

MANOVA results showed that willingness to develop a web-based course (Wilk's Λ=.61, $F(15, 42) = 1.76$, p=.076) did not significantly affect the combined dependent variable of discussion, student reports, library work, students at chalkboard, individual assignments, manipulatives, computer assisted instruction, tests, simulations, field trips, guest speakers, teacher demonstrations, time spent with entire class, time spent with small groups, and time spent supervising individuals.

Summary

The purpose of this study was to investigate how the interaction with web-based course development influences instructional techniques in traditional classroom-based environments. As a part of this purpose, this study surveyed the status of current teaching methods of Computer Science and Information Systems faculty members within traditional classroom-based courses.

A non-experimental, cross-sectional, case study design was used in order to investigate how the interaction with web-based course development influences instructional techniques in traditional classroom-based environments. The population included in this project consisted of 413 full-time CS and IS faculty members employed at public and private, two year and four year higher education institutions in the state of Missouri. Participants were self-selected based on their willingness to participate in the

study, creating a non-probability sample. A return rate of 244 respondents, was found to represent the population with a certainty between 90-95% for the statistical tests performed. Chapter four presented findings in four sections. These findings were obtained from a systematic analysis of data.

Reliability and Descriptive Measures - Research Question One

This section first detailed internal reliability conducted on the items contained in the MTQ. These items were tested using a Cronbach alpha (Cronbach, 1951) and an item-total analysis (Cronk, 1999). The item-total analysis indicated that the dependent variables, lecture and televised instruction, were not correlated with the total. Frequency statistics indicated that lecture was used so often and televised instruction was used so infrequently as to diminish these correlations. These two variables were removed and all remaining items were found to be significantly correlated at greater than 0.3. The Cronbach alpha coefficient was re-calculated at 0.69 after lecture and televised instruction were removed.

Descriptive data were calculated and analyzed with regard to demographics, experience developing web-based courses, and instructional techniques. Demographic variables included faculty rank, tenure status, gender, private or public institution, college or university, two year or four year institution, and total years teaching. Experience developing web-based course was measured with variables including currently developing a web-based course, have developed a web-based course, number of developed web-based courses, time since developed first web-based course and willingness to develop a web-based course. Instructional techniques included lecture, discussion, student reports, library work, students at chalkboard, individual assignments,

manipulatives, televised instruction, computer assisted instruction, tests and quizzes, simulations, field trips, guest speakers, teacher demonstrations, time with entire class, time with small groups and time supervising individuals.

Demographics and Instructional Techniques - Research Question Two

This section reported on the analysis of the effects demographic independent variables had on instructional techniques. A MANOVA showed that two year or four year institution, college or university, and gender significantly affected the defined instructional techniques. Faculty rank, tenure status, private or public institution and total years teaching had no significant affect on instructional techniques. Further analysis was performed on those variables found to significantly affect instructional techniques. Of the defined instructional techniques, discussion, student reports, chalkboard work, individual assignments, manipulatives, computer assisted instruction, simulations, demonstrations and time with entire class were significantly different for faculty at a two year or four year institution. Discussion, student reports, chalkboard work, individual assignments, manipulatives, computer assisted instruction, simulations, field trips, demonstrations and time with entire class were significantly different for faculty at a college or university. Student reports, individual assignments, manipulatives, simulations, time with entire class and time with individuals were significantly different for male and female faculty (see Table 33 for a summary of significant variables in the next section).

After the MANOVA tests were performed, discriminant analyses were also conducted to further describe the significant differences. Three functions were found.

The first function indicated that two predictor variables significantly differentiated between faculty members who taught at a two year or four year institution.

These two variables were manipulative or laboratory materials and computer-assisted instruction. Results indicated that those faculty members who use manipulatives and computer-assisted instruction most frequently are likely teaching at a two year institution.

The second function indicated that two predictor variables significantly differentiated between faculty members who taught at a college or university. These two variables were manipulative or laboratory materials and computer-assisted instruction. These results indicated that those faculty members who use manipulatives and computer-assisted instruction most frequently are likely teaching at a college.

The third function indicated that two predictor variables significantly differentiated between male and female faculty members. These two variables were time spent with entire class and student reports or projects. These results indicated that those faculty members who spend a great deal of time with the entire class as a whole and use student reports or projects least frequently are likely male.

Development and Techniques – Research Questions Three and Four

This section described the analysis of the effects of web-based course development on instructional techniques. Web-based course development was considered through the use of the following independent variables; currently developing a web-based course, have developed a web-based course, number of developed web-based courses and time since developed first web-based course.

MANOVA results showed that currently developing a web-based course was the only variable that significantly affected instructional techniques. ANOVA tests followed to further describe how currently developing a web-based course affected the instructional techniques considered. The results of these ANOVA tests indicated that

individual assignments, manipulatives, field trips and demonstrations significantly differed for faculty members currently developing a web-based course (see Table 33).

Table 33
A Summary of Techniques with Significantly Different Mean Scores by Group

Technique	Two Year or Four Year Institution	College or University	Gender	Currently Developing a Web Course
Discussion	X	X		
Student Reports	X	X	X	
Chalkboard Work	X	X		
Individual Assignments	X	X	X	X
Manipulatives	X	X	X	X
Computer Assisted Instruction	X	X		
Simulations	X	X	X	
Field Trips		X		X
Demonstrations	X	X		X
Time With Entire Class	X	X	X	
Time With Individuals	X		X	

A discriminant analysis was conducted to further describe the significant differences found in the MANOVA tests conducted. One function was found to be significant.

The function indicated that two predictor variables significantly differentiated between faculty who were currently developing a web-based course and faculty who were not. These two variables were individual assignments and teacher demonstrations. These results indicated that those faculty members who use individual assignments and teacher demonstrations most frequently are likely developing a web-based course.

Willingness and Instructional Techniques – Research Question Five

The fifth research question was presented in order to explore whether a faculty member's willingness to develop a web-based course affected his or her instructional techniques. MANOVA results showed that willingness to develop a web-based course did not significantly affect instructional techniques. Because the independent variable

was found to not significantly affect the dependent variable, no further ANOVA tests or discriminant analyses were performed.

The next chapter will investigate the implications these findings hold for faculty members, colleges and universities. An introduction to the chapter will be given and an overview of the study will be provided, along with a review of the research design. Then, findings will be discussed, conclusions will be drawn and recommendations will be given. Finally a chapter summary will be offered.

CHAPTER FIVE

OVERVIEW, FINDINGS AND RECOMMENDATIONS

This study updated the Modified Teacher Questionnaire (MTQ) (Weiss, 1978) for use on the World Wide Web (referred to as "the web" later in this chapter) and examined the externalization of web-based instructional techniques demonstrated in traditional classroom-based settings. This chapter is divided into seven sections. First, an overview of the study is provided. This overview includes a summary of the problem statement, the purpose of the study and the research questions and null hypotheses. Second, the study's research design is summarized. This section discusses the population and sample and the statistical analysis methods used. Third, a discussion of findings is given. Findings are organized similarly to chapter four in that each research question is addressed through the use of four distinct sub-sections delineated by research question. Fourth, a section on *Creating Meaning* is offered as a means to interpret the findings. Fifth, conclusions are drawn. Sixth, recommendations are provided, and seventh, a summary is offered.

Overview

Education, along with society at large, is being reshaped by advances in technology and telecommunications. Colleges and universities must respond to new benefits and pressures as these advances evolve. Chapter two of this study provided a review of the related literature in four key areas. First, the literature indicated that education was the first industry to embrace the web as a way to utilize innovative instructional delivery mechanisms, foster web-based collaboration and focus learning on the student and not the learning environment. Second, the facilitating conditions, along with the social pressures that colleges, universities and faculty members face were

examined and how they press schools to offer web-based courses and experiences to students. Third, both web-based and traditional classroom-based teaching methods were examined. Emphasis was given to ways in which web-based teaching methods differed from traditional classroom-based teaching methods. Fourth, externalization as defined by Nonaka and Takeuchi (1995) was explored, as to how involvement in web-based course design is later demonstrated in traditional classroom-based teaching environments. Very little literature was related to "redefining roles of key participants" (Berge & Mrozowski, 2001, p. 6) in web-based instruction. In fact, no research was found that considered how web-based course development affected an instructor's teaching methods or techniques.

Problem Statement

Recent research has suggested that in order to promote student learning, teachers must use a variety of instructional techniques that actively engage students (Hargreaves, 2003; Bruffee, 1999; Katz & Henry, 1993; Meyers & Jones, 1993; Raths, Wassermann, Jonas, & Rothstein, 1986; Hills, 1979). Additionally, the web has been touted as a method of diversifying instructional techniques (Salomon, 1992). Surprisingly, little research has been done that investigates how experience with web-based courses diversifies a faculty member's instructional techniques (Berge & Mrozowski, 2001). Even as the educational community spends enormous time and money on web-based courses, there is a lack of information as to how the process of developing a web-based course might expand an instructor's instructional techniques, even within their traditional, classroom-based courses.

Purpose of the Study

The purpose of this study was to respond to a lack of information and investigate how the interaction with web-based course development influences instructional techniques even in traditional classroom-based environments. In order to accomplish this primary purpose, this study also surveyed the status of current teaching methods within traditional classroom-based courses. Furthermore, the externalization of web-based instructional techniques was a focal point of this analysis.

Research Questions and Null Hypotheses

Research questions and null hypotheses were developed in order to guide the study. Each is given in turn.

Research question 1. What classroom instructional techniques are reportedly used by Computer Science (CS) and Information Systems (IS) college and university faculty members in the state of Missouri?

Research question 2. Are there relationships or differences among, and between, CS and IS college and university faculty member classroom instructional techniques when grouped by total years teaching, private school or public school, 2 year school or 4 year school, college or university, gender, faculty rank, or tenure status or non-tenure status?

Research question 3. Do CS and IS faculty members in Missouri who have developed web-based courses and CS and IS faculty members in Missouri who have not developed web-based courses utilize different classroom instructional techniques?

Research question 4. Does the faculty member's amount of experience in web-based course development influence his or her classroom instructional techniques?

Sub research question 4.1. Among those faculty members who have developed a web-based course, does the number of web-based courses developed influence a faculty member's classroom instructional techniques?

Sub research question 4.2. Among those faculty members who have developed a web-based course, does the amount of time passed since the faculty member first developed a web-based course, in years, influence the faculty member's classroom instructional techniques?

Sub research question 4.3. Among those faculty members who have developed a web-based course, do those who are currently developing a web-based course and those who are not currently developing a web-based course utilize different classroom instructional techniques?

Research question 5. Among those faculty members who have not developed a web-based course, does willingness to develop a web-based course influence classroom instructional techniques?

H_o1. There are no statistically significant relationships or differences among, and between, CS and IS college and university faculty member classroom instructional techniques when grouped by total years teaching, private school or public school, 2 year school or 4 year school, college or university, gender, faculty rank, or tenure status or non-tenure status.

H_o2. There is no significant difference in classroom instructional techniques between faculty members who have developed web-based courses and those who have not.

H_o3. A faculty member's amount of experience in web-based course development has no significant influence on his or her classroom instructional techniques.

H_o4. Among those faculty members who have not developed a web-based course, the willingness of the faculty member to develop a web-based course does not significantly influence instructional techniques.

Design of the Study

The instrument used in this survey was developed by The Research Triangle Institute for the National Science Foundation Survey of Science, Mathematics, and Social Studies Education (Weiss, 1978) and was updated for use on the web in this study. A quantitative, cross-sectional case study survey research design was used in order to gather and analyze data for appropriate relationships and differences (Ury, 2003; Mertler & Vannatta, 2002; Vogt, 1999; de Vaus, 1995).

Population and Sample

The population in this study included all full-time CS and IS instructors, regardless of rank, at all 2 year and 4 year, public and independent, higher education degree granting institutions in Missouri (Coordinating Board for Higher Education, 2004). The entire population (N=413) was sent an email (see Appendix C) that described the study, along with a clickable hyperlink that directed them to the on-line statement of informed consent (see Appendix B) and corresponding study instrument. The sample

collected was a self-selected sample as defined by Vogt (1999) consisting of all data collected from the instrument.

Statistical Analyses

Because dependent variables were likely to be correlated, a one-way multivariate analysis of variance (MANOVA) was used to control for inter-correlations among dependent variables (Mertler & Vanatta, 2002) for each research question. Additionally, discriminant analyses were considered the reverse process of the MANOVA tests preformed (Tabachnick & Fidell, 1996). This study utilized a discriminant analysis for research questions four and five. The purpose of the discriminant analysis was to classify subjects by independent variables (see Table 34).

Table 34
Summary of analyses used by research questions

Research question	Analysis type	Grouping variable for MANOVA
1	%	None
2	MANOVA	Demographics
3	MANOVA	Have developed
4	MANOVA/Discriminant Analysis	See sub-questions
4.1	MANOVA/Discriminant Analysis	Number of developed courses
4.2	MANOVA/Discriminant Analysis	Time since developed
4.3	MANOVA/Discriminant Analysis	Currently developing
5	MANOVA/Discriminant Analysis	Willing to develop

Discussion of Findings

This section restates research questions and corresponding null hypotheses and summarizes data analyses from Chapter Four. The findings that follow arrived from data analyses outlined previously.

Reliability and Descriptive Measures - Research Question One

Research question one was given as "What classroom instructional techniques are reportedly used by Computer Science (CS) and Information Systems (IS) college and

university faculty members in the state of Missouri?" Due to the fact that this research question simply surveys the current instructional techniques in use, no null hypothesis was offered that corresponded to this research question.

Measured instructional techniques included lecture, discussion, student reports, library work, students at chalkboard, individual assignments, manipulatives, televised instruction, computer assisted instruction, tests and quizzes, simulations, field trips, guest speakers, teacher demonstrations, time with entire class, time with small groups and time supervising individuals. CS and IS instructors were grouped by demographic data and experience developing web-based courses.

Demographic variables included faculty rank, tenure status, gender, private or public institution, college or university, two year or four year institution, and total years teaching. Experience developing web-based course was measured with variables including currently developing a web-based course, have developed a web-based course, number of developed web-based courses, time since developed first web-based course and willingness to develop a web-based course.

In agreement with current literature, lecture was reportedly used more frequently than any other method with over 90% of respondents using lecture "just about daily" or "at least once a week." This high frequency of reported use may have accounted for lecture being uncorrelated with the other indicators and therefore an unreliable indicator of instructional techniques. Discussion was the second most-frequently used instructional technique with three-fourths of respondents using discussion "just about daily" or "at least once a week." Field trips were used less frequently than any other reported

technique with under 3% of respondents using field trips "just about daily" or "at least once a week" (see Table 15 on page 54).

Respondents were also asked to delineate how they spent time in their most recent class. Three categories were offered. These categories were working with the entire class, working with small groups, and working with individuals. Nearly one-half of the respondents indicated working with the entire class for 76% - 100% of the time. Around 2% of respondents indicated working with small groups for 76% - 100% of the time, and about 4% of respondents indicated working with individuals for 76% - 100% of the time.

Demographics and Instructional Techniques - Research Question Two

Research question one was given as "Are there relationships or differences among, and between, CS and IS college and university faculty member classroom instructional techniques when grouped by total years teaching, private school or public school, 2 year school or 4 year school, college or university, gender, faculty rank, or tenure status or non-tenure status?" Null hypothesis one was given as "There are no statistically significant relationships or differences among, and between, CS and IS college and university faculty member classroom instructional techniques when grouped by total years teaching, private school or public school, 2 year school or 4 year school, college or university, male or female, faculty rank, or tenure status or non-tenure status." Based on the findings summarized below, null hypothesis one was rejected.

MANOVA analyses showed that gender and type of institution, specifically two year or four year institution, and college or university, significantly affected the defined instructional techniques. Faculty rank, tenure status, private or public institution and total years teaching had no significant affect on instructional techniques. Of the defined

instructional techniques, discussion, student reports, chalkboard work, individual assignments, manipulatives, computer assisted instruction, simulations, demonstrations and time with entire class were significantly different for faculty members at a two year institution and faculty members at a four year institution (see Table 19 on page 59). Discussion, student reports, chalkboard work, individual assignments, manipulatives, computer assisted instruction, simulations, field trips, demonstrations and time with entire class were significantly different for faculty members at a college and faculty members at a university (see Table 20 on page 61). Student reports, individual assignments, manipulatives, simulations, time with entire class and time with individuals were significantly different for male and female faculty members (see Table 21 on page 62).

After the MANOVA tests were performed, discriminant analyses were also conducted to further describe the significant differences. Three functions were found.

The first function indicated that two predictor variables significantly differentiated between faculty members who taught at a two year institution and faculty members who taught at a four year institution. These two variables were manipulative or laboratory materials and computer-assisted instruction. Results indicated that those faculty members who use manipulatives and computer-assisted instruction most frequently are likely teaching at a two year institution.

The second function indicated that two predictor variables significantly differentiated between faculty members who taught at a college and faculty members who taught at a university. These two variables were manipulative or laboratory materials and computer-assisted instruction. These results indicated that those faculty members

who use manipulatives and computer-assisted instruction most frequently are likely teaching at a college.

The third function indicated that two predictor variables significantly differentiated between male and female faculty members. These two variables were time spent with entire class and student reports or projects. These results indicated that those faculty members who spend a great deal of time with the entire class as a whole and use student reports or projects least frequently are likely male.

Development and Techniques – Research Questions Three and Four

Research questions three and four along with corresponding null hypotheses two and three are given below in the form of subsections. These subsections outline the multiple parts of these research questions and null hypotheses.

Research question 3. Do CS and IS faculty members in Missouri who have developed web-based courses and CS and IS faculty members in Missouri who have not developed web-based courses utilize different classroom instructional techniques?

Null hypothesis 2. There is no significant difference in classroom instructional techniques between faculty members who have developed web-based courses and those who have not. Based on the findings summarized below, null hypothesis two was not rejected.

Research question 4. Does the faculty member's amount of experience in web-based course development influence his or her classroom instructional techniques?

Sub research question 4.1. Among those faculty members who have developed a web-based course, does the number of web-based courses developed influence a faculty member's classroom instructional techniques?

Sub research question 4.2. Among those faculty members who have developed a web-based course, does the amount of time passed since the faculty member first developed a web-based course, in years, influence the faculty member's classroom instructional techniques?

Sub research question 4.3. Among those faculty members who have developed a web-based course, do those who are currently developing a web-based course and those who are not currently developing a web-based course utilize different classroom instructional techniques?

Null hypothesis 3. A faculty member's amount of experience in web-based course development has no significant influence on his or her classroom instructional techniques. Based on the findings summarized below, null hypothesis three was rejected.

MANOVA results showed that currently developing a web-based course was the only variable that significantly affected instructional techniques. ANOVA tests followed to further describe how currently developing a web-based course affected the instructional techniques considered. The results of these ANOVA tests indicated that the use of individual assignments, manipulatives, field trips and demonstrations was significantly higher for faculty members currently developing a web-based course than those faculty members who were not developing a web-based course (see Table 30 on page 73).

A discriminant analysis was conducted to further describe the significant differences found in the MANOVA tests conducted. One function was found to be significant.

The function indicated that two predictor variables significantly differentiated between faculty who were currently developing a web-based course and faculty who were not. These two variables were individual assignments and teacher demonstrations. These results indicated that those faculty members who used individual assignments and teacher demonstrations most frequently are likely developing a web-based course.

Based on these findings, null hypothesis two was not rejected. No significant difference in classroom instructional techniques was found between CS and IS faculty members in Missouri who have developed web-based courses and CS and IS faculty members in Missouri who have not developed web-based courses. However, null hypothesis three was rejected due to the fact that those faculty members who were currently developing a web-based course utilized significantly different classroom instructional techniques than those who were not developing a web-based course. No other type of web-based course development experience was found to influence classroom instructional techniques.

Willingness and Instructional Techniques – Research Question Five

Research question five was given as "Among those faculty members who have not developed a web-based course, does willingness to develop a web-based course influence classroom instructional techniques?" Null hypothesis four was given as "Among those faculty members who have not developed a web-based course, the willingness of the faculty member to develop a web-based course does not significantly influence instructional techniques." Null hypothesis four was not rejected based on the findings summarized below.

The fifth research question was presented in order to explore whether a faculty member's willingness to develop a web-based course affected his or her instructional techniques. MANOVA results showed that willingness to develop a web-based course did not significantly affect instructional techniques. Because the independent variable was found to not significantly affect the dependent variable, no further ANOVA tests or discriminant analyses were performed.

Creating Meaning

This study demonstrated four distinct phenomena while looking at the instructional techniques of CS and IS faculty members. Three of these phenomena were related to characteristics of instructional techniques demonstrated by three demographic groups. These three demographic groups were faculty members from colleges as compared to faculty members from universities, faculty members from two year institutions as compared to faculty members from four year institutions and male faculty members when compared to female faculty members. The term "one to many" was used to describe instructional techniques where one faculty member interacted simultaneously with many students. This "one to many" description is traditionally a term used to describe a similar database relationship where one database entity of a specific type interacts with many entities of a different type (Elmasri & Navathe, 2004; Kroenke, 2004).

This research found "one to many" instructional techniques entrenched more deeply by male faculty members, at four year institutions and institutions who identify themselves as universities. Examples of these techniques include lecture, entire classroom discussion and tests or quizzes. Further study will be recommended in the

Recommendations section of this chapter (see page 99) in order to more fully focus on these separate phenomena that this research brought to light. In order to fully understand these three phenomena, suitable theoretical lenses should be used to direct and interpret any subsequent results.

The fourth phenomenon revealed that faculty members who were currently developing a web-based course used more diverse instructional techniques than those faculty members who were not developing a web-based course. This observation can be better understood by using Nonaka and Takeuchi's (1995) knowledge spiral, which was defined as the theoretical lens for this study. This study identified both the act of teaching a traditional classroom based course long with the act of developing a web-based course as externalization. By viewing these activities as externalization we can conclude that while a faculty member was externalizing in one way, externalization in another was modified. We can also conclude that once the externalization of developing a web-based course was complete, faculty members returned to familiar patterns of externalizing instructional techniques that were also used by those currently uninvolved in web-based course development. More specifically, once web-based course development was complete for faculty members, they returned to this familiar center where they used individual assignments, manipulatives, field trips and teacher demonstrations less frequently. This study identified this phenomenon as a "return to center" dynamic. When original values for individual assignments, manipulatives, field trips and teacher demonstrations are normalized, this dynamic can be examined more closely.

Faculty members were asked to identify how often they used individual assignments, manipulatives, field trips and teacher demonstrations on a scale of one to

five. On average, faculty members who were externalizing by developing a web-based course indicated using individual assignments more often by .38, manipulatives more often by .89, field trips more often by .20 and teacher demonstrations more often by .65. However, faculty who had previously developed web-based courses, but were not currently developing a web-based course had returned to the normalized scores for each of the four variables (see Figure 11).

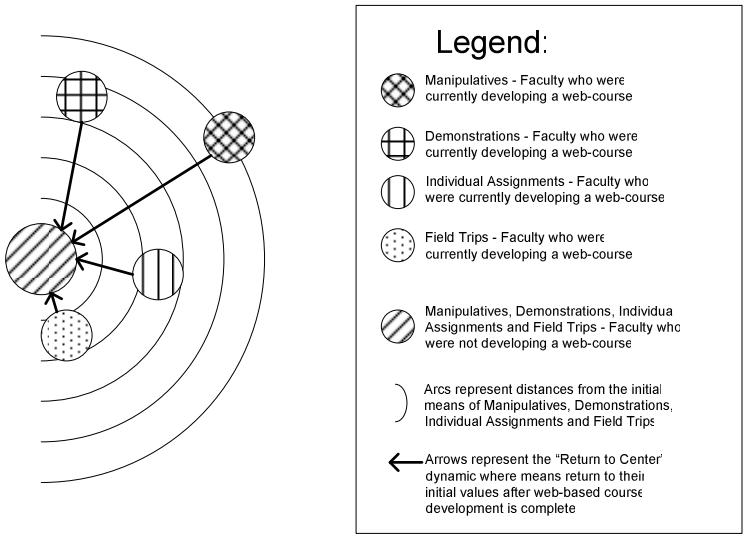

Figure 11. The return to center dynamic.

Conclusions

New knowledge was obtained from the findings in this study and the subsequent rejections of null hypotheses one and three. This new knowledge affords the ability to suggest the following conclusions.

1. The Modified Teacher Questionnaire (MTQ) is a reliable tool that can be used on the World Wide Web to collect instructional techniques of CS and IS faculty members. The MTQ, however, cannot be used to reliably assess lecture or televised instruction as a component of instructional techniques.

2. Lecture and “one to many” instructional paradigms continue to prevail at higher education institutions. This study confirmed research conducted by Freiberg and Driscoll (2000) indicating that most instruction was done for the entire class as a group with little individual interaction between faculty members and students.
3. Universities are more dependent on these “one to many” traditional teaching techniques than colleges. This might be because colleges, especially those offering only two year programs, are more responsive to the facilitating conditions and pressures that web-based teaching imposes than their four year and university counterparts. As indicated in the *Creating Meaning* section of this chapter, “one to many” is traditionally a term used to describe a database relationship where one database entity of a specific type interacts with many entities of a different type (Elmasri & Navathe, 2004; Kroenke, 2004). This research uses "one to many" to describe a similar behavior where one faculty member interacts simultaneously with many students. Examples include lecture, entire classroom discussion and tests or quizzes.
4. Female CS and IS faculty members were open to the development of hands-on activities for students. Traditional teaching models are more entrenched in male teachers.
5. Web-based course development has been adopted by many faculty members, but faculty members who were seasoned with a large amount of experience were rare.

6. Past web-based course design experience had little influence on classroom instructional methods. Other items, such as type of institution, gender and current web-based course design experience had greater influence on instructional methods.
7. This study illustrated a "return to center" dynamic, whereby externalization of web-based instructional techniques was illustrated, but only while a faculty member developed a web-based course and not afterwards. "Return to center" describes a behavior whereby faculty members' instructional techniques come back to their original postures after web-based course development is complete. This study looked only at the process of externalization, but showed that a breakdown in the knowledge creation spiral (Nonaka and Takeuchi, 1995) existed somewhere in the combination, internalization or socialization quadrants.

Recommendations

As is certain for any research project, when some questions are answered, still more become apparent. Based on the findings and conclusions made in this study, the following recommendations are offered for further study.

1. Further refinement of the MTQ should take place so that lecture can be included in the various instructional techniques reliably measured.
2. Replication of this study using differing populations (i.e., English faculty members or Education faculty members) should be performed in order to discover how faculty members in various disciplines utilize web-based instructional techniques.

3. Colleges and universities should locate and adopt models that encourage faculty members to diversify teaching methods and interact more directly with students in individual and small group settings.
4. More research should confirm and investigate why gender, teaching at a college or university, and teaching at a two year or a four year institution influence instructional techniques.
5. Research should continue regarding the influence of web based course development on instructional techniques using different theoretical lenses (i.e., learning theory or change theory).
6. More research should be focused on Nonaka and Takeuchi's (1995) knowledge creation spiral as a lens to view colleges and universities. Specifically, the breakdown of knowledge creation in internalization, combination or socialization should be addressed.

Summary

Since 1990, the educational landscape has been shifting due to advances in web-based technology and telecommunications. Colleges and universities are responding in different ways to new benefits and pressures as these advances evolve. This study updated and utilized the MTQ in order to examine the externalization of web-based instructional techniques as demonstrated in traditional classroom-based settings. This chapter was divided into six sections. First, an overview of the study was provided. This overview included a summary of the problem statement, the purpose of the study and the research questions and null hypotheses. Second, a review of the research design was provided. This section summarized the study as a quantitative, cross-sectional case study

survey research design. The MANOVA and discriminant analysis were used in order to analyze the data acquired. Third, a discussion of findings was provided. Findings were organized such that each research question and null hypothesis was addressed through the use of distinct sub-sections. Two null hypotheses were rejected and two null hypotheses were not rejected. Findings indicated that the independent variables two year or four year institution, college or university, gender and currently developing a web-course significantly influenced a faculty member's instructional techniques. Fourth, conclusions were given and finally recommendations were provided. These conclusions and recommendations challenged institutions, faculty members and researchers to diversify instructional methods, increase student-faculty interaction during class-time and more fully study how knowledge creation at higher education institutions relates to experiences gained from developing web-based courses.

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Appendix A

The Modified Teacher Questionnaire

Thank you for your participation in this survey. If you have questions, please contact Douglas Hawley at hawleyd@william.jewell.edu

This survey has three sections. Please complete each section before submitting form.

Section 1: Personal information

Please indicate your tenure status. ○ Tenure ○ Non-tenure

Please indicate your faculty rank. Please specify

Please indicate the number of years that you have been teaching.

Please indicate your gender. ○ Female ○ Male

Do you teach at a private or public institution? ○ Private ○ Public

Do you teach at a college or university? ○ College ○ University

Do you teach at a two-year, or four-year degree granting institution? ○ Two Year ○ Four Year

Are you currently in the process of developing a web-based course? ○ Yes ○ No

Have you developed at least one web-based course in the past? ○ Yes ○ No

Section 2: Your teaching

The following questions relate to one of your classroom-based courses. A classroom-based course is a course where the instructor and all students enrolled in the course meet regularly on campus in a specific building and room.

Do not respond to the following questions related to a course you teach where some class meetings are held on-line.

When answering the following questions, consider only one course you teach.

How often do you use each of the following techniques in teaching to the class? If a technique does not apply to your class, please select 1, "Never."

	Never	Less Than Once A Month	At Least Once A Month	At Least Once A Week	Just About Daily
Lecture	1	2	3	4	5
Discussion	1	2	3	4	5
Student reports or projects	1	2	3	4	5
Library work	1	2	3	4	5
Students working at chalkboard	1	2	3	4	5
Individual assignments	1	2	3	4	5
Students use hands-on manipulative or laboratory materials	1	2	3	4	5
Televised instruction	1	2	3	4	5
Computer-assisted instruction	1	2	3	4	5
Test or quizzes	1	2	3	4	5
Simulations (role-play, debates, panels)	1	2	3	4	5
Field trips, excursions	1	2	3	4	5
Guest speakers	1	2	3	4	5
Teacher demonstrations	1	2	3	4	5

Section 3: Your most recent lesson in this class.

Please answer the following questions specific to your most recent lesson in this class. Do not be concerned if this lesson was not typical of instruction in this class.

How many minutes did a typical student spend in class (including teacher-led instruction as well as small-group and individual work) during your most recent lesson in this class? ☐ minutes

Did that lesson take place on the most recent day your school was in session? ◯ Yes ◯ No

Approximately how many of the minutes in that lesson were spent in each of the following general instructional arrangements?

	Number of Minutes
The teacher working with the entire class as a group (e.g. lecture, test, etc.).....	☐
The teacher working with small groups of students	☐
The teacher supervising students working on individual activities.....	☐

Submit Results

Thank you for participating in this survey. You cooperation is appreciated.

Questionnaire Notes:

When the question "Have you developed at least one web-based course in the past?" is checked "Yes", the following questions appear.

How many web-based courses have you developed in the past? ☐

How long (in months) has it been since you developed your first web-based course? ☐

Otherwise, if the same question is checked "No" the question below appears.

Would you be willing to develop a web-based course? ◯ Yes ◯ No

Appendix B
Copied from http://study.skyspan.cc/informedConsent

Statement of Informed Consent

Thank you for participating in this study of web-based course development for the University of Missouri. This study is being conducted as a doctoral dissertation and results may be published in the future. I am using this survey to find out what classroom instructional techniques are reportedly used by Computer Science (CS) and Information Systems (IS) college and university faculty members in the state of Missouri. Furthermore, I am interested in relationships and differences in CS and IS college and university faculty member classroom instructional techniques when grouped by total years teaching, private school vs. public school, 2 year school vs. 4 year school, college vs. university, male vs. female, faculty rank, tenure status vs. non-tenure status, and experience in web-based course development. The questionnaire will take approximately 10-15 minutes to complete and submit via the World Wide Web.

- **Participation in this study is completely voluntary**.
  You may withdraw from participation at any time you wish, including in the middle of the questionnaire or after it is completed. You may choose not to answer any single question or group of questions if you choose. If you decide at a later time that you do not want me to use your questionnaire in my study, I will respect and adhere to your decision.

- **Your identity and the identity of your organization will be protected in reporting of my findings**.
  I will use a code or pseudonym rather than your real name or the name of your institution in my report. Even if your name or the name of your institution appears in public records of events in my study, I will use a code or pseudonym throughout the reporting.

- **You may contact the researcher**.
  Douglas Hawley, by phone at 816-415-7678 or by e-mail at hawleyd@william.jewell.edu

- **You may contact the researcher's faculty advisor.**
  Dr. Phillip E. Messner, by phone at 660 562-1478 or by e-mail at pemday@mail.nwmissouri.edu.

- **For additional information regarding human participation in research**
  please feel free to contact the UMC Campus IRB Office at 573-882-9585.

If at this point you are still interested in participating, please submit the consent form below. Print this web page for future reference. Thank you for your time and consideration.
Sincerely,
Douglas Hawley

By clicking the button below, I agree to participate in the study of web-based course development for the University of Missouri. I understand that this questionnaire will be grouped with similar data for use in a doctoral dissertation that will include printed reports and published materials, my participation is completely voluntary, I may withdraw my participation at any point in the study, and my identity and the identity of my organization will be protected in reporting of the findings.

Appendix C
Correspondence with Subjects

Sent April 27th, 2004 to all 413 subjects.

I am conducting research for a dissertation as partial fulfillment of my doctoral degree through the University of Missouri. My dissertation is entitled "The Influence of Developing a Web-based Course on University Professor Classroom Instructional Techniques as Measured by the MTQ" and requires that I collect data from a group of Computer Science and Information Systems Professors.

I would appreciate it if you could take a few minutes to complete the survey linked to this message. The survey contains 30 questions and will take you approximately 10-15 minutes to complete. All responses will be kept strictly confidential and no school or individual will be named in this study.

It is not anticipated that you will personally experience any benefits or risks by this study, and you will not be personally rewarded in any way by participating in this research. You will, however, be contributing to research related to the field of Computer Science and Information Systems and will be assisting me in my completion of this dissertation.

Your cooperation in this research is completely voluntary. You may withdraw your consent at any time and discontinue participation.

Please let me know if you have questions, and feel free to contact me at any time. You may also contact my principle advisor, Dr. Phillip Messner at (660) 562-1478. For questions about your rights as a study participant, contact the University of Missouri Institutional Review Board at (572) 882-9585.

Your timeliness in completing the consent form, and questionnaire is greatly appreciated. Please follow the link below (by copying and pasting into your browser) to complete the informed consent document and subsequent questionnaire.

http://study.skyspan.cc/webform/informedConsent.aspx?page=88482

Thank you for your time.

Douglas D. Hawley
(660)652-3437 (home)
(816)415-7678 (work)
hawleyd@william.jewell.edu (email)

Sent April 29th, 2004 to 277 remaining subjects.

Dr. <Lastname>,

Tuesday I sent you a message asking you to participate in dissertation research. If you had trouble opening the link to the questionnaire, you may use the one given below:

http://study.skyspan.cc/webform/informedConsent.aspx?page=88482

Please let me know if you have questions. Sorry for the inconvenience.

Douglas Hawley
Assistant Professor of Computer Science
William Jewell College
(816)419-7678
hawleyd@william.jewell.edu

Sent May 4th, 2004 to 209 remaining subjects.

Dr. <Lastname>,

I realize that you are busy this time of year. At this point, I still do not have enough responses from my previous mailing to analyze data and complete the dissertation.

Before you leave for the summer, if you could spend 10 minutes (maybe 5 if you are a quick reader) and complete the survey located at the following hyperlink, it would be very much appreciated.

http://study.skyspan.cc/webform/informedConsent.aspx?page=88482

Thanks so much. Your cooperation is truly valued.

Douglas Hawley
Assistant Professor of Computer Science
William Jewell College
hawleyd@william.jewell.edu

Sent August 19th, 2004 to 182 remaining subjects.

I hope you had a great summer! Last April I sent you a message inviting you to help me with some research I am doing for my dissertation.

If you could quickly complete the survey located at the following hyperlink, it would be very much appreciated. If the survey takes longer than 10 minutes, please feel free to discontinue.

http://study.skyspan.cc/webform/informedConsent.aspx?page=88482

I realize that your time is valuable and would not ask unless it was extremely important. Thanks so much for your time.

Appendix D

Schools Used in the Study

All full-time Computer Science and Information Systems instructors, regardless of rank at the following schools were contacted for participation in this study.

Schools were identified by the Missouri Coordinating Board for Higher Education

Public Institutions

Central Missouri State University, 4-year
Crowder College, 2-year
East Central College, 2-year
Harris-Stowe State College, 4-year
Jefferson College, 2-year
Lincoln University, 4-year
Linn State Technical College. 2-year
Metropolitan Community Colleges, 2-year
  Blue River Community College
  Longview Community College
  Maple Woods Community College
  Penn Valley Community College
Mineral Area College, 2-year
Missouri Southern State University - Joplin, 4-year
Missouri Western State College, 4-year
Moberly Area Community College, 2-year
North Central Missouri College, 2-yeaar
Northwest Missouri State University, 4-year
Ozarks Technical Community College, 2-year
Southeast Missouri State University, 4-year
Southwest Missouri State University, 4-year
Southwest Missouri State University-West Plains, 4-year
St. Charles Community College, 2-year
St. Louis Community College System, 2-year
  Florissant Valley
  Forest Park
  Meramec
State Fair Community College, 2-year
Three Rivers Community College, 2-year
Truman State University, 4-year
University of Missouri System, 4-year
  University of Missouri-Columbia, 4-year
  University of Missouri-Kansas City, 4-year
  University of Missouri-Rolla, 4-year
  University of Missouri-St. Louis, 4-year

Independent Institutions

A. T. Still University of Health Sciences
Aquinas Institute of Theology
Assemblies of God Theological Seminary
Avila University
Baptist Bible College
Calvary Bible College
Central Bible College
Central Christian College of the Bible
Central Methodist College

Cleveland Chiropractic College
College of the Ozarks
Columbia College
Conception Seminary College
Concordia Seminary
Cottey College, two-year
Covenant Theological Seminary
Culver-Stockton College
Drury University
Eden Theological Seminary
Evangel University
Fontbonne College
Hannibal-LaGrange College
Jewish Hospital College of Nursing and Allied Health
Kansas City Art Institute
Kenrick-Glennon Seminary
Lester L. Cox College of Nursing and Health Sciences
Lindenwood University
Logan University
Maryville University of Saint Louis
Midwest Theological Seminary
Midwestern Baptist Theological Seminary
Missouri Baptist University
Missouri Valley College
Nazarene Theological Seminary
Park University
Rockhurst University
Saint Louis Christian College
Saint Louis College of Pharmacy
Saint Louis University
Saint Paul School of Theology
Southeast Missouri Hospital College of Nursing
Southwest Baptist University
Stephens College
University of Health Sciences College of Osteopathic Medicine (The)
Washington University
Webster University
Wentworth Military Academy & Junior College, Two-year
Westminster College
William Jewell College
William Woods University

VITA

Douglas Dean Hawley was born in Maryville, MO on July 31, 1969. He attended South Nodaway public school in Barnard, MO and received his B.A. in Mathematics and Education in May, 1991. He completed his M.S. in Computer Science with an emphasis in Networking and Telecommunications from the University of Missouri, Kansas City in August, 2000 and his Ed. D. in Educational Leadership and Policy Analysis from the University of Missouri in Columbia, in May 2005. Currently, he is an Assistant Professor of Computer Science at William Jewell College in Liberty, MO. He is married to Lillian Kathryn (Williams) Hawley and has two daughters; Darell Dean Hawley, and Brooklyn Phelps Hawley.