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Technology Integration Barriers in a Technology-Rich Environment: A CBAM Perspective

by

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled “Technology Integration Barriers in a Technology-Rich Environment: A CBAM Perspective” submitted by Kevin Wayne Schoepp in partial fulfillment of the requirements for the degree of Master of Arts.

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ABSTRACT

This research attempts to describe the relationships between barriers to technology integration and the behavioral, affective, and temporal constructs in a technology-rich environment. A technology-rich environment is one in which both faculty and students have unfettered access to technology, primarily computer hardware and software.

The study uses three established tools to measure these associations. Barriers are evaluated using a modified version of a perception of barriers instrument designed by Hadley and Sheingold (1993). The two other major measures have been developed out of Concerns Based Adoption Model (Hall, Wallace, & Dossett, 1973). The behavioral aspect uses the Technology Implementation Standards Configuration Matrix designed by Mills (2002), while the affective aspect uses the Stages of Concern Questionnaire (Hall, George, & Rutherford, 1986). The temporal aspect is measured through a simple question probing the length of time one has taught within a technology-rich environment.

The results of this investigation indicate that barriers are indeed perceived differently in a technology-rich environment, and that a number of relationships do exist between the aforementioned constructs.

PREFACE

My interest in computer technology is a rather new development. The newness of this development is key to my current thesis because it emphasizes the rapid change that has occurred in computer technology over the past 5 or 6 years. In addition, as my attitude towards teaching with technology changed, in coordination with the technology, so did my perception of barriers.

My first real interactions with computers occurred in high school in 1986. I took an introductory computer course and absolutely abhorred the course. It was never anything more than punching keys on a keyboard as was directed by sets of worksheets. To this day I still wonder what I was supposed to be achieving in that course. Whatever it was, it did not happen. In fact, it probably dulled my interest in computers for a number of years.

My next interaction with computers came in my introductory computer course my first year of university. Again I have no idea of what I was to have accomplished in that course, so not surprisingly, I accomplished very little. As I reflect, I remember that it was pre- Windows 3.1 operating system and everything we did seemed like Greek to me. It seemed nothing more than following instructions in order to make the computer do something. What that something was or how it would be of value to me in my future endeavors was never made clear. I had developed a fairly negative attitude towards computers in education because of these first two experiences. This negative attitude was the first barrier that I needed to overcome before I could recognize the value of integrating technology into teaching and learning.

The spread of the graphical user interface began to change the way I looked at computers. As I progressed through my degree program, I began to see the value of the computer as a glorified typewriter. We got our first computer at home, and I used it to word process. I remember being confused with the terminology that was being used at the time. As with most beginners, I did not understand the difference between the Microsoft Windows operating system and the Microsoft Word application; to me they were both just Windows. I was beginning to see the value in a computer, but in my mind it was not yet worth much of an investment. The computer at home was upgraded, and my skills on it increased, but it was not something with which I was really comfortable yet. The first few years after graduating, my computer use was very limited, and I did not own one at home.

The next time that a computer impacted my life was an experience that I will never forget. At the start of the school year, I received a phone call from a principal concerning a teaching position that had just opened up in her school. The initial offer included teaching some computer classes to the junior high students. I was not comfortable with teaching the computer classes, so they made some adjustments in the scheduling and offered me a position free of computer classes which I accepted. Even though I was offered a position, I remember thinking that I should never again allow my lack of computer skills prevent me from taking a teaching position. However, I never really did anything about it. A change in my attitude was occurring, and a barrier was being overcome. I was beginning to see how computers could affect me personally, but I did not yet recognize their importance in my teaching.

The next year I began to hear about the Internet, but it was still not something into which I would invest too much time. I would occasionally surf the Internet, and I had set up an email account, but that was where my interaction had ended. I then accepted an English teaching position in Bangkok, Thailand, my second foray into teaching English abroad, and this is where I began to recognize the benefits of computers to educators. In my previous experience teaching English abroad, the students were completely reliant on the teacher as their only source of English, either as themselves or through the use of the odd English newspaper or magazine. The graphical World Wide Web changed that forever. Its introduction into my life was a eureka moment. I realized that students now had access to more information than was ever thought possible before. I knew that this had to have an affect on teaching. My initial attitudinal barriers had been overcome, and I now wanted to learn about integrating technology into my teaching. However, other more concrete barriers remained. Although the school at which I taught in Bangkok had a computer lab, there was no Internet connection. I tried to persuade the administration that Internet access could be of great value to the students, but the connection never came. This was my first real experience with a lack of resources acting as a barrier.

Upon returning from Thailand, I decided to enroll in a Masters program in Teaching English as a Second Language (TESL). This was the first time that I had my own computer. A computer along with Internet access was something that I could no longer live without. They became integral parts of my teaching and learning. During this degree program, I wanted to be able to create my own web site, so I took a 3 hour HTML course at the university and had my own web site up complete with a CV and personal section later the next day. With this experience, I was off and running. Later that term, I offered to redesign the TESL department web site and was given the opportunity. I continued to work on web design because I viewed the web as something that would change our world, and I wanted to be part of it.

Following graduation, I accepted a teaching position in Istanbul, Turkey, at a new university with a laptop program. This meant that all faculty and students were provided with computers. Clearly, my web design skills and the way I spoke of the importance of technology in education helped to get me the position. Although, the experience at this institution was fraught with the difficulties associated with starting a new university, working in a brand new technology-rich environment provided a tremendous opportunity. For example, I was able to become a technology leader because of my interests and skills. It was hard not to get caught up in the impact of technology because it was all around us. For the first year we had laptops, digital projectors, and high speed Internet, but little else in terms of technology or educational software. We were expected to integrate technology into the curriculum that was being designed as we went, but were given little other guidance. Overall, teachers did an adequate job of finding and sharing ways to integrate technology into the learning. The lack of educational software actually forced teachers to come up with ways to integrate the technology into the learning. However, the quality of the integration of technology into the teaching and learning did vary greatly from teacher to teacher. By the second year, software had arrived and WebCT was in use, but the use of technology remained rather haphazard although it was increasing. This initial foray into a technology-rich environment was somewhat disappointing because of the limited progress that was made regarding teaching with technology. Though the barrier of limited access had been removed, there were obviously a number of barriers still present that were preventing faculty from integrating technology into their teaching. It was at this time that I decided that there must be a better way to go about integrating technology into teaching and learning, so I decided to return to graduate school to learn more.

In the Educational Technology program, barriers to technology integration remained the area of most interest to me because of my previous experiences. In particular, I was interested in the perception of barriers in an environment where lack of access had been removed. A technology-rich environment removes some of the common barriers to technology integration that are often cited. Hence, such an environment is a prime location to research whether or not technology will simply diffuse through teaching over time or if it is a complex process which can be accelerated through identifying the relationships between key variables such as barriers in order to guide future technology planning and professional development opportunities. These main ideas have helped guide this research.

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Chapter One

INTRODUCTION

In comparison to one of the foundations of education, the textbook, computer-based technology-- henceforth referred to as technology-- has made astonishing strides in a comparatively minute period of time. It took nearly 500 years from the invention of Gutenberg's printing press until textbooks achieved their current level of vast permissiveness. However, technology, if we go as far back as the advent of the personal computer, has gained fairly widespread utilization in a brief 25 year history. Even more astonishing is "the fact that the capabilities and functionality of what we call personal computers have changed by orders of magnitude" (Becker, 2000a, ¶ 2). This means that what was once considered leading edge technology has been rendered completely obsolete in an astonishingly short period of time. Hence, the rapid proliferation of modern technology is actually much more impressive than it initially appears.

Despite the advances and increased levels of integration within the classroom, naysayers claim that very little has actually been accomplished vis-à-vis the integration of technology into the classroom. However, the argument that technology has been prevalent in schools for years and has yet to be integrated to any degree may be moot. First, the common technology integration barrier of poor or limited access to technology (Beaudin, 2002; Beggs, 2000; Hadley & Sheingold, 1993; Jacobsen, 1998) remains a very legitimate concern. Because a technology-rich environment removes many of the common barriers to technology integration, it is the most legitimate location in which to explore technology integration. Second, technology has changed so much in recent years that research done before the World Wide Web and high speed processors, while providing some insights, is actually dealing with an altogether different and inferior technology. In addition, computers were unable to run sophisticated learning software because they were not powerful enough (Poole, Sky-McIlvain, & Jackson, 2004). They were not of great value to teachers.

This current research project is based upon the belief that only recently, since the spread of the World Wide Web and high speed computer processors, has technology become easy enough to use and of enough value for most teachers to pursue it as a tool for teaching. Technology had previously only been the realm of the innovators and early adopters (Rogers, 1995). Technology is now accessible to far more teachers and students. In addition, with more and more institutions removing the barrier of access through the implementation of programs such as a laptop program, the degree to which technology is being integrated into teaching and learning must be further explored.

Purpose and Rationale

The purpose of this research is to investigate the relationships between faculty's perceived barriers to technology integration, level of technology integration, concerns toward technology integration, and exposure to a technology-rich environment. Besides discovering the association between barriers and these constructs, the findings will present a faculty profile which could help to guide future technology integration planning and professional development endeavors. This documentation could also be utilized as a benchmark on which to evaluate growth or deterioration in technology integration over time at the institution.

As a matter of policy, the institution under investigation states that it exploits technology to realize its goal of effectively preparing students for the modern work environment (Zayed University, 2002). The underlying reason for integrating technology is to improve learning. This study will be a preliminary exploration into the degree in which technology is being integrated into teaching and learning within a specific institution. By focusing directly on faculty's perceived barriers to technology integration, level of technology integration, concerns toward technology integration, and exposure to a technology-rich environment, the accumulated findings should present a robust and comprehensive picture of the current state of technology integration within the university. This is a necessary first step in the possible design and implementation of a technology integration plan and appropriate professional development. For example, an instructor found to be at a high level of computer proficiency and yet not integrating technology into the classroom might require a different intervention than would a teacher that lacks basic technology skills but is extremely keen to integrate technology into their teaching. This research will hopefully identify these natural groupings and then be able to recommend appropriate actions.

Since the process of technology integration is complex and multi-faceted, the relationships between all the aforementioned concepts require examination. Within this research, there exists two critical components developed out of the Concerns Based Adoption Model (Hall & Hord, 2001) that require measurement. They will form the framework for this research. The first, level of technology integration, is concerned with the behavioral aspect of how technology is implemented. The second, concerns toward technology integration, is related to the affective feature of how technology is implemented. Besides these key constructs, knowledge about the perceived barriers is important if one recognizes that the removal of barriers facilitates the integration of technology. Finally, exposure to technology integration will either support or refute the slow revolution explanation which posits that given time, an increasing number of teachers will integrate technology into their classrooms (Rogers, 1995). All of these constructs must be measured if one is to fully comprehend the concept of technology integration.

Research Questions

The goals of this research project will be attained through answering the following questions:

1. What do faculty in a technology-rich environment perceive as barriers to technology integration?
2. In a technology-rich environment, what are the relationships between perceived barriers to technology integration and…
   - stage of concern?
   - level of technology integration?
   - exposure to a technology-rich environment?
3. In a technology-rich environment, what are the relationships between…
   - level of technology integration and stage of concern?
   - stage of concern and exposure to a technology-rich environment?
   - level of technology integration and exposure to a technology-rich environment?

Significance of the Study

There are two major reasons why this research is unique and significant. First, it offers novel insights into technology integration because, as a barrier, poor access to technology has been removed. Prior research (Becker, 2000b; Reiser 2002) has shown that anything less than anytime anywhere access to technology acts as a barrier. The seemingly inconsequential act of having to book a computer lab is, in fact, a significant barrier. Because of this, a technology-rich environment can provide an essential feature of an investigation into barriers to technology integration. In addition to this facet, the relationships between the behavioral, affective, and temporal variables in a technology-rich environment are also significant. The simple fact that technology is so prevalent may change or alter either the concerns about it or its level of implementation.

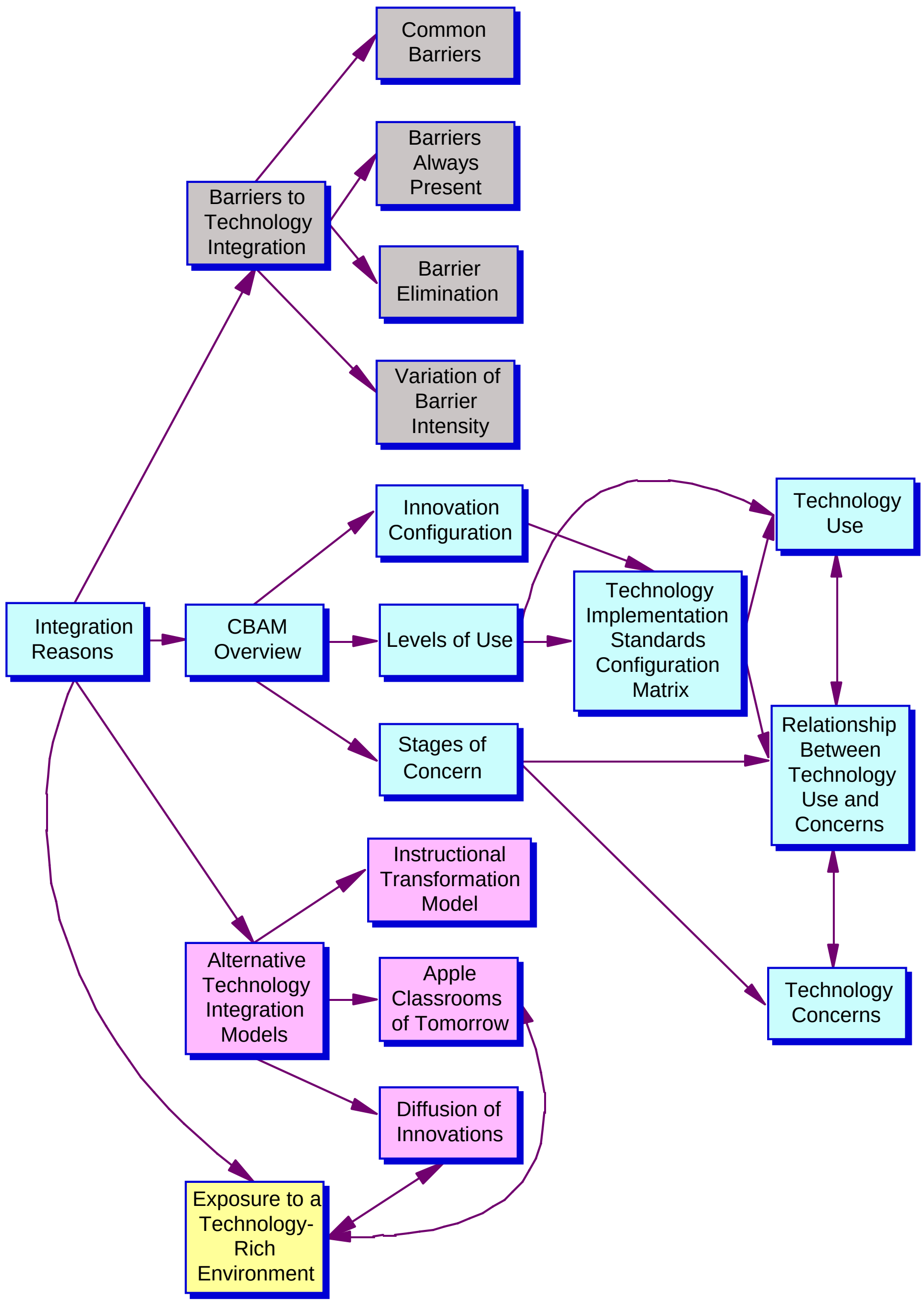
Chapter Outline

Chapter Two is a summary of the most relevant literature that pertains to the integration of technology into teaching and learning. This means that the focus of the literature review is on barriers to technology integration and the Concerns Based Adoption Model (CBAM) (Hall, Wallace, & Dossett, 1973) because it forms the primary theoretical underpinning for this study. Chapter Three describes the methodology employed in this research project. This comprises sections about the instrument, data collection procedures, and participants involved in this study. The penultimate chapter, Chapter Four, presents the results and analysis of the data gathered from this study. Chapter Five, discusses the research findings in relation to the existing body of knowledge and proposes implications of this information. Finally, it also provides recommendations as to the future directions of technology integration planning and offers suggestions for future research.

Chapter Two

LITERATURE REVIEW

Figure 1. *Literature Review*



Introduction

Much of the current literature into technology integration claims that technology has had a very limited impact in the classroom (Cuban, 2001; Cuban, Kirkpatrick, & Peck, 2001; Newhouse, 2001b). A major premise of this thesis is that this claim is debatable because the most important variable concerning technology integration, accessibility, has rarely been at adequate enough levels to accurately evaluate its rate of adoption within education. For the purposes of this research, “ample accessibility” is synonymous with “technology-rich”. Both terms define a teaching and learning environment in which access to technology is not a concern for either faculty or student. In this particular instance, technology-rich means that faculty and learners have their own laptops, while the university has internet accessible classrooms which include digital projectors, and all the expected and required software. Since this project is examining key technology integration constructs such as the behavioral, affective, and temporal aspects and their relationships to barriers within this technology-rich environment, this research may provide novel insights into technology integration and contribute to the existing body of knowledge.

The purpose of this chapter is to critically examine technology integration literature and reflects efforts to find and present multiple views that are most relevant to this research. In doing so, this section should demonstrate why the problem being examined is worthy of investigation and how the methods being applied may provide the answers. The body of literature that currently exists with regards to the integration of technology into teaching and learning is both large and diverse. Therefore, the concentration of the study will be on the essential relationships between barriers to technology integration, level of technology integration, concerns toward technology integration, and exposure to a technology-rich environment. This will hopefully begin to lay the foundation for suggesting reasons for the degree of faculty technology integration which could, in turn, guide future technology integration planning and professional development endeavors within the institution.

Prior to beginning the main literature review it is important to understand why technology integration is desirable since this desirability is the major assumption of this research project. After explaining this assumption, this chapter first examines barriers to technology integration. Focus will be on the identification of commonly cited barriers and includes an explanation of how the reporting of said barriers differs. This provides the framework for the first research question, *what do faculty in a technology-rich environment perceive as barriers to technology integration?* The second part of the review details the components of the CBAM. This section describes the research that relies solely on this model to provide insights into both the behavioral and affective aspects of technology integration. Hence, it offers insights into two components of the second research question, *in a technology-rich environment, what are the relationships between perceived barriers to technology integration and stage of concern or level of technology integration?* The next segment of the review will examine and critique alternative models that have been used to describe certain key aspects of technology integration. These add insights into both research questions 2 and 3. Finally, research into the relationship between length of time having taught in a technology-rich environment and actual level of technology integration will be scrutinized. This supports the third part of the second research question, *in a technology-rich environment, what are the* *relationships between perceived barriers to technology integration and exposure to a technology-rich environment?* Based on the literature this may, in fact, be the dominant variable in determining the degree of technology integration in a technology-rich environment. The CBAM review along with the Exposure review presents the outline needed for answering question 3, *in a technology-rich environment, what are the relationships between…*

- *level of technology integration and stage of concern?*
- *stage of concern and exposure to a technology-rich environment?*
- *level of technology integration and exposure to a technology-rich environment?*

Reasons for Technology Integration

The major assumption of this research project is that the integration of technology into teaching and learning is advantageous. Because of this assumption, it is important to provide support for this belief. Currently, within the realm of educational technology (the area most often associated with technology integration), the theory of learning known as constructivism dominates. Therefore, this section will first provide reasons for integrating technology into teaching and learning and then expand into an explanation of constructivism because it is a theory that has become nearly synonymous with educational technology.

There are a number of reasons why an educator may want to integrate technology. Underlying all of these is the belief that it will improve student learning. According to Roblyer and Edwards (2000), there are five reasons for using technology in education:

1. Increased student motivation;

2. Unique instructional capabilities- for example, students are able to access authentic learning resources through the Internet;
3. Increased teacher efficiency- for example, teachers are now able to quickly produce effective materials targeted toward learner needs;
4. Enhanced student information age skills;
5. Support for constructivist approaches- for example, an asynchronous discussion board could be used to facilitate the creation of a shared understanding.

These five reasons do form a sound rationale for the integration of technology into teaching. However, in order for technology use to have a resounding impact on learning, constructivist approaches must dominate the learning environment. The other reasons have long been a benefit to teaching and learning and yet little has been accomplished. Current technology with its emphasis on communication is better able to foster constructivist approaches.

Constructivism is the theory of learning in which one believes that knowledge is constructed not transmitted through meaningful learning. Jonassen, Peck and Wilson (1999) claim that this belief requires a massive shift from teacher-centered to learner-centered learning environments and that technology is a powerful tool to facilitate meaningful learning. Meaningful learning is learning in which students are actively engaged through things such as authentic problem solving activities. This type of learning can utilize tools such as the Internet to help students to solve problems and present solutions. While levels of technology integration can be increased without adopting constructivist methods, it would appear that truly effective technology integration cannot occur without a move towards constructivist pedagogy. This is the key element in any move towards technology integration.

Barriers to Technology Integration

This research began with an investigation into what is currently known about the state of technology integration into teaching in technology-rich environments. The results of this initial enquiry made it clear that technology integration barriers were of the utmost importance when investigating technology-rich environments. This is because it appears that even with the main tangible barrier, lack of access to technology, removed, resistance to technology integration remains. This is an attempt to ascertain what barriers remain.

There currently exists a robust body of literature which describes the influences of barriers on technology integration (Anderson, Varnhagen & Campbell, 1998; Bariso, 2003; Beaudin, 2002; Becker, 2000b; Beggs, 2000; Cuban, 2001; Ertmer, 1999; Ertmer, Addison, Lane, Ross & Woods, 1999; Hadley & Sheingold, 1993; Jacobsen, 1998; Newhouse, 1999; Pajo & Wallace, 2001; Rogers, 2000; Snoeyink & Ertmer, 2002). Although a great deal is known, gaps do exist in the literature. One of the gaps occurs because of the recent advances in technology, for example, the proliferation of the Internet, and the increases in computer memory and speed. The other gap relates directly to the accessibility of technology. Most often, the lack of adequate technology access is cited as the most prominent barrier to technology integration. Although some research (Apple Computer, 1995) has been done to learn about the impact of technology-rich environments on teaching and learning, technology has progressed to such an extent since the completion of the Apple Classrooms of Tomorrow (ACOT) that more research is now required. Within ACOT, they tried to answer the one simple question, *what happens to students and teachers when they have access to technology whenever they need it?* As previously mentioned, this unfettered access issue is synonymous with the concept of a technology-rich environment which is essential to this research. At the institution under investigation, the wealth of technology offers the opportunity to add this missing dimension to the existing literature.

A barrier is defined as "any condition that makes it difficult to make progress or to achieve an objective" (WordNet, 1997). The objective under scrutiny in this study is increased technology integration. The understood and yet unspoken connotation of a barrier is that its removal acts as an aid towards the achievement of the objective. Therefore, the study of barriers as they pertain to technology integration is essential because this knowledge could provide guidance for ways to enhance technology integration. Ertmer (1999) echoed this sentiment, in stating that by providing "teachers with knowledge of barriers, as well as effective strategies to overcome them, it is expected that they will be prepared to both initiate and sustain effective technology integration practices" (Conclusion section, para. 4).

This research investigates the affective aspect (feelings) of technology integration through the utilization of the Stage of Concerns questionnaire. It also examines the behavioral aspect (actual level of technology use) through the Technology Integration Standards Configuration Matrix (TISCM). Finally, the temporal aspect (length of time having taught in a technology-rich environment) is explored through the time question included within the questionnaire. This three-pronged approach to investigating barriers provides a unique and robust methodology and is a strength of this project. To build upon this previous research, this section is premised upon the following concepts:

1. Although sometimes labeled differently, there is an established set of commonly referenced technology integration barriers;
2. Barriers to technology integration are always experienced no matter the environment;
3. The degree to which the intensity of barriers to technology integration is reported differs according to the reporters' level or stage of technology integration;
4. Recommendations as to the methods of technology integration barrier elimination differ according to the type and intensity of the barrier.

Common Barriers

The act of integrating technology into teaching and learning is a complex process and one that may encounter a number of difficulties. These difficulties are known as barriers. In order to lay the foundation for this entire section, it is necessary to illustrate the established set of common technology integration barriers. Although these are often labeled, measured, and rated differently, researchers (Anderson et al.1998; Bariso, 2003; Beaudin, 2002; Becker, 2000b; Beggs, 2000; Cuban, 2001; Ertmer, 1999; Ertmer, Addison, Lane, Ross & Woods, 1999; Hadley & Sheingold, 1993; Jacobsen, 1998; Newhouse, 1999; Pajo & Wallace, 2001; Rogers, 2000; Snoeyink & Ertmer, 2002) have identified these or similar variations as widespread barriers:

1. lack of computers
2. lack of quality software
3. lack of time

4. technical problems
5. teacher attitudes towards computers
6. poor funding
7. lack of teacher confidence
8. resistance to change
9. poor administrative support
10. lack of computer skill
11. poor fit with the curriculum
12. lack of incentives
13. scheduling difficulties
14. poor training opportunities
15. lack of vision as to how to integrate

In order to draw conclusions, researchers have long attempted to categorize barriers according to the similarities or differences between them. Although dissimilar labels have been applied, similar patterns have repeatedly emerged. The degree to which specificity of classification is employed has both positive and negative ramifications. The more specific the classification, the more difficult it is to generalize findings, while the more general the categorization, the less accurate the generalizations. This is important because it is nearly impossible to draw conclusions with perhaps 100 different barriers. However, if they can be grouped with other like barriers, it is much easier to draw conclusions. Often the label of either internal or external barriers are applied. A general consensus exists with reference to the meanings of these terms. Internal barriers are considered those barriers which are developed from attitudes and perceptions towards technology integration, while external barriers are those elements of the process which are recognized as outside of the control of the teacher such as the accessibility of technology and technical support. The aforementioned barriers could be categorized accordingly (see Table 1).

Table 1. Classification of External and Internal Barriers

External Barriers	**Internal Barriers**
lack of computers	teacher attitudes towards computers
lack of quality software	lack of teacher confidence
technical problems	lack of time
poor funding	resistance to change
poor administrative support	lack of computer skills
scheduling difficulties	poor fit with the curriculum
lack of incentives	lack of vision as to how to integrate
poor training opportunities	

Both Rogers (2000) and Ertmer, Addison, Lane, Ross, and Woods (1999) utilized very similar classification systems in their attempts to accurately label technology integration barriers. Rogers labelled barriers as internal, external, or crossovers between the two. For example, internal barriers are those based upon teacher attitudes and skill level, while external barriers are those such as technology support, and access to computers. Crossover barriers are those such as time. Time can be an external constraint or it can be self-imposed. For instance, through the process of prioritization, a teacher could be able to find the time to integrate technology. Ertmer et al. have also used the terms internal (second-order) and external (first-order) barriers. Where Rogers differs is in the interpretation of lack of time and funding and the institutional culture as being crossovers between the internal and external classifications.

Commonly, barriers are neither classified as external nor internal barriers; they are merely treated independently or are grouped through a factor analysis. This is the approach taken in this study. Hadley and Sheingold (1993) conducted a study involving known technology integrators at the 4-12 grade level, their factor analysis identified the following seven themes (ranked here from the most to least) which accounted for over 50% of the variance. The most cited barriers to technology integration were:

1. Poor administrative support;
2. Problems with time, access, space, supervision, and operations;
3. Poor software;
4. Curriculum integration difficulties;
5. Teacher’s attitudes and knowledge towards computers;
6. Computer limitations and inadequate numbers of computers;
7. Lack of technical support.

Building upon the barrier work done by Hadley and Sheingold (1993), Jacobsen (1998) identified similar findings at the post-secondary level. The major difference was that the majority of faculty felt that technology was now an adequate fit with their curriculum. This finding was by no means an isolated incident. In fact, it seems to represent the beginning of a trend. In another study conducted at a post-secondary institution, Beggs (2000) also found that a lack of relevance to the faculty members discipline received the second lowest barrier rank with nearly 65% of all respondents rating it only somewhat important or not important. Other parallels between these works was a dominance of external barriers since lack of time, lack of equipment and lack of training were the top rated barriers to technology integration. Beaudin (2002) continued to investigate the role of barriers into technology integration using the instrument designed by Jacobsen but this time in the K-12 environment. Though major technological advances had been made between Beaudin's study and the seminal work done by Hadley and Sheingold, the results were strikingly similar. External barrier items such as time and poor accessibility remained highly consequential. A similarity between the Jacobsen, Beggs, and Beaudin findings which are a massive divergence from the Hadley and Sheingold work was that teachers were least likely to agree with the concept that computers do not fit with the course or the curriculum. Obviously, a shift in one component of an internal barrier has occurred since fewer instructors now perceive a misalignment between their course content and technology integration. A logical conclusion from this is that this belief in combination with a technology-rich environment should only aid faculty in better integrating technology with course content.

At first glance, it appears that Maddux's (1998) claim that "it is essential that computers be placed in classrooms. Until that happens, true integration is unlikely to take place" (p. 8) remains true. The consistent pre-eminence of external barriers can be misleading however. Snoeyink and Ertmer (2002) in researching three technology-novice elementary teachers noted the overall pattern of responsibility shifting. They felt that the teachers attributed their lack of computer use to external barriers rather than accept responsibility for themselves. Similar findings were reported by Bariso (2003) at the post-secondary level. Through a combination of quantitative and qualitative research methods, it was established that motivation and attitudes were not preventing faculty from integrating technology into their teaching. The faculty "seemed to have confidence, positive attitudes, and high motivation to embrace ILT [Information and Learning Technologies]" (p. 88). Responsibility, however, was again placed on external barriers such as lack of time, lack of training, and lack of computers, but the legitimacy of these concerns was not evaluated. The significance of these results for this study is once more that with the key barrier of access removed, which barriers will be dominant and what will the relationship be between these barriers and the behavioral, affective, and temporal aspects?

Barriers Always Present

To best demonstrate the existence of barriers to technology integration independent of the environment, it is essential to examine the recent history of technology in the classroom. This allows one to see that as the main barrier, lack of technology access, was removed, other barriers still remained. Nevertheless, common sense dictates that in institutions that lack sufficient access to technology, effective technology integration would be a daunting, if not impossible task. According to Ertmer (1999) teachers would not automatically integrate technology into teaching and learning even if all extrinsic barriers such as access, time, and technical support were removed. Furthermore, Cuban, Kirkpatrick, and Peck (2001), in reviewing the frequency of teacher technology use in technology abundant high schools, stated that decision makers believe that creating abundant access to technology would lead to an increased level of technology use in the classroom. However, while this is certainly a requirement, it is but an initial step. They found that abundant access to technology was not enough to ensure technology integration. This means that even in better than average technology-rich schools, teachers were still not integrating technology to any substantial degree. It appeared that even the straightforward task of scheduling a computer lab, acted as a barrier. Yet again, the essential element of this study is that as a laptop institution, access to technology is not an issue. This provides depth to the investigation into the remaining technology integration barriers.

The relationship between plentiful technology, enhanced technology integration, and barriers does not appear to be straightforward. In a longitudinal study built around a portable computer program, Newhouse (1998) stated that many of the common barriers associated with the adoption of the innovation were still present. Some of the barriers preventing teachers from integrating technology were poor computer literacy, lack of time, lack of confidence, and hardware malfunctions. Though access as a barrier had been overcome, others still remained. Similar sentiments are echoed by Cuban (2001) since he found that lack of time and inadequate generic training remained technology integration barriers in technology-rich high schools. He also noted that at technology-rich Stanford University, faculty continue to cite lack of time and poor technical support as barriers to technology integration. One contradictory piece of evidence, comes from the Rogers (2000) K-12 study. Rogers surveyed 1000 randomly selected art teachers and incorporated both quantitative and qualitative methods. A full 507 eligible respondents were included in the results. It was found that approximately 67% of the most advanced technology adopters did not discuss any barriers. This anomaly can probably be interpreted in two ways. First, it supports the hypothesis that barrier intensity decreases as skill improves. Second, the format of the survey did not facilitate selecting intensity of barriers; it only allowed for an open-ended response which negatively impacted the validity and reliability of the findings. In support of Rogers, Becker (2000b) in a large study (approximately 2,250 participants) into Internet use by teachers found that Internet accessible computers in the classroom significantly increased the amount of student

Internet use in comparison to situations where Internet access is limited to outside the classroom. It appeared that easy access did facilitate Internet use. Nevertheless, research seems to indicate that barriers exist, regardless of the abundance of technology.

Variation of Barrier Intensity

The third concept from which this barrier section is premised, *the degree to which the intensity of barriers to technology integration is reported differs according to the reporters' level or stage of technology integration,* is evocative. It begins to provide an understanding for the existence and intensity of barriers other than simply the degree of technology access. The general consensus is that teachers rate barriers less problematic as their technology integration skills increase and that the intensity of specific barriers is dissimilar at different levels of the integration process (Anderson et al. 1998; Hadley & Sheingold, 1993; Rogers, 2000).

The research which supports the position that intensity of barriers declines as the level of technology integration increases utilizes different theories and models to group the subjects. However, the support for this position is the important element. The different theories or models used should not cloud the research findings. Anderson et al. (1998) used the *Diffusion of Innovations* framework (Rogers, 1995) as their guide. In a study which contrasted Early Adopters (EA-those who adopt an innovation before the typical group member) with Mainstream Faculty (MF-the typical group member) at the post-secondary level, they found that EAs rated most of the barriers lower than the MF. This finding is confirmed by Rogers (2000) K-12 enquiry which determined that as teachers became more comfortable utilizing technology, their focus on barriers decreased. This research relied upon the 5-step model of technology adoption designed by Reiber and Welliver (1989) which describes the stages of technology implementation. In contrast to these results, Jacobsen (1998) revealed strong agreement between respondents to most barriers using the aforementioned *Diffusion of Innovations* framework. In fact, Early Adopters (EA) and Mainstream Faculty (MF) only disagreed on two of the 20 selected response items. Regarding these two items, EAs expressed stronger disagreement than MF that they were unsure of how to integrate computers, and that computers did not fit with their curriculum. Although not explicitly stated, this could be interpreted as refutation of the previous findings. The similarity between the rated intensity of barriers did not seem to follow the trend.

Still much of the research certainly points to significant differences concerning the degree to which specific barriers are perceived according to the level of technology integration. Results indicate that even though some faculty are expert technology integrators, all faculty experience, to a greater or lesser degree, barriers to implementing technology into teaching and learning (Jacobsen, 1998). For example, Anderson et al. (1998) noted that the MF and the EAs differed significantly on two barriers. They identified lack of time and lack of information and knowledge as significant barriers for MF but not EAs. When comparing MF to EAs, Jacobsen's research confirmed that lack of information and knowledge was a barrier, but not that lack of time was a barrier. Lack of time was only identified as a barrier in the overall level of agreement, not between MF and EAs.

In an attempt to synthesize the existing knowledge as it pertains to the shift in perceived barriers, Rogers (2000) used an intensive literature review in coordination with the results of her two studies, K-12 and post –secondary. The conclusions were that external barriers are most intense at the beginning stage of the adoption process, but this is only after the internal barriers such as attitudes towards technology in teaching have been overcome. Similarly, Hadley and Sheingold (1993) established their own groups of technology adopters because they focused their research on known technology innovators. The most prominent difference amongst their categories was that *Enthusiastic Beginners* rated all barriers as less intense, while the *Unsupported Achievers* experienced significantly more intensity of all barriers. Even with these technology integrators, there appears to be differences in the degree and selection of barriers to technology integration. Perhaps this demonstrates that the intuitively pleasing hypothesis which states that certain barriers are more prominent and predictable at certain levels is not so straightforward.

Barrier Elimination

Recommendations as to the methods of eliminating technology integration barriers differ according to the type and intensity of the barrier. However, regardless of the barriers involved, “if teachers do not have sufficient equipment, time, training, or support, meaningful integration will be difficult, if not impossible, to achieve” (Ertmer, 1999, Obtaining Resources Section, ¶ 1).

To summarize the generally agreed upon concepts, Rogers (2000) wrote:

1. the less sophisticated technology integrator will require more professional development (sessions on ways to integrate technology) and more basic technical support (who to call when the computer crashes) because they are less independent;

2. the more advanced technology integrator will require more sophisticated technology support (things like learning how to make a CD) and advanced professional development (sharing sessions with other advanced integrators).

Ertmer (1999) explains that less advanced levels of professional development could mean that teachers will

> need opportunities to observe models of integrated technology use, to reflect on and discuss their evolving ideas with mentors and peers, and to collaborate with others on meaningful projects as they try out their new ideas about teaching and learning with technology. (Developing a Vision section, ¶ 2)

Prior to even these recommendations, Fabry and Higgs (1997) posited that one method to enable teachers to experience the potential of technology is to have them use the technology as productivity, management, and communication tools. This initial introduction is believed to be an integral stage in the progression toward technology integration. Further analysis, provided by this study, into the association between barrier intensity, level of use, and stage of concern, discussed in the next section will add depth to this knowledge.

Concerns Based Adoption Model (CBAM) Overview

Although identification of barriers is paramount when investigating technology integration, it does not provide enough of an understanding. Being able to categorize user responses towards said barriers according to either the user's actual level of technology integration or their feeling towards integration supplies the needed robustness. This depth is offered through the application of the Concerns Based Adoption Model (CBAM). The

CBAM has been identified as the ideal tool to investigate the integration of technology because of its thorough research history into educational change. Its focus on both the affective aspect (Concerns) and the behavioral (Levels of Use) provides an essential depth to the investigation. It allows the researcher to learn what is currently happening with the innovation, the integration of technology into teaching and learning, and provides some insights as to why this is so.

The CBAM consists of three sections, the Stages of Concern (SoC)- a measure of the perceptions and feelings towards the innovation, the Levels of Use (LoU)- an assessment of the degree to which the innovation is being implemented, and the Innovation Configurations (IC)- a clarification as to the meaning of the innovation itself. Each component serves a different purpose and together they are able to provide a robust representation of the adoption process in an educational context. Each component of the CBAM will be examined in order to explain its relationship to this research. By the end of this first section, what the CBAM is and what it measures should be unmistakable.

Stages of Concern (SoC)

The foundation of the CBAM is the *concerns of teachers* work done by Fuller (1969) in the area of teacher preparation. Through this work, she eventually identified four major clusters into which teacher concerns about teaching could be subdivided: Impact, Task, Self, and Unrelated (Hall & Hord, 1987). “Concerns theory reports that at the early stages of an innovation, teachers’ concerns tend to be more personal. As personal concerns are resolved, teachers tend to be more concerned about the application (task and the impact of the innovation)” (Vaughan, 2002, ¶ 1). It was found that these concerns progressed in a predictable manner as teachers became more skilled in their job.

These main subdivisions form the overall structure for the seven specific *Stages of Concern about the Innovation* which are refocusing, collaboration, consequence, management, personal, informational, and awareness. The aforementioned stages progress from the awareness level, where the person is not involved with the change, to the refocusing stage, where the person is skilled, experienced, and looking for ways to alter the existing innovation. Refer to Table 2 for a detailed description of the Stages of Concern and their relationship to Fuller's Concerns. The SoC, because of its unique affective perspective, will be used in this project.

Table 2. Stages of Concern with Fuller's Concerns

SoC	SoC Description	Fuller's Concerns
6- Refocusing	The focus is on exploration of more universal benefits from the innovation, including the possibility of major changes or replacement with a more powerful alternative. Individual has definite ideas about alternatives to the proposed or existing form of the innovation.	Impact
5- Collaboration	The focus is on coordination and cooperation with others regarding use of the innovation.	
4- Consequence	Attention focuses on impact of the innovation on students in his/her immediate sphere of influence. The focus is on relevance of the innovation for students, evaluation of student outcomes, including performance and competencies, and changes needed to increase student outcomes.	
3- Management	Attention is focused on the processes and tasks of using the innovation and the best use of the information and resources. Issues related to efficiency, organizing, managing, scheduling, and time demands are utmost.	Task
2- Personal	Individual is uncertain about the demands of the innovation, her/ his inadequacy to meet those demands, and her/ his role with the innovation. This includes analysis of her/ his role in relation to the reward structure of the organization, decision making, and consideration of potential conflicts with existing structures or personal commitment. Financial or status implications of the program for self and colleagues may also be reflected.	Self
1- Informational	A general awareness of the innovation and interest in learning more detail about it is indicated. The person seems to be unworried about herself/ himself in relation to the innovation. She/ he is interested in substantive aspects of the innovation in a selfless manner such as general characteristics, effects, and requirements for use.	
0- Awareness	Little concern about or involvement with the innovation is indicated.	Unrelated

Note. Adapted from Hall, George, and Rutherford (1986) and Hall and Hord (1987)

Levels of Use (LoU)

Levels of the innovation’s use are measured by the LoU interview which is an attempt to describe the behaviors of the users and the nonusers in regards to the innovation. “The focus is not on how they feel, but on what they do in relation to the innovation” (Hall, & Loucks, 1977, p. 265).

The CBAM does not see implementation of an innovation as a dichotomous event, but rather as a process with different levels, so based upon research by Hall et al. (1973), an eight level paradigm has been created. The bottom three levels in hierarchical order, nonuse, orientation, and preparation, fall within the general realm of the nonuser. The top five levels in hierarchical order, mechanical, routine, refinement, integration, and renewal, encompass the user sphere (see Table 3). The levels demonstrate a continuum of growth from not using an innovation to skill, experience, and looking for ways to alter the existing innovation much like the SoC. The major limitation with the LoU interview is that it is extremely time-consuming and, according to the CBAM authors, requires a three day training and certification program in order to utilize it.

Table 3. Levels of Use of an Innovation

LoU	LoU Description
VI- Renewal	State in which the user re-valuates the quality of use of the innovation, seeks major modifications of or alterations to present innovation to achieve increased impact on clients, examines new developments in the field, and explores new goals for self and the system.
V- Integration	State in which the user is combining own efforts to use the innovation with related activities of colleagues to achieve a collective impact on clients within their common sphere of influence.
IV B- Refinement	State in which the user varies the use of the innovation to increase the impact on clients within immediate sphere. Variations are based on knowledge of both short- and long-term consequences for clients.
IV A- Routine	Use of the innovation has stabilized. Few if any changes are being made in ongoing use. Little preparation or thought is being given to improving innovation use or its consequences.
III- Mechanical Use	State in which the user focuses most effort on the short-term, day-to-day use of the innovation with little time for reflection. Changes in use are made more to meet user needs than client needs. The user is primarily engaged in a stepwise attempt to master the tasks required to use the innovation, often resulting in disjointed and superficial use.
II- Preparation	State in which the user is preparing for the first use of the innovation.
I- Orientation	State in which the user has recently required or is acquiring information about the innovation and/or has recently explored or is exploring its value orientation and its demands upon user and user system.
0- Non-Use	State in which the user has little or no knowledge of the innovation, no involvement with the innovation, and is doing nothing toward becoming involved.

Note. Adapted from Hall, Loucks, Rutherford, and Newlove (1975).

Because of this constraint, the behavioral aspect of the CBAM will be measured by the Technology Implementation Standards Configurations Matrix (TISCM). The TISCM (discussed in more detail later) is a questionnaire designed out of the Innovation

Configurations (IC) concept and is a way to gauge the level of technology integration. Although the LoU is not being directly employed, the ideas that it purports are actualized through the TISCM. Hence, the LoU is being described in detail.

The following analogy pertaining to driving a car clarifies the differences between the SoC and the LoU. In terms of levels of use,

> the person at Level III Mechanical Use… would be apt to step on the brake too hard, forget to push in the clutch, shift in disjointed ways, and focus entirely on the next ten yards of the road. By contrast, the person at Level IVa Routine use would be able to drive from one place to another by smoothly operating the clutch, anticipating the entire trip, and not focusing overly much on the next turn in the road. (Hall & Hord, 1987, p. 17)

In contrast, the stages of concern

> would reveal how the driver feels about and perceives driving the car. Perhaps you can remember the "self" concerns you felt the first time you sat behind the wheel, engine off, and went through the motions, mentally regarding your competence and skill in driving and whether or not you could aim the car correctly…. The driver education teacher… will need to be reassuring and supportive when addressing self concerns. They will also probably want to spend more time addressing the task concerns dealing with details such as getting the car into gear and down the road. Hall & Hord, 1987, pp. 17, 18)

Innovation Configurations (IC)

The Innovation Configurations (IC) is the final component of the CBAM. Normally, the IC would be created by the teachers and researchers working together as they set out to describe the innovation. It is the creation of a shared understanding. Its purpose is to describe the operational forms that the innovation can take. Research has found that it is essential to define or configure the innovation because different users will operationalize the innovation in different ways (Hall & Hord, 2001). For example, there is a large amount of variance in the ways in which a teacher can integrate technology. A less sophisticated approach could entail students using email to submit assignments. A more sophisticated use might be utilizing web-based activities which are embedded with the curriculum. For the purposes of this investigation, IC is defined as the integrated use of technology into the classroom from the perspective of what a teacher has students do with technology.

The IC was not an original CBAM component, but it emerged out of research investigating variations in the Levels of Use into module use and team teaching (Hall & Loucks, 1977). Out of these two large scale studies, researchers found that there was in fact large variance amongst the ways in which teachers interpreted the innovation. Hence, what some teachers classified as use, others did not. Obviously this posed a major problem for the measurement accuracy for the Levels of Use, so the initiative of the IC was conceptualized. A two dimensional map is the accepted configuration of the IC.

> The purpose of the IC Map is to present carefully developed descriptions of different ways of doing the innovation. An IC Map will have a number of components (typically eight to fifteen), and each component will have a

> number of variations (typically two to six). The number of components will vary depending on the complexity of the innovation and the amount of detail needed. (Hall & Hord, 2001, p. 41)

The IC Map, in turn, is a useful tool for planning professional development, providing coaching, and for conducting research (Hall & Hord).

Technology Implementation Standards Configuration Matrix (TISCM)

Within this study, the Technology Implementation Standards Configuration Matrix (Mills, 2002) is the IC actualized and will be used to measure faculty's level of technology integration (see Appendix A Part 3- Technology Implementation Standards Configuration Matrix). Even though the TISCM is a form of an IC map, it has been designed as a checklist able to determine the level of technology integration into teaching and learning. It is actually a combination of both the LoU and the IC. The advantage of using the TISCM is that it is available in a questionnaire format; it is easy to distribute, quick to score, and easy to interpret. A disadvantage of this instrument is that it has not yet been utilized within higher education. Mills and Tincher (2003), however, state that it may be applicable to other educational contexts.

The TISCM attempts to measure the actual level of technology integration within the classroom by listing key components of technology integration along with the varying levels of use. For example, the items have been divided into three skill sets or phases: Phase 1 (Items 1-6)- *Using Technology as a Tool for Professional Productivity*, Phase 2 (Items 7-12)- *Facilitating and Delivering Instruction Using Technology*, and Phase 3 (Items 13-18)- *Integrating Technology into Student Learning*. Alongside each of the items within each phase exist descriptions of the varying degrees of use. Within the levels of use for each of these components there exists a spectrum of 5 possible levels of use ranging from ideal use to no use. The TISCM was designed so it could be used as a self-report instrument, so it is in the form of a checklist. Regarding the validity of the instrument, the TISCM was designed using the consensus-building process recommended by the CMAM authors. A committee of district stakeholders along with the TISCM author developed the 18 implementation standards after reviewing pertinent technology integration documentation. Its truth and accuracy were not to be absolute, but rather, the intent was to develop an instrument that provided reasonable estimates of reliability and validity (Mills, 2002).

The main purpose of Mills' research (2002) was to develop an instrument which could be used to evaluate the fidelity of technology integration. Using a group of 70 K-12 teachers, Mills was able to demonstrate the effectiveness of the instrument. The reliability of the instrument was determined through the use of a coefficient alpha to be .9130, while both a cluster analysis and discriminant analysis were able to confirm three proposed levels of technology integration. The three levels of technology integrating users are: *Operators*- least sophistication, *Facilitators*- medium sophistication, and *Integrators*- most sophistication. A one-way analysis of variance (ANOVA) resolved that significant differences did exist amongst the groups on 17 of the 18 components. In a study which built upon the initial developmental study, Mills and Tincher (2003) were further able to demonstrate the effectiveness of the TISCM through the application of similar methods and the use of a paired-samples t-test to measure significant change over the course of the school year.

Although the TISCM was designed around widely accepted technology integration standards, a misalignment between the TISCM components and what is expected within the environment under scrutiny could be problematic. Since there are currently no established guidelines as to the ways in which technology integration should occur at the university under inspection, the widely accepted standards that have been applied should be sufficient. In addition, further research conducted with the TISCM in other environments could enhance its validity as an instrument.

CBAM Technology Integration Perspectives

Because of the continued proliferation of technology in education, there is a growing body of literature which utilizes the CBAM as a tool to investigate the increasing role of technology into teaching and learning. The rather limited degree of integration has lead to a focus on the concerns of teachers as it applies to the implementation of technology into classrooms. Marcinkiewicz (1994) argues for concerns based research because "to understand how to achieve integration, we need to study teachers and what makes them use computers, and we need to study computers and what makes teachers want to-or need to- use them" (p. 234). Interestingly enough, the majority of the research focuses on only one component of the CBAM, most often the SoC or the LoU. Rarely, is the IC given more than a token representation in the research. Since the relationship between both the affective and behavioral facets of the technology integration process are a focus of this study, this section will critique the currently available research which deals with any of the three components of the CBAM. The research will be presented by works that investigate technology use, technology concerns, or are a combination of both use and concerns.

Relationship Between Technology Use and Concerns

There is not an overabundance of research which examines both the levels of technology use and the technology concerns. That which does, however, is able to demonstrate the relationship between the two key constructs. To reiterate, “Stages of Concern (SoC) addresses the *affective* side of change- people’s reactions, feelings, perceptions, and attitudes- Levels of Use has to do with *behaviors* and portrays how people are acting with respect to a specified change” (Hall & Hord, 2001, p. 81). Although these two constructs are probing the same innovation, they are evaluating it differently. Each perspective provides insights that would otherwise not be apparent. Newhouse (2001a) is able to support this premise because of what he found in a study looking at a portable computer program at a middle school. In terms of Concern, he found that 53% of the teachers were still located at Stage 0- Awareness after 3 years of the program. These results were shockingly low, but further analysis using Level of Use data, demonstrated that many of this group were actually regular computer integrators. Newhouse hypothesized that their lack of concern was because they misconstrued the meaning of not interested. They were not lacking interest, they were indicating confidence or a lack of concern. This misinterpretation also demonstrates one of the weaknesses of relying solely upon the peak Stage of Concern, rather than the entire user profile. Use of both of the SoC and the LoU concepts should alleviate this problem in the current study.

As would be expected, there is a hypothesized relationship between concerns and level of use. The purpose of a study done by Dooley, Metcalf and Martinez (1999) was to determine the role of a professional development program in the adoption of technology.

Using a naturalistic enquiry, rather than specific CBAM instruments, they set out to establish the percentage of teachers at different stages of concern and at different levels of technology use. They found that the high level technology users had higher order (impact and task) concerns, low technology users had lower order (self) concerns, and medium users had a mixture of concerns. This supports the findings of Hall and Hord (2001) who feel that, although there is an obvious correspondence between the SoC and the LoU, a linear one-to-one correspondence is far too simplistic. Although speculative, they feel that

> at the lower Levels of Use, the actions cause the arousal of concerns. For example, when a person attends an orientation workshop, the Stage 1 Informational and Stage 2 Personal concerns increase in intensity; use is driving concerns. At the higher levels, concerns would seem to drive LoU. A teacher who has concerns about certain students not doing well in mathematics will take action to learn about alternative approaches (LoU IVB Acquiring Information). (Hall & Hord, 2001, p. 94)

Even though each of these studies employed non-standard CBAM instruments, discovering the correspondence between use and concerns was also one of the purposes of Adams (2003) and Atkins and Vasu's (2000) work. The Computer Concerns Questionnaire (CCQ) (Martin, 1989) and the Levels of Computer Use (LCU) (Marcinkiewicz & Welliver, 1993) assessment were utilized by Adams rather than the traditional CBAM instruments because "given the complexity of computer innovations, it was deemed necessary to use specialized instruments designed to measure computing concerns and levels of computer use" (Adams, p. 287). Neither the CCQ or the LCU were used in the current study because it was felt that although they were computer specific, the advances in computer technology, since their creation, limits their effectiveness. The CCQ presents an eight stage hierarchy very similar to the SoC, while the LCU only offers three levels of hierarchical use- Nonuse, Utilization, and Integration. The 32 item CCQ has an internal reliability (Cronbach's alpha) ranging from .65 to .83 for the eight stages of concern and Pearson correlation of .66 to .84 (Martin, 1989). The findings of the study clearly indicated that "those with higher integration levels also expressed higher-order concerns than those reporting lower integration levels" (Adams, p. 298). These post-secondary findings were echoed by Atkins and Vasu's middle school study. They used the CCQ along with the Teaching with Technology Instrument (TTI), an instrument designed around basic teacher technology competencies. The reliability of the TTI has been established using Cronbach's alpha and is .95. They ascertained that a significant correlation did exist between the instruments. In particular, that "as teachers become more knowledgeable about technology integration, their concerns tend to move from lower levels… to higher levels" (Atkins & Vasu, p. 291).

Gershner and Snider (2001) while not specifically investigating the relationship between the Soc and LoU did notice one. Their study involved 49 middle and high school teachers receiving training in the use of the Internet as an instructional tool. They utilized both the SoC questionnaire and the LoU interview, but unfortunately only 11 of the 49 teachers participated in the post-test SoC, so results must be interpreted accordingly. Additionally, the SoC questionnaire was only available electronically which may have impacted the data collection because those not keen on technology, may have avoided the web-based questionnaire. At the end of the first year of the program, they found that statistically significant differences in concerns and use had occurred. Although no individual data was provided for each of the constructs, one could interpret the results as an indication of parallel progression between concerns and use.

Evidence which demonstrates the more complex relationship between use and concerns comes from Newhouse (1999) in his research into the portable computer program. Overall the study ascertained that very little technology integration had occurred even with the students owning their own portable computers. During the third year of the study, the researcher conducted an in-depth analysis of one of the teachers using both the LoU interview and the SoC questionnaire. The teacher was determined to be at LoU Level IVA, Routine, which means the use of technology has stabilized, and little thought or preparation is given to improving technology use (Hall & Loucks, 1977). In terms of the concerns, the teacher was identified as at peak Stage 2, Personal, but with a low Stage 1, Informational. Hall and Hord (1987) posit that this combination probably indicates that the person has "self concerns, tend to be more negative toward the innovation and generally not open to information about the innovation per se" (p. 54). The simple linear relationship between the SoC and LoU is disproved with this teacher, but further analysis of the constructs does effectively describe the teacher's concerns and use of technology.

Technology Concerns

Although unable to offer information pertaining to the relationship between concerns and use, much research does offer insights into the importance of concerns with reference to technology integration (Hope, 1997; Martin, 1989; Mills, 1999; Newhouse, 2001b; Rakes & Casey, 2002; Vaughan, 2002). A renewed interest into concerns research has been driven by the continued deployment of technology in educational settings but the minimal levels of use that have remained. According to Hope (1997) “the intensity of teachers’ concerns about an innovation and the degree to which those concerns can be resolved have bearing on successful innovation implementation” (p. 150). Obviously, the concerns of teachers must be taken into account if technology integration is to succeed. The concerns research seems to indicate two trends vis-à-vis technology. The first is that the lower order stages of concern continue to dominate. The second is that movement through the stages of concern does occur, but it is a time consuming process.

There is much evidence which suggests that teachers’ stage of concerns about technology have remained low (quite concerned and apprehensive) even with the increased levels of technology in schools. Mills (1999) investigated the concerns of elementary teachers with reference to an Integrated Learning System (ILS), and found that even though all the teachers utilized the ILS, the lower order or self concerns still dominated to a great extent. Though the ILS had been in the schools for a minimum of two years, 75.4% of teachers rated either Stage 1, Awareness, Stage 2, Informational, or Stage 3, Personal, as the most intense concern. Only 9.2% of teachers had a peak stage at the impact level. Both Newhouse (2001b) and Rakes and Casey (2002) confirm these findings at high access secondary and K-12 levels respectively. According to Newhouse, of the 40 teachers participating in the four year portable computer program, a full 50% rated self concerns as the most intense. Rakes and Casey in their large (N=659) study focused on both the peak stage of concern, second highest concern, and the lowest concern in order to have a more sensitive interpretation of the data. Their group data indicated that most teachers had Stage 2, Personal concerns, and that the lowest rated concern for the aggregate data was Stage 4, Consequence. A low Stage 4 means that teachers were most concerned about how technology would impact them and not yet demonstrating any concern for the impact upon students. An important limitation of this research is that since this SoC questionnaire was delivered electronically, the data may be skewed towards the more technology-savvy teacher. The results of the data do not seem to corroborate this position however.

There is only one contradictory piece of evidence to the claim that teachers concerns regarding technology have remained lower order. Hope (1997) in a study of 16 elementary teachers found that 57% of teachers were at the impact level. However, this finding may be attributable to the very precise and limited innovation configuration. For the purposes of Hope's study, the IC was defined as a teacher technology workstation and two specific software productivity products.

The second theme arising from the concerns research is that change is a developmental process, but one that is very time consuming. According to Hope (1997), there was significant movement towards higher order concerns and away from the lower order concerns over the course of an entire school year. The results confirmed that teacher concerns about innovations are not entrenched, but also that teacher involvement in technology integration is a long term process. Newhouse (2001b) further supported the premise that movement occurs, but found that the process of technology integration can take years. He found that although the movement of teachers was similar to the established theme, the movement was incremental. A full 50% of teachers still identified self concerns as the most intense after four years of the portable computer program. Vaughan (2002) conducted concerns based research into the benefits of a two week intensive technology integration program on 79 K-12 teachers which utilized both the SoC questionnaire and qualitative methods in order to add complexity and depth to the SoC findings. The results indicated that

> change is a process not an event. The qualitative and quantitative data collected in this study confirms this assumption. Teacher concerns about SchoolNet technology changed continuously and in a developmental progression. The stages of concern unfolded in the direction and sequence that the theory and past research suggested. Past research suggests that teachers typically progress through a predictable sequence of Stages of Concern as they become involved in using or implementing any innovation. The CBAM Stages of Concern instrument and the qualitative investigations informed us that teachers had concerns that changed over time. (Vaughan, 2002, Discussion of Findings, ¶ 1)

Change as a developmental process is clearly in evidence, but where this research is in opposition of the previous research is that substantial movement occurred after only two weeks. Prior research indicated that change was a long term process, but here it was short term. The limited duration and lack of measuring the actual levels of integration of this research are major limitations of this study. It is far too easy to for study participants to state that their concerns have changed. Actually implementing this development (integration of SchoolNet technology) into daily practice is much more difficult. This demonstrates why it is important to include both the affective and the behavioral aspects of technology integration into such change research.

Technology Use

Although knowledge about the concerns of teachers is essential, the Levels of Use concept also provides invaluable information to understand "*how* people are acting with respect to a specified change" (Hall & Hord, 2001, p. 81). However, much of the research about levels of technology implementation only affirms that use is a complex and multi-stage construct and that levels of implementation remain low. This section will critique the latest evidence regarding levels of technology use and present some of the attempts to create a questionnaire assessment for technology integration.

Not unexpectedly, there have been recent efforts to develop measurement instruments capable of labeling levels of technology use. Nevertheless, Hall and Hord (1987) state that

> since LoU is a behavioral concept, paper/pencil questionnaires will not work. In spite of our best efforts to discourage researchers from building paper/pencil LoU questionnaires, however, several abortive attempts have been made. Attempting to assess Levels of Use with such a questionnaire is similar to attempting to read semaphore signals by turning on the radio: The receiver medium does not fit the format of the message. A behavioral variable cannot be assessed with a nonbehavioral measure. When someone attempts to assess Levels of Use with a questionnaire, the result is a partial assessment of concerns about use rather than a direct description of use or a direct assessment of concerns. (p.94)

However, it appears that the CBAM authors are overstating their case because a number of researchers have been able to measure the level of use construct using paper and pencil questionnaires. In 1992, Jardine conducted a study into the levels of computer use involving K-12 teachers and confirmed that there were teachers at each of the first six CBAM Levels of Use as operationalized by the study. The study utilized its own questionnaire to categorize the levels of use, but only 457 of the 531 participants were able to be classified. The confirmation of levels of use specific to technology integration is supported by both Moersch (2001) and Mills (2002); although, they too have developed their own instruments. Moersch's Levels of Technology Implementation framework (LoTi) is aligned conceptually with the CBAM and has seven discrete implementation levels ranging from Nonuse 0 to Refinement 6 (1995). It is a 50 item selected response questionnaire which has been used extensively to measure teachers' level of technology implementation. From 1999 to 2001, approximately 40,000 teachers had taken the LoTi questionnaire. Teachers were categorized at each of the levels of implementation and the vast majority of educators (approximately 69%) were at Level 2, Exploration, or lower (Moersch, 2001). "This means that technology-based tools supplement existing instructional program as tutorials, educational games, and simulations. The electronic technology is used either as extension activities or enrichment exercises" (Moersch, 1995, p. 42). Mills and Tincher (2003) applied the TISCM to evaluate the levels of technology integration for a group of K-12 teachers. Although developed specifically as a CBAM IC map, the instrument in its form, does assess levels of technology use. They discovered that there were three specific levels of use, but that the distribution of teachers was more sophisticated than in other research. Nonetheless, research seems to indicate that levels of technology integration continue to remain low, but that levels of use as a construct is multi-stage and complex. Clearly, the comprehensiveness of the abovementioned research refutes the claim made by the CBAM authors that you cannot measure a behavioral variable with a non-behavioral measure. The reliability and validity of the TISCM were the paramount issues in its development. Levels of technology use can be measured by self-report instruments; hence, the utilization of the TISCM as a measure of a behavioral variable in the current study is warranted.

Alternative Models to Explain Technology Integration

Besides the CBAM, a number of other models and theories have been developed to investigate the process of implementing an innovation. Additionally, with the recent and continued proliferation of technology in education a number of models have been developed or applied which attempt to explain the technology adoption process. While some, the Apple Classrooms of Tomorrow (ACOT) model and the Instructional Transformation model, have been designed specifically for the integration of technology, others such as the Diffusion of Innovations theory, have a more general application. The one similarity that they all have is that they can describe certain aspects of the technology integration process. These are useful because they generally posit that integration is a long term process which is hierarchical in nature. The current study investigates the idea that integration is a long term process by enquiring as to the length of time a faculty member has taught in a technology-rich environment. Perhaps some insights as to the legitimacy of this claim will be discovered. In turn, these findings often provide valuable suggestions as to the type of intervention that would be most effective for particular candidates. Interpreted as a whole, they add a richness and depth to explaining the technology integration process that would not otherwise be possible.

Diffusion of Innovations

The main benefit of this theory is that it provides useful labels for the adoption process. However, Newhouse, Trinidad and Clarkson (2002) claim that it is limited to a descriptive role because it fails to “suggest how to help a person looking to make better use of some technological innovation” (p. 31). Nonetheless, it posits a widely accepted framework that can be effectually applied to describing the adoption of technology into teaching and learning. This descriptive limitation is being addressed in the current research by relying more ardently on the CBAM for suggestions of ways to help a person wanting to increase their level of technology integration.

Rogers *Diffusion of Innovations* theory (1995) proposes that an innovation is diffused through a social structure over time; change is a process, not an event. The *Diffusion of Innovations* theory argues that the adoption of a new technology, such as technology in schools, follows predictable patterns within a community. The stages that occur as part of the decision to adopt the innovation and a sample of these same stages specific to integrating technology into teaching and learning are:

1. knowledge- learn of an innovation and begin to understand its function through overhearing talk of technology integration over noon hour;
2. persuasion- form a positive attitude toward the innovation by reading about the benefits of technology integration in a professional magazine;
3. decision- begin to commit to the innovation through designing a series of Internet based lessons;
4. implementation- begin to utilize the innovation by instituting a series of problem based lessons built around WebQuests;

5. confirmation- seek reinforcement that the innovation is positive through issuing a class survey measuring learner attitudes toward technology use.

There is an obvious correspondence between these stages of adoption and the stages of concern . For example, a person at the confirmation stage would also be identified within the impact stages within the SoC (see Table 2).

The rate at which an innovation such as the integration of technology into teaching and learning is adopted is dependent upon the perception of its characteristics by teachers- whether or not the innovation is worthwhile. Anderson et al.1998) found that these characteristics were perceived as weak since many mainstream faculty felt a lack of compelling reasons to adopt technology. Teachers did not feel that the reasons for adopting technology were good enough, and they felt that they could teach effectively without adopting technology. In terms of length of time to adopt an innovation, Adams (2003) investigated the level of adoption in the third year of a five year technology integration program at the post-secondary level and found that 25% of faculty remained nonusers. Kershaw (1996) stated the process can be expected to take between five and ten years. Evidently, the adoption process is complex and very time consuming. According to Rogers (1995), the characteristics of a new technology under review which affect the rate of adoption are:

1. relative advantage- the degree to which technology integration is perceived as better than current classroom practice;
2. compatibility- the degree to which technology integration is seen as consistent with current pedagogical beliefs;

3. complexity- the degree to which integrating technology into the classroom is perceived as difficult;
4. trialability- the degree to which technology integration can be experimented with;
5. observability- the degree to which the results of technology integration can be shared with peers.

The ideas behind these classifications should be valuable later when interpreting the data generated from this research. Since time is one of the variables under examination, the concepts imparted from the *Diffusion of Innovations* are critical to gain an understanding as to why technology has or has not been integrated.

ACOT

The *Apple Classrooms of Tomorrow* (ACOT) projects were conducted over a ten year period to investigate “what happens to students and teachers when they have access to technology whenever they need it” (Apple Computer, 1995). Researchers found that teachers must travel through a number of developmental stages before they have fully integrated technology into their teaching (see Table 4).

Table 4. ACOT Stages of Development

Stage	Examples of What Teachers Do
Entry	Learn the basics of using new technology
Adoption	Use new technology to support traditional instruction
Adaptation	Integrate new technology into traditional classroom practice. Here, they often focus on increased student productivity and engagement by using word processors, spreadsheets, and graphics tools.
Appropriation	Focus on cooperative, project-based, and interdisciplinary work-incorporating the technology as needed and as one of many tools.
Invention	Discover new uses for technology tools, for example, developing spreadsheet macros for teaching algebra or designing projects that combine multiple technologies.

Note. From Apple Computer (1995, p. 16)

Reaching the pinnacle of the model was a slow and arduous process closely tied to the teachers' beliefs about learning- a move to a more constructivist perspective was required (Sandholtz, Ringstaff, & Dwyer, 2000). One of the major implications from the ACOT research is that unlimited access to technology did enhance levels of technology integration. Because of this implication, the technology-rich nature of the institution under investigation should aid in the testing of this finding.

Instructional Transformation Model

The Instructional Transformation model was developed by Rieber and Welliver (1989) to describe the process of adoption of an innovation, in particular, to examine educational technology in schools. According to Marcinkiewicz and Welliver (1993), the model developed out of the CBAM (Hall, Loucks, Rutherford, & Newlove, 1975) and the Diffusion of Innovations theory (Rogers, 1995). It has been used by researchers (Adams, 2003; Marcinkiewicz, 1994) to explain the level at which teachers occupied on the hierarchy of technology adoption. “The importance of the model of Instructional Transformation is that it addresses the fundamental variance in the adoption of computer use. It describes the progression of a teacher from the onset of the adoption of computers” (Marcinkiewicz & Welliver, 1993). The stages of progression, very similar to the ACOT stages, are:

1. Familiarization- when teachers become aware of technology and its potential uses.
2. Utilization- when teachers use technology, but minor problems will cause teachers to discontinue its use.
3. Integration- when technology becomes essential for the educational process and teachers are constantly thinking of ways to use technology in their classrooms.
4. Reorientation- when teachers begin to rethink the educational goals of the classroom with the use of technology.
5. Revolution- the evolving classroom that becomes completely integrated with technology in all subject areas. Technology becomes an invisible tool that is seamlessly woven into the teaching and learning process. (Newhouse et al. 2002, p.18)

Marcinkiewicz and Welliver (1993) developed the Levels of Computer Use assessment (LCU) as a way to apply the Instructional Transformation model. Although the LCU is concerned with a LoU type of assessment, it diverges from the CBAM instrument. Hall and Hord (1987) state that the LoU can only be measured by observation and interview, whereas the LCU assessment is a questionnaire. Due to difficulty in assessing all the stages of the Instructional Transformation model, the final form of the LCU is only able to make three classifications. The categories of use that can be determined are utilization, integration, and that of total non-use. The LCU was field tested on two separate occasions, once with 23 elementary teachers and after modifications, with a group of 170 elementary teachers. The Coefficient of Reliability has been measured at .96 (Marcinkiewicz & Welliver). Marcinkiewicz (1994) in the study of 170 elementary teachers confirmed that the LCU was able to determine the actual level of computer use. The results indicated that nearly half (45%) of the teachers were at the Nonuse level, only 8% were at Integration, and the remaining 47% were at Utilization. The study concluded “that the adoption of computer use may indeed occur incrementally or hierarchically as described by instructional transformation” (Marcinkiewicz, p. 232). As would be expected with the proliferation of technology in education, Adams (2003) found that the percentage of users at the Utilization and Integration levels increased. The LCU now indicated normal distribution. Other findings demonstrated relationships between the LCU, SoC, and the Diffusion of Innovations adopter categories. There was a correlation between the LCU and SoC, and the adopter categories were aligning with the distribution of the SoC and the LCU. It appears that there exists a close connection between the models represented, and that they do provide valuable insights from different perspectives into technology integration.

Exposure to a Technology-Rich Environment

Since lack of access is a commonly referred to technology integration barrier, it is natural to assume that if this barrier were removed, the level of technology integration would be higher in technology-rich environments than in environments which still had lack of access as a barrier. This component of the literature review examines whether or not instructors will simply begin to integrate technology into their teaching if they are exposed to a technology-rich environment. If this were the case, unlimited access would seem to be the key predictor variable for the level of technology integration. However, the research is mixed in this regard, and the only relevant research for this portion of the investigation is from technology-rich environments.

Confirmation of this hypothesis can be found in two sources. First, over its ten years, the ACOT (Apple Computer, 1995) project found that teachers were able to progress all the way to Stage 4- Appropriation, rather quickly. With support, teachers reached this advanced phase in only a few months time. Without as much support, teachers still attained this advanced stage, but it took longer. The second source of confirmation is not as strong, but it is specific to the university under investigation. Kontos (2001) did not measure the actual levels of integration at this laptop institution, but did ask some important questions. He found that 93% of faculty believed that the laptops improved their technology skills and that nearly 80% enjoyed working at a laptop university. Although not a direct assessment of integration levels, technology skill levels and attitudes toward the innovation are variables that will affect use. The results indicate that at least on the affective level, a technology-rich environment aids technology integration.

Findings contrary to the aforementioned hypothesis are also available. Cuban (2001) noticed that technology integration into teaching was falling short of expectations at both the high school and university levels. In an intensive investigation into technology use at two technology-rich high schools, he proved that “despite abundant access to information technologies in both high schools, and contrary to expectations of promoters, teachers made infrequent and limited teacher use of computers in classrooms" (p. 97). Similar results were found at Stanford University where most faculty are serious technology users, but they did not incorporate these same tools into the daily teaching. One weakness of Cuban's claim is that his definition of a technology abundant environment is still not technology-rich enough. For truly technology-rich environments, we should look at laptop programs because the key barrier of access has sufficiently been eliminated. In direct opposition to the studies which seem to indicate that exposure to a technology-rich environment will aid technology integration, Newhouse (2001a), discovered that over half (12/23) of the teachers remained nonusers after four years of the portable computer program at a secondary school.

Chapter Conclusion

One of the purposes of this literature review was to provide support for the study in terms of processes and research questions. In particular, the literature review lays the groundwork for the methodologies to be employed. The forthcoming chapter takes this framework and transforms it into the relevant components of the processes of this study.

Chapter Three

METHODOLOGY

This research is primarily descriptive, correlational, and explanatory, but is in no means experimental. It is an attempt to gather information about the complex relationships that exist amongst key variables with regard to the integration of technology into teaching and learning in a technology-rich environment. This investigation is focused on the affective, reported behavioral, and temporal aspects of the integration process from the perspectives of a faculty working in a technology-rich university.

The principal mode of enquiry for this study is quantitative in nature while the research is a case study. Within the framework of a World Wide Web-based questionnaire, the primary quantitative method employed is selected response items, while the qualitative technique, an open-ended response item, has a secondary role. The web-based questionnaire approach was selected due to a number of assiduously measured circumstances. First, prior technology integration research has established that a questionnaire can measure the variables under scrutiny (Hadley & Sheingold, 1993; Mills, 2002; Newhouse, 2001a). Second, Anderson and Kanuka (2003) have been able to identify a number of benefits to web-based questionnaires. Finally, since this research was conducted at a technology-rich university with campuses in two different cities, it seemed the ideal location to conduct web-based research into technology integration. Although not a true mixed methods approach, an open-ended item was included because as Berg (2001) has stated, “ by combining several lines of sight, researchers obtain a better, more substantive picture of reality” (p. 4). The two methods complement one another. It is expected that the open-ended response item will provide further insights into the variables under examination, that is, add more depth to the investigation

Study Participants

This study surveyed faculty members at a recently opened technology-rich Middle Eastern university. The entire faculty were invited to participate, approximately 288 teachers spread across both the Dubai and Abu Dhabi campuses. Partially because of this geographic barrier, the World Wide Web was selected as the medium from which to accomplish this research. Hence, a 75 item web-based questionnaire stored on a University of Calgary server (i.e., http://www.ucalgary.ca/~kwschoep/) was administered to participants (see Appendix A).

No general demographic data such as gender, age, or years teaching was collected because these variables were not considered to be useful for providing technology integration recommendations. It was thought to be more valuable to learn about the relationships between concerns, skills, and perceived barriers vis-à-vis technology integration since these can be altered and changed through sound technology planning and targeted professional development. However, some background information concerning the subjects is beneficial.

The participants are all expatriates with at least 3 years teaching experience coming from a variety of primarily Anglophone countries. As English is the medium of instruction at the institution, westerners dominate the faculty and the years of experience are a condition of employment. No faculty members have been in their position for more than 5 years because the university only opened in the fall of 1998. They all possess at least a Masters degree, but the vast majority have been accredited at the doctoral level. In relation to technological proficiency, there was expected to be a range of skill levels, but a basic skill level was expected to exist because “the university puts a lot of emphasis on information technology’’ (Kontos, 2001, ¶ 23). At the institution this emphasis is demonstrated through the laptop ownership program, the mandatory use of an electronic grade and attendance application, and the pervasive use of communication technology such as email.

Description of the Technology-Rich Environment

As has been mentioned, the cornerstone of this technology-rich environment is the laptop computer that is provided to each faculty member and student. Besides the laptops, a number of other resources make this institution technology-rich. Some of the more pertinent resources will be described to better illustrate the term technology-rich within this context. In addition to the physical resources, a short explanation of the professional development opportunities and technology support will be provided.

Regarding data storage and sharing, there are a number of external computer drives that allow faculty to share files with one another or with students. There is also a private drive specific for each campus computer user which can be accessed from anywhere on either of the two campuses. Many departments use these network drives to share important program information, but a number of departments use Blackboard™ for this purpose. Blackboard has the advantage of being accessible off campus. A number of faculty use Blackboard as an integral part of their face-to-face classroom. However, the university does not offer any pure distance learning courses at this time.

Every classroom in the institution is fully wired for high speed Internet access, and includes a digital projector and printer. In addition to wired Internet access, there a limited number of locations where wireless access is established. Wireless network cards are available free from the IT helpdesk. Besides the standard Office™ software installed on each computer, other more targeted software packages are available for download off the network. For example, the English department has a selection of English language learning applications. Currently, the university is very open to the purchase of additional software if its purpose can be explained and justified. Any faculty member is able to request a software purchase. Other types of technology such as digital cameras, audio devices, and a recording studio are also available and in use. The English department, for instance, has recorded all their own listening activities through utilization of the recording studio. The recordings are then delivered to the students as .mp3 digital audio files using the laptops.

Although the physical resources of this technology-rich environment are comprehensive, the professional development opportunities and technology support are rather weak. For nearly all of the past academic year, neither campus has had a technology trainer. This position, recently brought back, had been eliminated in the latest round of budget cuts. This meant that faculty had no one to turn to with concerning basic technology questions such as *how do I input data into SPSS?* While there are a few educational technologists employed, much of their time is spent trouble shooting applications such as Blackboard. Rarely, are they ever able to get out and work productively with faculty. This means that most professional development is provided by other faculty members on a volunteer basis. These professional development sessions are often organized by the Center for Teaching and Learning, a department with a mandate to help improve teaching at the university. However, no systematic or structured professional development program is in place. Regarding specific technical issues, the helpdesk is available, but they are often overburdened. Lack of immediate help can leave faculty and students frustrated.

Instruments

A strength of this web-based questionnaire is that it is concerned with the affective, behavioral, and temporal aspects of technology integration. No other methods were required to collect the data. More specifically, it was designed to investigate the relationships between faculty's perceived barriers to technology integration, level of technology integration, concerns toward technology integration, and exposure to a technology-rich environment. This will hopefully suggest reasons for the degree of faculty technology integration which could, in turn, guide future technology integration planning and professional development endeavors within the university. This documentation could also be utilized as a benchmark on which to evaluate growth or deterioration in technology integration over time.

The 75 item web-based questionnaire (see Appendix A*)* is separated into 4 sections which measure the abovementioned constructs. The first 3 parts, *Stages of Concern, Exposure to a Technology-Rich Environment, and the Technology Implementation Configuration Matrix* contain 54 closed response items. The final part, *Barriers to Technology Integration*, consists of 20 closed-response items and the only one open-ended item. Two of these sections have been developed out of CBAM research (Hall et al. 1973). The first, the SoC, measures beliefs and perceptions. The second, the TISCM, measures actual level of technology use. The Barriers to Technology integration section has also been guided by past research (Anderson et al.1998; Cuban, et al. 2001;

Hadley & Sheingold, 1993; Jacobsen, 1998; Newhouse, 2001b). Because of the rich research history of most of this instrument, very little was needed in terms of confirming its reliability or validity.

Part 1- Stages of Concern

The first section of the instrument is a slightly modified version of the SoC questionnaire (Hall & Hord, 2001). The SoC has been designed to evaluate the affective concerns of teachers as they navigate through the change or adoption process, which in this research is technology integration into teaching and learning. The SoC data will be used to answer part one of question 2, *In a technology-rich environment, what is the relationship between perceived barriers to technology integration and stage of concern?,* and part one and two of question 3, *In a technology-rich environment, what is the relationship between stage of concern and level of technology integration or exposure to a technology- rich environment?.*

Regarding the SoC modification, in the CBAM research of Newhouse (2001b), the word *innovation* in the questionnaire was replaced with *portable computer programme*, words more accurate for the study. Through personal communication with Hord, Newhouse confirmed that no additional instrument validation was required because of the instruments sound and respected research history. According to Hall and Hord (1987) the SoC questionnaire is the appropriate tool for evaluating concerns for research and studies in which the reliability of data is paramount. The test-retest correlations range from .65 to .86 and the estimates of internal consistency range from .64 to .83. The CBAM has been a respected and verified tool in educational research for over 30 years.

The Soc questionnaire contains 35 items which are individually rated along an eight-point continuum (i.e., 0= Irrelevant, 1 & 2= Not true of me now, 3 & 4= Somewhat true of me now, 5, 6, & 7= Very true of me now) designed to measure the feelings and perceptions of an individual towards an innovation, in this case technology integration. As with much research (Adams, 2003; Dooley et al. 1999; Newhouse, 2001a; Newhouse, 2001b), the key element under investigation will be the peak stage of concern which is identified through an accepted algorithm built around the results of the SoC questionnaire (see Appendix B). The stages of concern are representative of an increasing sophistication in relation to the innovation. The stages of concern from novice to expert are: Stage 0- Awareness, Stage 1- Informational, Stage 2- Personal, Stage 3- Management, Stage 4- Consequence- Stage 5- Collaboration, and Stage 6- Refocusing. The stages of concern can be further collapsed into groups based upon the work of Fuller (1969) which identified four levels of concerns: unrelated, self, task, and impact. These two methods of identifying the stage or level of concern regarding technology integration were used as natural research groups. Due to limited sample size (n= 69), classification according to Fuller's stages seemed most appropriate. If the CBAM was used directly, the limited number of subjects within each stage would have hindered the trustworthiness of the statistical analysis.

Part 2- Exposure to a Technology-Rich Environment

The second part of the questionnaire is the most concise and least complex of the four sections. It is only one question and requests information concerning exposure to a technology-rich environment. The question will be used to answer part three of question 2, *In a technology-rich environment, what is the relationship between perceived barriers* *to technology integration and exposure to a technology-rich environment?,* and parts two and three of question 3, *In a technology-rich environment*, *what is the relationship between exposure to a technology- rich environment and stage of concern or level of technology integration?*. The question requires that the subjects select one of four lengths of time which best represent the number of years they have taught in a technology-rich environment. The four options have been selected because of the newness of the institution under investigation, the rapid changes that have recently occurred with regard to ICT, and prior research (Dwyer, Ringstaff, & Sandholtz 1990; Hall & Hord, 2001; Newhouse, 2001a; Rogers, 1995) which demonstrates that adoption of an innovation is a long-term process. This question is essential because it will permit an investigation into the *slow evolution* process posited and refuted by Cuban et al. (2001). They claim that Rogers' *Diffusion of Innovations* position, that is, increasing numbers of teachers will integrate technology gradually over time is not accurate. This section again provides natural research groupings to be compared against the other variables under scrutiny.

Part 3- Technology Implementation Standards Configuration Matrix

The third section of the questionnaire is the 18 item TISCM designed by Mills (2002) as an actualized IC map capable of measuring the level of technology integration. Hence, it is used to answer part two of question 2, *In a technology-rich environment, what is the relationship between perceived barriers to technology integration and level of technology integration?*, and parts one and three of question 3, *In a technology-rich environment, what is the relationship between level of technology integration and stage of concern or exposure to a technology-rich environment?*. The 18 items are divided into three skill sets or phases: Phase 1 (Items 1-6)- *Using Technology as a Tool for*

Professional Productivity, Phase 2 (Items 7-12)- *Facilitating and Delivering Instruction Using Technology*, and Phase 3 (Items 13-18)- *Integrating Technology into Student Learning*. Through selection of the most appropriate of the five descriptors ranging in numerical value from 0 to 4 at each item, a score is calculated. Each subject is calculated an overall technology integration score and a score at each of the three aforementioned phases. The higher the overall scores, the more advanced the subject is in terms of integrating technology. The most advanced technology integrator is labeled an *Integrator;* the least advanced technology integrator is labeled an *Operator;* the mid-range technology integrator is labeled a *Facilitator*. Mills found that the internal consistency of the TISCM provided an alpha coefficient of .91. Further analysis (Mills & Tincher, 2003) has demonstrated that the TISCM is an effective tool for evaluating the level of technology integration. A Cluster analysis provided the creation of groups of participants. Data analysis will focus around the subjects' identified group in relation to the other research variables.

Part 4- Barriers to Technology Integration

The final part to the questionnaire pertains to the perceived barriers to technology integration and is comprised of 21 items. Because the perception of barriers is fundamental to this research, it helps answer research questions 1 and 2. For the first 20 items, respondents use a 5-point scale (i.e., 1= Strongly Disagree, 2= Disagree, 3= Undecided, 4=Agree, 5= Strongly Agree) to indicate the degree to which they perceive an item to be a barrier. They then respond to one open-ended statement which asks for any additional barriers. Past research (Anderson et al. 1998; Cuban et al. 2001; Hadley & Sheingold, 1993; Jacobsen, 1998; Newhouse, 2001b) guided the creation of the list of barriers. It was felt that an adapted list was required because the commonly reported barrier of poor access to technology was not a concern in this technology-rich environment. The information garnered from the open-ended item will be analyzed qualitatively and be explored to identify any common themes in the responses. The closed-response items will be scrutinized with descriptive quantitative techniques and then examined for any relationships that may exist between the other variables.

Procedure

Web-based Questionnaire Pilot Study

The web-based questionnaire was designed by the current researcher using a combination of HyperText Markup Language, Cascading Style Sheets, and JavaScript. In terms of its web design, it was tested on a variety of Windows™ operating systems and a number of Internet Explorer™ browsers. The focal point of the web design compatibility concerns dealt with usability in an IBM ThinkPad™ environment with a Windows™ operating system using a newer version of Internet Explorer™ because this is the dominant configuration that is provided to the instructors as part of the laptop program at the university. Since much of the questionnaire came from well-established measurement tools, very little user feedback was sought regarding the content of the questionnaire. It was basically the assembly of individually respected parts into a never before developed whole to best meet the needs of this research. However, three faculty members did review the questionnaire for usability and content concerns. They were very pleased with the usability and design of the questionnaire, but one faculty member did ask for clarification on some of the SoC questions. Revisions were made throughout the pilot process to ensure that the best possible questionnaire was developed. These faculty members did go on to participate in the main study.

Recruitment

Participants were recruited for this study through email invitations which described the purpose of the research and procedures involved in participation (see Appendix C). After the initial email invitation had been sent on February 17, 2004, two other identical email invitation reminders reinforcing the purpose and procedures of the research were sent to faculty at intervals of one week and two weeks. Informally, the researcher was able to speak with and advertise to potential participants in the hallway or over lunch as part of the collegial environment that is enjoyed at the institution. The aforementioned recruitment techniques resulted in 69 faculty members agreeing to participate in this research project. This means that 69/288 (24%) of all the faculty responded.

Web-based Procedures

There exist some unique issues when utilizing the World Wide Web to conduct research. Because of this, the following section will describe the distinctive procedures and concerns involved in completing this web-based questionnaire. This will include the actions taken to complete the questionnaire and examinations into the guarantee of confidentiality and assurance that participation was voluntary.

Through the initial email invitation and subsequent email reminders, all possible candidates were provided with the web link for the questionnaire and were granted access to the web-based questionnaire website through the use of a project-wide password. The first page of the website was a welcome page used to confirm that the participant has arrived at the correct location and which provides instructions for entering the password protected portion of the website (see Appendix D). The instructions were to simply enter the username and password that were supplied with the email and to click the *Enter* button. Once inside the password protected section of the website, the first step for participants was to read the consent form (see Appendix E). The participants were unable to proceed to the questionnaire itself until the terms of this form had been agreed upon. The act of clicking the *I Agree* button on the consent page was tantamount to providing consent. Obviously, with web-based research, one is unable to collect a signature, but this method is considered legally binding by software vendors (Jacobsen, 1998). Next, subjects completed the four sections of the web-based questionnaire. JavaScript within the webpage ensured that all of the items were completed prior to submission. If a participant attempted to submit incomplete data, they were directed to return to the incomplete item or items. This method was selected because the SoC and the TISCM require complete data to be reliable. The entire questionnaire needed to be completed at one sitting. Following completion of the questionnaire, subjects clicked the *Submit* button to conclude the process. All submitted data was securely stored on a University of Calgary server. Upon successful data submission, participants were automatically linked to a *Thank You* webpage (see Appendix F) which ensured that the research results would be available at the completion of the project. Email contact information was provided throughout the website to be of assistance to the participants.

Submissions were completely anonymous and could in no way be traced back to individual faculty members. The data received stated that it had come from the University of Calgary and contained no traceable information. The quantitative data was then collected off the server and entered into SPSS 12.0™, while the qualitative data was pasted into MS Word™. Other than scanning for identical submissions, no other methods were employed to guarantee that no faculty member submitted more than one set of data.

Voluntary participation was guaranteed because of the rigorous process that needed to be completed in order to participate in this study. First, the candidates had to choose to link to the research website from the email invitations. Second, they chose to enter the username and password to come into the password protected portion of the website. Third, participants had to agree with the conditions stated on the consent form. Finally, they decided to submit the data upon completion of the questionnaire. They were free to stop their participation at any time, but their data could not be removed once submitted because of the anonymous nature of the questionnaire.

Web-based Research Issues

There are a number of issues, both positive and negative, that should be considered before one is to embark on web-based research. It is becoming an increasingly common method of conducting research which until recently remained rather unusual. Not a lot was known about this data collection method because it is so new. In a large comparative study concerning the trustworthiness of web-based studies, Gosling, Vazire, Srivastava, and John (2004) found that web-based "methods are of at least as good a quality as those provided by traditional pen-and-pencil methods" (p. 102). However, as Carbonaro, Bainbridge and Wolodko (2002) state, it is not yet possible to describe one process that would be successful in all situations, technological variance makes this impossible. Therefore, it is essential that researchers understand the key issues surrounding web-based research, so that they can make informed research decisions. This section will describe some of the more pertinent issues and then relate them to the current study.

One of the most commonly cited problems in conducting web-based research is that there are often difficulties with technology. Beaudin (2002) writes of computer crashes and submission problems, but claims that some of these issues are out of the control of the researcher and to some degree must be expected. On a related topic, Carbonaro et al. (2002), stress the importance of user testing and thorough browser and platform compatibility testing. Both of these technology-based concerns were minimized in this project through prior testing and by the fact that there exists a standard technology platform because of the laptop program. Another oft-cited issue is that of response bias (Anderson & Kanuka 2003; Carbonaro et al.). In this context, response bias is the belief that by using a web-based questionnaire, the data will be skewed towards technology-savvy instructors because only they are comfortable enough with the technology to participate in such research. At this institution, this concern has once again been minimized. It is a laptop university and all faculty have some basic technology skills as a condition of their employment. They have also been required to participate in a number of institutional surveys in the past.

Besides the problems, there are of variety of factors that positively influenced the utilization of a web-based questionnaire. The first consideration to a web-based format was given because the research was to be performed over two distinct campus locations. Researchers (Anderson & Kanuka, 2003; Beaudin, 2002; Jacobsen, 1998) have stated that a benefit of web-based research is the ease of which it can reach multiple geographic locations. The fact that no mail, postage, or paper was required to complete this questionnaire greatly simplified the data collection and saved money. Another determining factor for selecting web-based research was that data collection is immediate and can be easily transferred to SPSS with very little coding error (Carbonaro et al. 2002; Beaudin; Jacobsen). The speed and accuracy at which data was gathered and entered into SPSS was a major strength of the web-based research. Through the use of a cumulative data file stored on a University of Calgary server, this benefit was realized.

Chapter Conclusion

The next step after the collection of the data is to analyze and interpret the findings. Hence, the upcoming chapter will describe the findings of the selected research methods. The focus of this chapter is therefore a robust statistical analysis and to a lesser degree, a qualitative interpretation.

Chapter Four

ANALYSIS AND INTERPRETATION OF RESULTS

This chapter summarizes and presents the questionnaire results from this study. Data collection occurred between February 17, and March 9, 2004. The questionnaire data has been subjected to a number of statistical analyses in order to explore, describe, and better interpret the findings. Results will be reported according to each of the components of the questionnaire. Once this preliminary analyses has been completed, the relationships between these sub-scales will explored in order to answer the fundamental research questions. Qualitative data from the open-ended response item will be analyzed separately from the quantitative data because of the limited responses provided.

Data Collection Issues

Complete questionnaire data was collected from 69 faculty members out of the possible 288 (24% return). Of these, 68 completed the web-based version while one participant provided a paper version because of technical problems encountered during data submission.

Data collection issues need to be addressed especially since this survey was only available on the web. It was thought that a baseline of technology skills would exist at the institution because, as a laptop university, faculty have been exposed to and are expected to communicate electronically. In fact, the faculty have been required to complete web-based surveys concerning a number of university matters. It seemed logical to assume that fear or lack of technology skill would not have kept people away from the questionnaire. Nevertheless, a number of faculty made comments pertaining to difficulties completing the web-based questionnaire. The difficulties have been categorized as either questionnaire entrance problems or data submission glitches. These or similar problems may have occurred more often than is known by the researcher, but it is impossible to determine the exact number of problems experienced.

With reference to questionnaire entrance problems, a variety of separate incidences occurred. Two participants contacted the researcher via email in order to explain that they were unable to enter the questionnaire after entering the password and username. In both cases, they were provided with a separate link to access the questionnaire directly. Through follow up correspondence, they stated that they had subsequently been able to complete the survey. One participant contacted the researcher after receiving the initial invitation to participate in the research and stated that he would gladly participate in the study. He requested that the researcher forward him the questionnaire. In reply, the researcher commented that the method of data collection was in fact a web-based questionnaire; however, a paper-based version would be supplied if that was desired. Further follow up with this person confirmed that he had completed the web-based questionnaire instead of the paper-based questionnaire which he had originally requested. Another participant contacted the researcher with a request for the username and password. This was provided and he was able to submit the survey.

A number of minor technical problems regarding data submission were also experienced. It was obvious from the data in the database that some participants had submitted more than once. Identical data, including comments, appeared consecutively but a few seconds apart on the recorded submission times. Hence, the repeat copies were eliminated from the records. One participant was unable to submit, so she supplied a finished paper version of the questionnaire. This participant explained that she had received the *The page cannot be displayed* error webpage upon submission, so she printed up the questionnaire. She also emailed the questionnaire webpage which she had saved on her computer, but unfortunately the results were not present upon receipt of this email attachment. The webpage did not save the results of the HTML form. Only the webpage minus the selections was received.

A final colleague approached the researcher and said that they had participated in the study, but they were not forwarded to the thank you page after submission. It is not known whether or not this data was entered into the database. Beaudin (2002) also encountered these data submission errors. It would seem that the web still remains a volatile entity with regard to data collection. Perhaps the benefits of using more sophisticated software designed especially for electronic data collection such as described by Anderson and Kanuka (2003) remains the best alternative.

Categorization of Participants according to Results

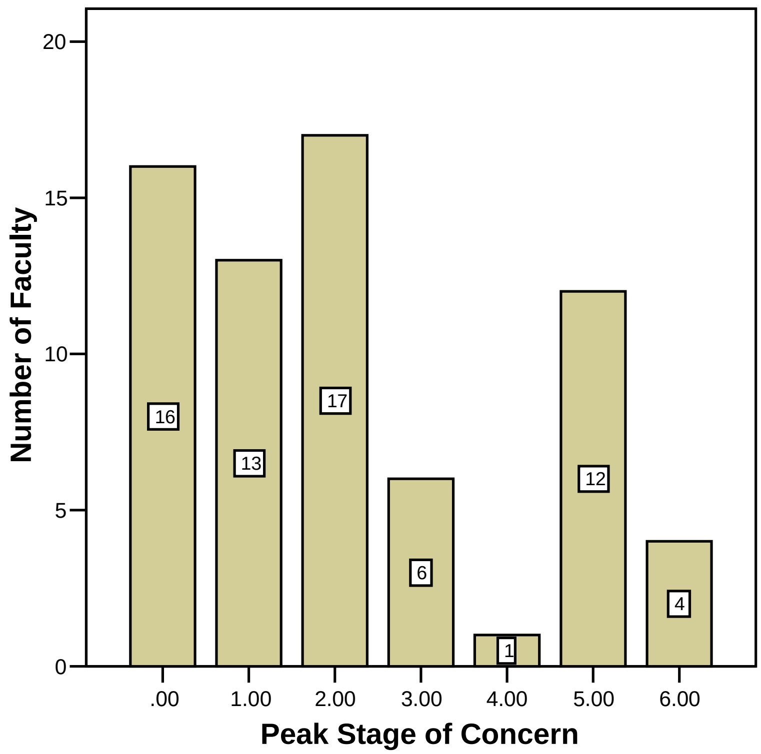
Results from the Stage of Concern questionnaire, the Technology Implementation Configuration Matrix, and the length of time having taught in a technology-rich environment, were used to label the participants. For the sake of transparency, all of the questionnaire items include the number of times each option was selected (see Appendix A). The Stages of Concern questionnaire relies upon the execution of a number of operations. Once completed, the researcher is able to determine the peak stage of concern through the utilization of a percentile rank table. According to Hall et al. (1986) all stages other than Stage 0 can be directly interpreted based upon this peak stage. However, Stage 0- Awareness, is a stage in which both users and non-users may register a high score. This is because they interpret the Stage 0 statements differently. The non-users rate these statements highly because they are in no way yet concerned with the innovation. They do not even think about it. The more advanced users may rate these statements highly because they have progressed so far past these statements. They have moved so far beyond these statements that they are no longer pertinent to them, so they are in no way concerned with them. Hall et al. (1986) also claim that other sources of data which provide judgment of whether or not the person is a user of an innovation may be used to categorize the participants. Because of this, it may be necessary to also analyze the scores from Stages 1 and 2 for those at Stage 0. Generally, nonusers will also have high scores at these stages while users will not. A total of seven faculty members were reclassified by looking at both their Stages 1 and 2 scores and then identifying the next highest stage. This data was supported by the fact that all of these participants were categorized as the most advanced users according to the TISCM. The TISCM results themselves were not used as a direct way of re-categorizing all of those at Stage 0 because one of the goals of this research was to determine the relationship between these two measures. This would have contaminated the data by presenting a false correlation between the SoC and the TISCM. The results of the SoC questionnaire are in Table 5.

Table 5. Peak Stages of Concern

Stage of Concern	**Frequency**	**Percent**
6- Refocusing	4	5.8
5- Collaboration	12	17.4
4- Consequence	1	1.4
3- Management	6	8.7
2- Personal	17	24.6
1- Informational	13	18.8
0- Awareness	16	23.2

The results show that the most faculty are at the lower end of the concerns scale. This is an indication that faculty are concerned with the concept of technology integration. Figure 2 illustrates that 46 participants (66.7%) are at the elementary stages.

Figure 2. Number of Faculty with Each Peak Stage of Concern



"Another way to treat group data is to aggregate individual data by developing a profile that presents the mean scores for each stage of the individuals in a group" (Hall et al. 1986, p. 32). Using the percentile rank, this was done since it is a measure that will normally reflect the leading high and low stages of a group. Table 6 demonstrates the mean scores at each of the stages for all of the participants.

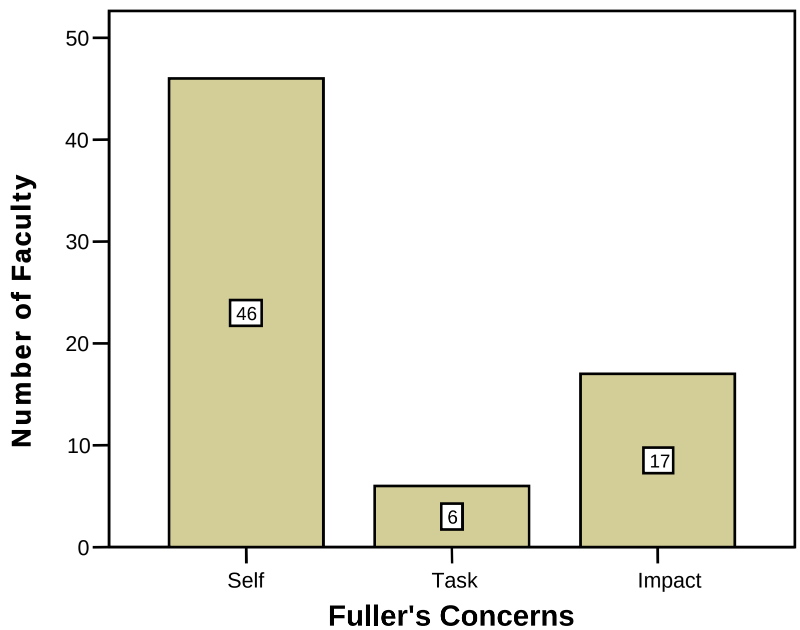
Table 6. Stage of Concern Group Mean Score

Stage of Concern	**Group Mean**
6- Refocusing	52
5- Collaboration	52
4- Consequence	33
3- Management	60
2- Personal	70
1- Informational	69
0- Awareness	81

This assumption was tested through the utilization of the Spearman correlation coefficient which is designed to analyze ranked variables. The number of faculty at each stage was correlated with the group means. Not unexpectedly, it measured .901 which indicates a powerful correlation and demonstrates that this is a fairly accurate measure. Basically, it demonstrates that the higher the group mean, the more dominant that stage.

Closely related to the Peak Stage of Concern is the construct of Fuller's Concerns. For the purposes of this research, these stages are simply an amalgamation of the Stages of Concern. Due to the limited sample size, the 3 categories provided by Fuller adequately group the data according to concerns. The Stages of Concern have been grouped together to form the Self, Task, and Impact stages as defined by Fuller. As Figure 3 illustrates, the first 3 Stages of Concern are combined to create the Self stage, the fourth Stage of Concern becomes the Task stage, and Impact stage is created through the amalgamation of stages 4, 5, and 6.

Figure 3. Number of Faculty in Fuller's Stages



Because these three groups are merely a merger between the Stages of Concern, the findings help to confirm the aforementioned interpretation which shows the dominance of the Self stage in this study.

In order to group the participants according the their level of technology integration, the TISCM was utilized. Participants were labeled as either Integrators, Facilitators, or Operators based on their total score out of 72 (see Table 7).

Table 7. Number of Faculty at Each TISCM Level

TISCM Level	**Frequency**	**Percent**	**Mean – Max. 72**
Integrators	37	53.6	62.08
Facilitators	23	33.3	46.04
Operators	9	13	30.22

Integrators are the most sophisticated users while Operators the least sophisticated. The score out of 72 was garnered by taking the score out of four from each of the 18 technology integration items. Each item employed descriptions of 5 different levels of technology use. Zero points were awarded if *None of these* was selected and the scale moved progressively through varying levels of sophistication to one, two, three, or four points. Once the total score was calculated a cluster analysis was run in order to identify homogenous groups. The three groups from the cluster analysis became the three TISCM groups. Over half (53.6%) of the participants were classified as Integrators, and only 9 were labeled at the least advanced stage- Operators. Cronbach's alpha showed a reliability of .91 for this scale.

Of the 69 participants, nearly half (47.8%) stated that they have taught in a technology-rich environment for 5 or more years. The definition of technology-rich is an institution where neither the faculty or students are required to seek out technology. It is available to them at all times. A laptop university is one of the few environments where this definition is applicable. Only 2 (2.9%) of the faculty have worked in a technology-rich environment for less than one year. The remaining subjects (49.2%) have been in such an environment between 1- 4 years (see Table 8).

Table 8. Exposure to a Technology-Rich Environment

Years	**Frequency**	**Percent**
5 or more	33	47.8
3-4	27	39.1
1-2	7	10.1
Less than 1	2	2.9

Barriers to Technology Integration

Although there is a wide range to the degree in which faculty members integrate technology, all faculty experience barriers to technology integration. To examine the degree to which barriers were identified, participants were given 20 statements to indicate their level of accord. The items employed a Likert scale (1- Strongly Disagree- not a barrier, 2- Agree, 3- Undecided, 4- Agree, 5- Strongly Agree- a major barrier). Cronbach's alpha showed a reliability of .80 for this scale. This indicates a strong level of internal consistency. Table 9 lists the items in a descending manner for level of agreement according to the item's mean score. The dichotomous score for each variable has also been included. This score was calculated by assigning 1 point for either a Strongly Agree or an Agree and no value for the other options. Hence, the maximum score that could be achieved on this scale was 69. This scale is useful in identifying the number of times a barrier was actually identified as being a barrier. The following section will first discuss the barriers according to their mean score and then in relation to the dichotomous score.

Table 9. Rank of Barriers to Integrating Technology

Item	**Mean**	**Std. Dev.**	**Dich.**	**Dich. %**
Faculty unsure as to how to effectively integrate technology.	4.04	.812	58	84.1%
The current reward structure does not adequately recognize those utilizing technology.	3.88	.993	45	65.2% **
There are no program standards as to what is expected for teaching with technology.	3.84	.993	47	68.1%*
There is a lack of sufficient technology training.	3.67	1.159	47	68.1% *
There is a lack of technical support regarding the technology.	3.61	1.191	44	63.8%
Faculty do not have sufficient time to integrate technology.	3.61	1.297	42	60.1%
There is a lack of support from administration.	3.52	1.119	39	56.5%
There is inadequate financial support to develop technology-based activities.	3.39	1.166	33	47.8% **
Faculty lack basic technology skills.	3.36	1.029	36	52.2 *
Technology training is offered at inconvenient times.	3.35	1.122	33	47.8
Generic technology training is irrelevant to teacher needs.	3.26	1.171	31	44.9
The curriculum does not allow enough time to integrate technology.	3.09	1.257	30	43.5
Faculty is not interested in integrating technology.	2.90	1.002	24	34.8
There is not enough evidence that using technology will enhance learning.	2.81	1.047	18	26.1 **
Technology is unreliable.	2.81	.974	19	27.5 *
Classroom management is more difficult when using technology.	2.54	1.119	18	26.1
Software is not adaptable for meeting student needs.	2.41	.828	7	10.1 **
Technology does not fit well for the course I teach.	2.30	1.142	13	18.8 *
There is a scarcity of technology for faculty.	1.97	.891	6	8.7
There is a scarcity of technology for the students.	1.88	.883	5	7.2

* The dichotomous rank is higher than the mean rank
** The dichotomous rank is lower than the mean rank

The current study found that faculty's knowledge as to how to effectively integrate technology and the shortcomings of the current reward structure were the most highly identified barriers. As would be expected in a laptop environment, the least identified statements were “there is a scarcity of technology for faculty” and “there is a scarcity of technology for the students.” The three other most highly rated barriers, lack of program standards, lack of technology training, and lack of technical support, paralleled the findings of the open-ended response item which asked for elaboration on technology integration barriers.

Interestingly enough, the barriers rated at the extremes, either as a major or inconsequential barrier, also recorded the smallest standard deviation. Only 7/20 barriers had a standard deviation of less than one. Of these, none were ranked from major to inconsequential barrier in positions 4 through 14. This means that the opposite ends of the scale had the least amount of variance and indicates a higher level of agreement for these items. The most neutrally ranked barriers also exhibited the highest standard deviations; hence, these results indicate that additional analysis is required.

As would be expected, the dichotomous scores showed general agreement with the mean rank. The Spearman correlation coefficient, designed to analyze ranked variables, measured .885 which indicates a very strong correlation. Only eight items were recognized as barriers by more than half of the respondents. These items in descending order from most strongly identified as a barrier to the weakest of the agreed upon barriers are:

1. Faculty unsure as to how to effectively integrate technology.
2. The current reward structure does not adequately recognize those utilizing technology.

3. There are no program standards as to what is expected for teaching with technology.
4. There is a lack of sufficient technology training.
5. There is a lack of technical support regarding the technology.
6. Faculty do not have sufficient time to integrate technology.
7. There is a lack of support from administration.
8. Faculty lack basic technology skills.

It appears that most faculty believe that the software and hardware is adequate. The weakness of the program is lack of training, support, time, and professional development that would help foster technology integration.

The largest discrepancy occurred between the statements “software is not adaptable for meeting student needs” and “technology does not fit well for the course I teach.” Only seven participants selected the software item as a barrier while a full 13 participants stated that technology did not fit well with their course. However, these items ranked according to their mean had software as the higher ranked barrier. The dichotomous ranks also confirm that the vast majority of faculty believe that there is more than enough technology available to both faculty and students, and that the lack of faculty knowledge as to how to integrate technology is the major barrier.

In addition to the aforementioned mean and dichotomous data, an exploratory factor analysis of the barrier items was conducted. The factor analysis was done in order to learn how the barriers may be related to one another. For the purposes of the study, only the strongest positive relationships (above .40) have been shown. (see Table 10).

Table 10. Barrier Factor Analysis

Component 1 **Eigenvalue- 4.62**	**Factor Loadings**	**Variance Percentage**
There is a lack of technical support regarding the technology.	.826	13.62
Technology training is offered at inconvenient times.	.801	
There is a lack of sufficient technology training.	.712	
Component 2 **Eigenvalue- 3.55**		
There is a lack of support from administration.	.665	13.01
The current reward structure does not adequately recognize those utilizing technology.	.804	
Faculty is not interested in integrating technology.	.448	
Faculty lack basic technology skills.	.488	
Faculty unsure as to how to effectively integrate technology.	.617	
There are no program standards as to what is expected for teaching with technology.	.582	
Component 3 **Eigenvalue- 1.84**		
Technology is unreliable.	.505	12.77
There is a scarcity of technology for faculty.	.901	
There is a scarcity of technology for the students.	.907	
Component 4 **Eigenvalue- 1.6**		
Faculty do not have sufficient time to integrate technology.	.779	12.31
The curriculum does not allow enough time to integrate technology.	.714	
There is inadequate financial support to develop technology-based activities.	.711	
Component 5 **Eigenvalue- 1.21**		
There is not enough evidence that using technology will enhance learning.	.767	11.13
Technology does not fit well for the course I teach.	.671	
Software is not adaptable for meeting student needs.	.583	
Classroom management is more difficult when using technology.	.500	
Component 6 **Eigenvalue- 1.05**		
Generic technology training is irrelevant to teacher needs.	.925	6.44
Total Variance Explained		69.28

The factor analysis (using varimax rotation) identified six separate components (related variables)which account for nearly 70% of all the variation. A further analysis of the components was done which involved identifying the mean of each of the relationships from the Likert scale measure. This same analysis was done using the total dichotomous score. Table 11 demonstrates the complete agreement between the ranks. Both measures confirm that the barriers within Component 3 were perceived to be of little consequence, while the barriers within Components 1 and 2 were major obstacles to technology integration.

Table 11. Component Rank Comparison

Rank	**Likert Mean**	**Component**	**Dich. Mean**	**Rank**
2	3.54	1	41.3	2
1	3.59	2	41.5	1
6	2.22	3	10	6
3	3.36	4	35	3
5	2.52	5	21.25	5
4	3.26	6	31	4

The components provide additional insight into the relationships between the barriers. The following section will label these components according to the composition of the individual barriers if a relationship is evident.

The common theme amongst the items which encompass Component 1 is that of a lack of technology training and support. The three barriers in this group accounted for nearly 14 % of the total variance. In addition, the items were very tightly loaded with the lowest item registering .71. This component was also the second highest rated as a barrier.

Another easily identifiable relationship exists between the barriers that are Component 3. The significance of this component is that it has been established as of the least consequence because it ranks at the bottom of both the scales. The three items were extremely strongly correlated. Two of the items were above .90 while the third item registered above .50. The theme for these items seems to be related to the technology-richness of the institution. Two items pertain directly to the adequate amounts of technology at the university and the third is a refutation that technology is unreliable. Participants strongly believe that the institution is a technology-rich environment.

Although Component 2 is a larger component than any other which emerged, it also had a dominant theme. It included 6 barriers which ranged in factor loadings from .80 to .49 and still accounted for over 13% of the total variance. It was also rated as the most dominant barrier. The theme around which these barriers are grouped is the lack of general technology support. Whereas Component 1 was specific to training, this component was far more general. It included such items as lack of reward structure, lack of program standards, and faculty unsure as to how to integrate technology.

The fourth component accounted for 12.31% of the total variance and had three items with a range of .71 to .79. The component was the third most strongly identified regarding barriers. It had a rather neutral group mean for the Likert scale of 3.36. The most obvious theme is that of the lack of time. Two items are time items and the third item claimed there is inadequate financial support. All of these items are obvious external barriers that have had a more dominant role in previous research. Both Beaudin (2002) and Jacobsen (1998) found that lack of time was perceived to be the strongest barrier to the integration of technology.

Component 5 lists four barriers which seem to be grouped according to the general lack of belief as to the efficacy of technology use in the classroom. However, these items were only the second lowest ranked barriers. These items accounted for 11.13 % of the variance, and had factor loadings from .50 to .77. Items such as *there is not enough evidence that using technology will enhance learning* and *technology does not fit well for the course I teach* typify the comments from technology non-users.

The final component is comprised solely of the barrier which claims *generic technology training is irrelevant to teacher needs.* This component is a bit of an anomaly because it would seem to be very closely related to Component 1 which is themed around lack of training and support. However, the factor analysis did not indicate a strong relationship. It was the fourth rated barrier component and had both the mean Likert score, 3.26, and the dichotomous barrier score, 31, which were closest to the centre.

Open-Ended Response Item

There was one open-ended item, and it asked participants to provide any additional barriers to technology integration. This item was completed by 36 out of the 69 participants (52.2%). The average length of response was 46 words, while the range was from only 4 words to 124 words. Due to the limited number of responses, this data will be reported as a whole rather than divided into the groups used in the quantitative analysis. The four major themes which emerged through the coding process were lack of support, lack of training, lack of curricular integration, and a general disbelief in the efficacy of teaching with technology. The following section summarizes this data, and provides representative excerpts for each of the themes.

The first major theme that emerged was that of a general lack of support. This barrier is very broad and encompassing, but one that is continually mentioned. One faculty member said that “*The complete lack of support is a major problem.”* Another elaborated on this by stating that "*Many people come here with high hopes because it is a laptop university, but they loose hope after a while because of limited support.*" This support seemed to quite often refer to people to turn to for help. It is believed that the IT helpdesk is unable to cope with the demands put on them. The statement: "*The people at the help desk are too busy*" is representative of the sentiment. Another colleague expanded on this concept by asserting that *"there needs to be people available to help teachers in the classroom.* To reiterate, the common idea behind the concept of support appeared to be having people available to provide support, whether this be for technical issues or pedagogical concerns.

The second emergent barrier, lack of training, is closely related to the first because it again relates to people. A faculty member wrote that *"the major problem at ZU is a lack of technology training."* However, training can only be provided if there are people whose job it is to train the faculty, and faculty do not believe this is being supplied. One participant wrote that there is a *"lack of really good trainers with the knowledge of how to combine pedagogy (teaching skills) and integration of technology into training."* The major focus of these comments was not training on specific software, but rather on "*practical demonstrations of how technology can be used in the classroom."* This belief was corroborated by the comment that *"faculty need to see exactly how they should integrate technology…don't just show Blackboard, show exactly how teachers who are successful are using Blackboard."* Further corroboration mentioned *"…the lack of appropriate 'modeling' of good practices in the use of IT for specific faculty purposes (i.e. how IT could facilitate realizing language learning outcomes)."* On a positive note, faculty look as if they recognize that training in software applications is not of great value. They require technology training that concentrates on the classroom.

Besides feeling that there are no people to turn to for either support or training, faculty also feel that technology integration is ignored by the curricula. The most comprehensive comment in this regard was: "*The integration of technology has no formal basis within the current university curricula. While there is no coherent or consistent use of technology throughout the university, other than the use of e-mail programs, integration is currently just a pipe dream.*" This desire for curricular guidance was substantiated by comments like "*if we are to integrate technology it should be an integral part of the core program…*" and "*when we change curriculum, we should also take advantage of the occasion to integrate IT within the curriculum.*" Many faculty identify lack of curricular integration as a major barrier to technology integration. They see curricular integration as a needed way to provide guidance for faculty.

The final major barrier to emerge from the data is that many faculty still perceive the use of technology in teaching as an unproven pedagogical method. Considering that the institution under scrutiny has been defined as technology-rich since it is a laptop university, this belief is surprising. One faculty member states that "*technology is NOT always a help. It may make things more interesting but my experience is students recall less (esp. w/ PowerPoint assists).---Not really a good way to teach human interaction and relationship development.*" This is supported by similar comments such as "*I am old fashioned in believing it is the teacher that makes the difference not the technology*" and "*I am very undecided about how faculty promote and enhance… learning through computers.*" One explanation as to why faculty feel this way is that " *in some cases at* *least, what may be 'gained' in terms of student learning isn't sufficient to compensate for all the 'up front' work involved."* This clearly relates back to both training and support because it would appear as though these faculty members do not fully understand methods to integrate technology into teaching. Some see it as nothing more than giving a PowerPoint presentation. One of the reasons that the TISCM was selected as a measurement tool is because it does provide examples of sophisticated learner-centered technology integration.

Relationships between Barriers and Emerged Groups

The first relationship to be investigated is that of barriers to technology integration and length of time having taught in a technology rich environment. The logical assumption in this regard is that the longer an individual has been exposed to a technology-rich environment, the greater the chances that they may in fact utilize the technology in their teaching. This, in turn, may change the way they perceive barriers to technology integration. This measurement was carried out in two ways using both the total barrier score and the dichotomous barrier score.

The first method utilized, compared the mean scores of the total barrier scale. This scale is used in an identical manner for the remainder of the relationships being investigated in this section. Since the 20 Likert scale items could be rated with a score of 1-5, the lowest possible score would be 20 and the highest possible scale would be 100. The higher the score, the higher the overall level of agreement or recognition of barriers. The lower the score, the lower the level of agreement or general belief of barriers. The largest group was those with at least 5 years experience in a technology-rich environment, and their mean was 62.36 which was neither the highest or lowest registered mean (see Table 12).

Table 12. Total Barrier Score by Exposure to a Technology-Rich Environment

Years	**Frequency**	**Mean**	**Std. Dev.**
5 or more	33	62.36	9.37
3-4	27	61	10.32
1-2	7	67.57	9.48
Less than 1	2	58.5	4.95

The lowest mean, 58.5, representing those with the least recognition of barriers was from the two participants with less than one year at a technology-rich institution. Because this group was only made up of two individuals, this data must be evaluated with caution. The group with 1-2 years experience had the highest mean score, 67.27. To determine if their were statistical differences amongst the Exposure groups, an one-way analysis of variance (ANOVA) was conducted. One way analysis of variance determined no significant difference ($p<.05$) between the groups (see Table 13).

Table 13. ANOVA of Exposure Groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	268.961	3	89.654	.949	.422
Within Groups	6141.851	65	94.490		
Total	6410.812	68			

The second scale utilized the total dichotomous score. This scale is used in an identical manner for the remainder of the relationships being investigated in this section. One point was awarded if either agree or strongly agree were selected on each individual Likert scale item. The highest possible score was 20. The lowest possible score was 0. As on the previous measure, the higher the score, the higher the overall recognition of barriers. The lower the score, the lower the general belief of barriers. Table 14 demonstrates that the lowest mean was again with the *Less than 1 year* group at 3.5. The highest mean was by the participants with 1-2 years of experience in a technology-rich environment. The two other groups ranging from 3 to 5 or more years experience were closely bunched with means between 8 and 9. For all of this data, there exists a large variance. Standard deviations range from 2.12- 3.77.

Table 14. Dichotomous Barrier Score by Exposure to a Technology-Rich Environment

Years	**Frequency**	**Mean**	**Std. Dev.**
5 or more	33	8.94	3.77
3-4	27	8.26	3.75
1-2	7	10	3.42
Less than 1	2	3.5	2.12

A one-way ANOVA was performed to evaluate if there were statistical differences amongst the groups. Results from this analysis again showed that no significant differences ($p<.05$) existed (see Table 15). Both of these results seem to

Table 15. ANOVA of Dichotomous Barrier by Exposure Groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	72.639	3	24.213	1.757	.164
Within Groups	895.564	65	13.778		
Total	968.203	68			

indicate that length of time having taught in a technology-rich environment does not affect the degree to which participants perceive barriers.

The second relationship to be discussed is that which exists between barriers to technology integration and the TISCM groups, which represent sophistication of technology integration. In descending order from most sophisticated to least sophisticated, the TISCM groups are Integrators, Facilitators, and Operators. The mean scores were very tightly grouped from 61.87 to 63.67 (see Table 16). The amount of variance was also similar. The standard deviations ranged from 8.30 to 10.73.

Table 16. Total Barrier Score by TISCM Group

TISCM Level	**Frequency**	**Mean**	**Std. Dev.**
Integrators	37	62.14	10.73
Facilitators	23	61.87	8.76
Operators	9	63.67	8.30

The data seems to indicate that there is strong accord between all of the participants but not between the separate groups. A one-way ANOVA confirmed this to be true (see Table 17).

Table 17. ANOVA of TICSM Groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	21.879	2	10.939	.113	.893
Within Groups	6388.933	66	96.802		
Total	6410.812	68			

This analysis found that there were no significant statistical differences ($p<.05$) between the TISCM groups. In fact, the barriers were weighted in a very similar manner to the previous Exposure groups.

Further analysis of the TISCM groups according to the total dichotomous score confirmed these findings. The means only ranged from 7.22 to 9.22 (see Table 18). Although all the groups selected less than half of the barriers as barriers, according to this measure, the most sophisticated users identified more barriers than did the least sophisticated users. This must be interpreted with caution because of the high level of variance for these means.

Table 18. Dichotomous Barrier Score by TISCM Group

TISCM Level	Frequency	Mean	Std. Dev.
Integrators	37	9.22	3.65
Facilitators	23	8.22	3.49
Operators	9	7.22	4.81

A one-way ANOVA determined that as interesting as these findings may be, there is no significant statistical difference ($p<.05$) between these groups (see Table 19).

Table 19. ANOVA of Dichotomous Barrier by TISCM Groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	34.464	2	17.232	1.218	.302
Within Groups	933.739	66	14.148		
Total	968.203	68			

It appears that, as a whole, there is general consensus amongst the faculty as to the impact of barriers, but there is no consequential disparity between the different level of user.

The association between concerns according to Fuller's groups and barriers to technology integration are the third to be analyzed. According to this scale, those with lowest-order concerns are at the Self stage, those with the medium-level concerns are at the Task stage, and those with the highest-order concerns are at the Impact stage. Comparing the means of the Total Barrier Score, demonstrated a range from 60.90 (Impact) to 72.17 (Task) with the Self stage at 61.46 (see Table 20).

Table 20. Total Barrier Score by Fuller's Concerns

Concern	Frequency	Mean	Std. Dev.
Impact	17	60.90	11.62
Task	6	72.17	7.28
Self	46	61.46	8.61

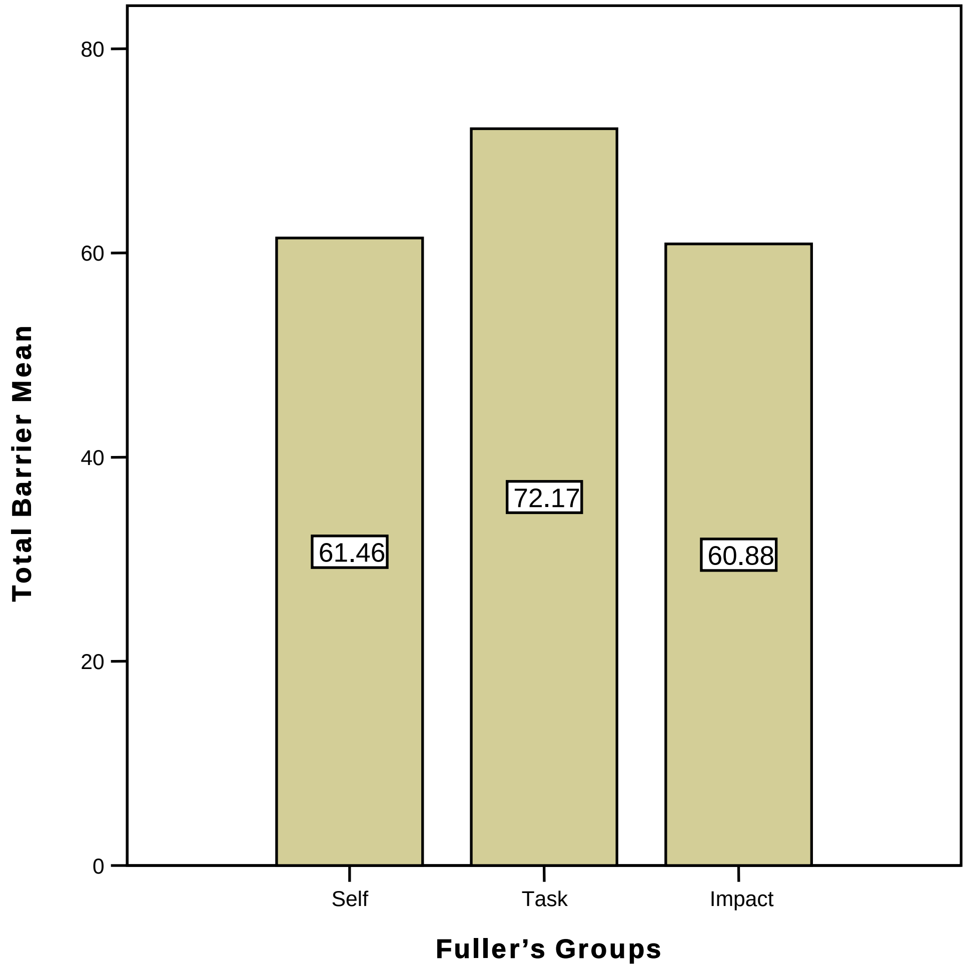
These mean scores are more widely dispersed than on any of the previous measures. A one-way ANOVA determined significant differences ($p<.05$) amongst the three Concern's groups (see Table 21). This means that the differences between the groups are more than would be expected by chance alone.

Table 21. ANOVA of Fuller's Groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	650.801	2	325.400	3.729	.029
Within Groups	5760.011	66	87.273		
Total	6410.812	68			

Figure 4 illustrates that the expected significant difference occurred between both the Task and Self groups and the Task and Impact groups.

Figure 4. Barrier Mean Score by Fuller's Groups



A post-hoc Tukey HSD confirmed that the significant differences ($p<.05$) did occur accordingly. This indicates that the Task group identifies with considerably more barriers to technology integration than do the lower or higher order participants. These same procedures were carried out on the Dichotomous Barrier Score as well in the hope to further support or refute the findings. Using this scale, the number of barriers cited by each group were once more closely clustered, but the mean of the Task group did appear to be somewhat larger than for the other two groups (see Table 22).

Table 22. Dichotomous Barrier Score by Fuller's Concerns

Concern	Frequency	Mean	Std. Dev.
Impact	17	9.1	3.85
Task	6	12.67	1.86
Self	46	7.93	3.62

A one-way ANOVA determined that a significant difference ($p<.05$) did exist amongst the variables (see Table 23).

Table 23. ANOVA of Dichotomous Barrier by Fuller's Groups

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	123.124	2	61.562	4.808	.011
Within Groups	845.079	66	12.804		
Total	968.203	68			

Consequently, a post-hoc Tukey HSD was performed to identify between which groups a significant difference existed. Results demonstrated a significant difference ($p<.05$) between only the Task and Self groups which is contrary to the previous results. However, the results would have been consistent with the Total Barrier Score if the significance level was set at the more conservative level of $p<.10$. The Concern groups' findings seem to indicate that those at the Task stage do notice or perceive more technology integration barriers than do the others.

The final relationships to be investigated exists between the components (like barriers) and all the abovementioned groups that have emerged from the data. The means were calculated for each of the components- this was calculated by calculating the means for each of the barriers which comprised the component. Following this procedure, one-way ANOVAs were done to discover if there existed any statistical significance. This was done for both the groups on one component and one group with all the components.

Very few of the relationships had any statistical significance. If a significance was identified, the amount of conflicting data was so great that it made analysis of this data nearly impossible. Hence, the mean scores were converted to a simple rank scale (1= strongest barriers, 6= weakest barriers). Tables 24, 25, and 26, demonstrate the ranks for each component with each individual group. This can then be compared to the rank at each of the other groups.

Due to lack of much statistical significance, only the most obvious or striking associations are of value. When the relationships amongst the TISCM groups are analyzed (Table 24), two concepts emerge. The first is the general agreement at one extreme. The technology-richness component is the least consequential barrier for all groups. However, with the component of most consequence there is disagreement between the less sophisticated users, Operators, and the more sophisticated groups. Both the facilitators and the integrators found general technology support to be of greatest consequence, but the Operators found lack of time to be the largest barrier.

Table 24. Barrier Components by TISCM Groups

Component	**Operators**		**Facilitators**		**Integrators**	
	Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
1- Lack of training and support	3.11	4	3.46	2	3.69	2
2- General technology support	3.37	2	3.49	1	3.71	1
3- Technology-Richness	2.52	6	2.51	6	2.18	6
4- Lack of time	3.43	1	3.44	3	3.3	4
5- Lack of belief	3.28	3	2.67	5	2.22	5
6- Generic technology training	3.11	4	3	4	3.46	3

General agreement was again found at the extremes amongst the Stage of Concern groups (Table25). Components 3, Technology-Richness, and 5, Lack of Belief, were ranked as either the fifth or sixth most consequential components. While at the other end of the scale, Component 4, Lack of time, was ranked as the most consequential barrier by users at the two advanced stages. This component was ranked a neutral third by those at the Self stage however. They felt that Component 2, General technology support, was the most important barrier. Regarding the other components, there was strong alignment amongst all of the groups.

Table 25. Barrier Components by Stage of Concern Group

Component	Self		Task		Impact	
	Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
1- Lack of training and support	3.41	2	4.1	1	3.73	2
2- General technology support	3.53	1	3.72	3	3.70	3
3- Technology-Richness	2.1	6	2.9	6	2.31	5
4- Lack of time	3.38	3	4.1	1	3.8	1
5- Lack of belief	2.6	5	3.29	5	2.01	6
6- Generic technology training	3.2	4	3.67	4	3.3	4

At this level of investigation, length of time having taught in a technology-rich environment did not appear to be of much consequence when looking at like barriers (Table26).

Table 26. Barrier Components by Exposure

Component	Less 1 year		1-2 years		3-4 years		5 or more years	
	Mean	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**	**Mean**	**Rank**
1- Lack of training and support	2.83	3	3.24	3	3.63	1	3.58	2
2- General technology support	3.33	1	3.81	2	3.51	3	3.63	1
3- Technology-Richness	2.67	5	2.43	6	2.06	6	2.28	6
4- Lack of time	2.67	5	4.05	1	3.35	4	3.27	3
5- Lack of belief	2.88	2	3.11	5	2.33	5	2.52	5
6- Generic technology training	2.5	4	3.14	4	3.52	2	3.12	4

A noticeable consensus emerged between the groups. Nevertheless, twice the ranks did indicate a lack of harmony. The most obvious involved Component 5, lack of belief. All groups with more than 1 year at a technology-rich institution discounted this component as a major barrier. Accordingly, it was the fifth ranked component. Those with less than one year at such an environment, still believed that there was a lack of evidence which demonstrated that integrating technology into the classroom would enhance learning. They ranked it as the second most powerful component. The other disagreement occurred on Component 4, Lack of time. Those with 1-2 years exposure, ranked this as the most important component, while the other groups either discounted it strongly or were mildly apathetic towards the item. The 1-2 year group identified lack of time to be of extreme consequence. It could be that people who have been at the institution longer have already developed materials, while the newcomers do not yet have such materials.

Relationships Between Emerged Groups

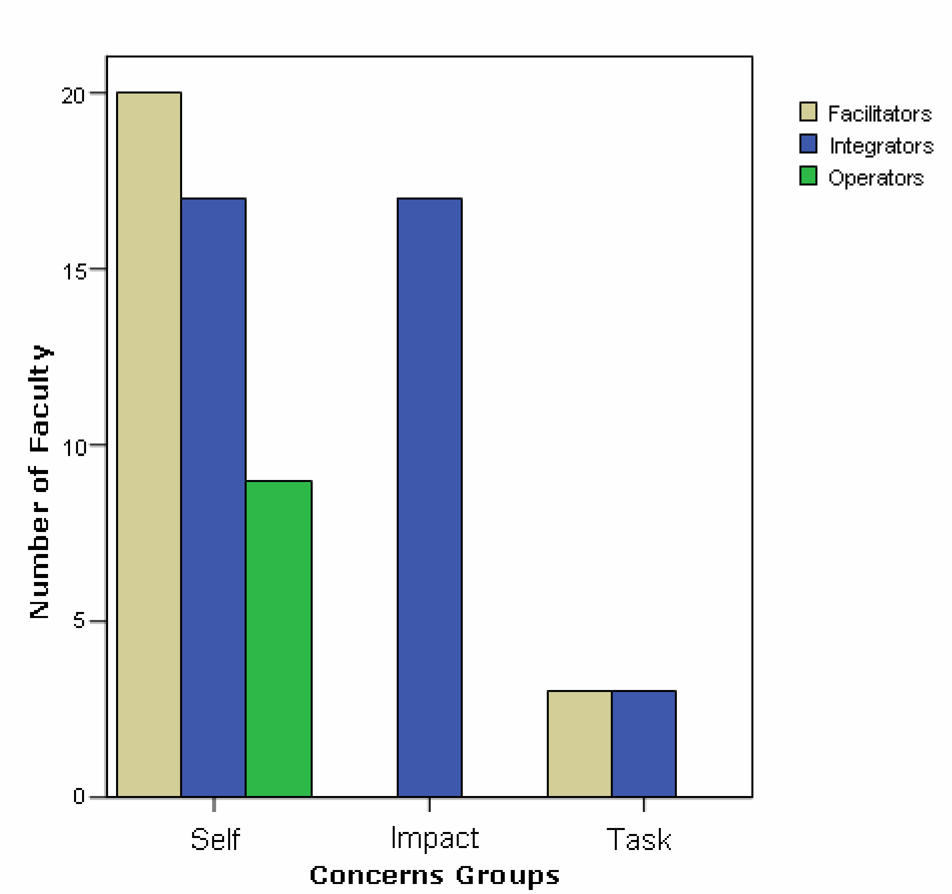
The final question that this study attempts to answer is what are the relationships between the groups that have emerged. Specifically, what are the relationships between

- level of technology integration and stage of concern?
- stage of concern and exposure to a technology-rich environment?
- level of technology integration and exposure to a technology-rich environment?

As Hall and Hord (2001) stated, a simple linear relationship between use and concerns, while intuitively pleasing, is far too simplistic. Only at the extreme ends of the scale does there appear to be an obvious relationship. Because of this uncertainty, it is essential to continue to probe these associations. Length of time having taught in a technology-rich environment (exposure) helps to evaluate the claim that over time people will adopt an innovation if it is desirable. The following section will endeavor to answer the abovementioned questions through the utilization of the most appropriate statistical operations.

The first relationship to be examined is that of level of technology integration and stage of concern. For this analysis, level of technology use was measured by the TISCM, and the stages of concern were taken from Fuller. Figure 5 demonstrates the distribution of the participants according to these classifications.

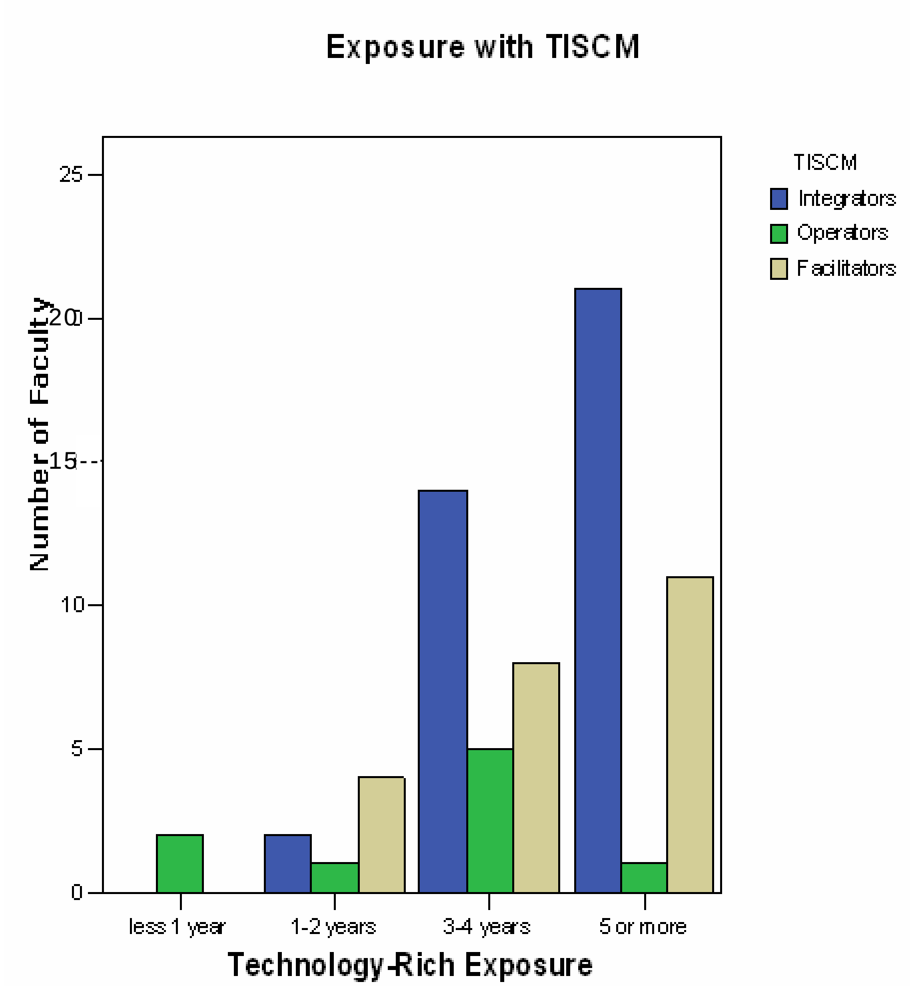
Figure 5. Concerns Groups with TISCM Groups



The chi-square test of comparison between level of technology integration and stage of concern was statistically significant, X2(6, N = 69) = 21.30, p = .000. Level of technology integration and stage of concern are related. The least sophisticated user according to the TISCM has been labeled an Operator. All nine of these users are also at the least advanced stage of concern which is the Self stage. The most advanced user is categorized as an Integrator. There are 37 (53.6%) people with this classification. Of these 37, 17 are at the highest stage of concern, 17 are at the lowest stage, and 3 are at the Task stage. The 20 participants at the more advanced stages of concern are expected. The 17 users at the lowest stage of concern seem to disprove the natural correspondence between level of use and stage of concern. However, the nine subjects recognized as the least erudite technology integrators, are also at the lowest stage of concern. This is supports the hypothesis which states that there is a linear relationship between level of use and stage of concern.

The second association to be analyzed is that of exposure to a technology-rich environment and level of technology integration. For this analysis, level of technology integration was again based upon the three groups that emerged out of the TISCM. Exposure was simply a measure of how long a person has taught in a technology-rich institution. The chi-square test of comparison between these groups was statistically significant, X^2 (6, N = 69) = 19.25, p = .004. This means that the concepts are related to one another. Figure 6 illustrates the distribution of participants according to these categories.

Figure 6. Exposure Groups with TISCM Groups



The most striking observation is that the most sophisticated technology users, Integrators, have also been teaching in a technology-rich environment for the longest period of time. Thirty-five out of the 37 Integrators have at least three years experience in such an institution. Yet again the technology-rich nature of the institution may demand of users a fairly high degree of sophistication. This complexity of use may be enhanced over time. The least advanced technology users, Operators, comprise just 9 (13%)of the total participants. Only one user has taught in a technology-rich environment for 5 years or more and remains at this rudimentary level. Facilitators are the medium-level users and make up 23 (33.3%) of the total users. Parallel to the most sophisticated users, none have less than one year at a technology-rich institution. The vast majority (19/23) of the Facilitators have 3 or more years of exposure. This data seems to support the hypothesis which states the longer a person is exposed to a technology-rich environment, the more they will integrate technology. However, the change process does seem to be very long term.

Stage of concern and exposure to a technology-rich environment is the final relationship to be examined. The chi-square test of comparison between exposure to a technology-rich environment and stage of concern was not statistically significant, $X2$ (6, N = 69) = 3.147, p = .790. Length of time having taught in a technology-rich environment and stage of concern do not appear to be related. Hence, no analysis of the cross tabulations have been performed.

Chapter Conclusion

A number of relationships have been probed and analyzed within this chapter. This analysis appears to demonstrate that, in general, a technology-rich environment does influence the perception of barriers to technology integration. In the upcoming chapter, these and other pertinent findings will be discussed in accordance with the research questions. In addition to this, the significance, limitations, further research suggestions, and recommendations from this research will be outlined.

Chapter Five

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

At its most preliminary stages, this research was conceptualized as a basic investigation into the degree of technology integration in a technology-rich environment. From these initial stages, the importance of both the change process and barriers to technology integration emerged. The established list of barriers and the Concerns Based Adoption Model (CBAM) appeared to be very appropriate tools from which to build this study. Nevertheless, the technology-rich aspect of the institution under investigation remained the key element to this study. Although a number of researchers have explored the construct of barriers, rarely has this concept been scrutinized at an institution that is not wanting of technology.

It was determined that a web-based questionnaire would be an appropriate data collection tool. The selected-response items along with the open-ended item provided similar information as to what faculty identify as barriers. These findings seem to both support and gainsay the findings of primary precursor work done by Hadley and Sheingold (1993), Jacobsen (1998), and Beaudin (2002). Much of the disagreement was not unexpected because of the technology-rich nature of the institution. The constructs described through the CBAM were essential to provide more depth and understanding in relation to one another and to barriers. These findings help guide the recommendations of this research.

The research results were first analyzed by identifying the characteristics of the participants. They were described according to their stage of concern, their level of technology integration, and the number of years having taught in a technology-rich environment. Next, the barriers to technology integration were evaluated according to their level of agreement. At this initial stage, the barriers were only evaluated according to the entire group data since the focus was on the barriers. The penultimate analysis involved the relationships between barriers to technology integration and length of time having taught in a technology-rich environment, stage of concern, and level of technology integration. This was done with the hopes of finding relationships between these emerged groups and the ways in which barriers are perceived. Finally, the data were analyzed according to the relationships between the groups. Amongst these groups there exists some intuitively pleasing and some empirically based associations, but these needed to be tested. The tighter the groups could be associated, the easier it would be to draw conclusions and make recommendations.

This chapter is organized to best present the discussion, conclusions, and recommendations of the research. Therefore, the chapter is initially structured in accordance with the three research questions. The first section will discuss question 1, *what do faculty in a technology-rich environment perceive as barriers to technology integration?* The second section is a description of the participants with regard to stage of concern, level of technology integration, and exposure to a technology-rich environment. Without this necessary background knowledge, it is difficult to appreciate the findings of the two remaining research questions. The third piece of this chapter will discuss question 2, *in a technology-rich environment, what are the relationships between perceived barriers to technology integration and…*

- *stage of concern?*
- *level of technology integration?*

- *exposure to a technology-rich environment?*

The next section discusses the results of question 3, *in a technology-rich environment, what are the relationships between…*

- *level of technology integration and stage of concern?*
- *stage of concern and exposure to a technology-rich environment?*
- *level of technology integration and exposure to a technology-rich environment?*

The chapter then offers an explanation of the significance of the research. In particular, the focus is on the technology-rich nature of the investigation. In order to candidly discuss the research results, the limitations of the study will then be described. The focus will be on the sample size and selection procedure, the generalizability, and the web-based instrument. This leads to the future research section which will describe what has been learnt and put forth by other questions that have emerged from the current study. The final section, recommendations, will tie together these research results with the accepted best practices regarding increasing the level of technology integration and the reduction of barriers.

Discussion

A discussion of the results coordinated with applicable prior research provides an in-depth understanding. Hence, the forthcoming section will discuss the research findings and their relationships to prior research. Occasionally, some suggestions as to how to overcome barriers are provided, but the majority of the recommendations follow in the next section.

Barriers to Technology Integration

As was anticipated, findings of the perceptions of barriers to technology integration both confirmed and contradicted prior work. It is perhaps within this construct that the influence of the technology-rich environment is most intense. This intensity is most evident when evaluating the overall rank of barriers. The following section will demonstrate the ways in which the current findings both affirm and refute prior research.

In the current study, scarcity of technology for either faculty or students was the least cited barrier. The barrier most referred to was the belief that faculty are unsure as to how to integrate technology. These findings were supported by both the mean scores and the dichotomous scores. It clearly appears that the technology-rich environment influences the perception of barriers, especially those that pertain to the accessibility of technology. This is understandable because availability of technology has been removed as a barrier. These findings were further supported through the factor analysis and subsequent component ranks. There was a strong consensus between the faculty members as to which barriers were of consequence and which were of little consequence. This is a powerful finding because this information can be used to design and create appropriate interventions. It is easier to target interventions if a consensus exists.

At times, the findings of this study differ from both the Jacobsen (1998) and Beaudin (2002) research possibly because of the technology-rich nature of the institution. At other times, there was accord. Both of those studies found that a lack of time to integrate technology and the difficulty in scheduling enough computer time for classes were the two dominant barriers. As was stated, these were not the most cited barriers in the current research. Concurrence between this study and the Jacobsen and Beaudin projects emerges when looking at the general theme of support. This includes such concepts as technological support, administrative support, and pedagogical support. Faculty or teachers in all of the studies did not feel as they were being provided with enough support to become effective technology integrators. Context specific support for this claim can be straightforwardly displayed. One of the core components for any university interested in integrating technology would be to have people whose job it is to train faculty in the use of the university's software. For the past year, no such person existed on either campus. Faculty had no one to turn to for basic software support or professional development. Any training that was being offered was done in a haphazard manner and relied upon volunteers from faculty and staff. It is very evident as to why faculty would feel that there is a lack of support. To summarize the findings of this section, the faculty feel that there is more than enough technology available to them. However, they do not believe that they are being supported, guided or rewarded in their attempt to integrate technology into their teaching.

There are a variety of recommendations that can be made in this regard. First, the university should restore, on a permanent basis, the position of IT trainer. Second, the university should try to create a more structured and permanent professional development program. This could be accomplished with the support of the Centre for Teaching and Learning. This is a department with a mandate to aid the development of teaching at the university. Finally, the institution could reward faculty in their attempts to integrate technology in their teaching by, for example, prioritizing the allotment of professional development funds to faculty members interested in pursuing technology related professional development opportunities.

Categorization of Participants

This section provides the background information which is necessary to interpret the answers to the second and third research questions. The faculty were classified according to three separate constructs, the affective aspect (concerns), the behavioral aspect (level of technology integration), and the temporal aspect (length of time having taught in a technology-rich environment) of technology integration. Regarding the Stages of Concern, 46 (66.7%) of the faculty were labeled at the elementary stages or the Self Stage. For this study, these lower order stages are characterized by either not being interested in technology integration, wanting to learn more about it, or being concerned as to how technology integration is going to affect them and their teaching. This means that most of the subjects appear to still be concerned with these issues and very little progression has occurred considering the technology available at the institution. These findings are supported by Newhouse (2001a) who found similar results in another study of a laptop program. He found that a full 53% of teachers remained at Stage 0 after 3 years. However, subsequent measures demonstrated that many of these teachers were actually technology users. This could be a demonstration of how a technology-rich environment forces faculty into levels of technology use that are beyond their stage of concern. The 17 (24.6%) participants that are at the advanced stages are concerned with improving the impact of technology integration on their teaching. They are already committed technology integrators, they are working to make it better. The remaining 6 (8.7%) users are currently attempting to integrate technology into their teaching. This means that some technical skills training and ideas on how to implement technology are their key concerns.

The level of use was measured using the TISCM . Mills and Tincher (2003) in developing this tool found the distribution of the teachers to be much less sophisticated or categorized as integrators than the results of this study (see Table 27).

Table 27. TISCM Results versus Current Project

TISCM Level	**Mills and Tincher**		**Current**	
	Percent	**Mean- Max. 72**	**Percent**	**Mean – Max. 72**
Integrators	35.9	60.46	53.6	62.08
Facilitators	43.6	47.56	33.3	46.04
Operators	20.5	28.63	13	30.22

While the mean scores for each of these groups are very similar, there are far more advanced users, Integrators, in the current research. In addition, this research had only 13% of participants at the lowest, Operator, level in comparison to 20% for Mills and Tincher. Perhaps, the technology-rich nature of the environment has an impact upon this distribution. That is to say, it is more difficult to remain an Operator in a technology-rich environment because much more is expected by the institution in terms of such things as electronic communication. It may also be easier to progress to an advanced level because of the availability of the technology, a barrier which has been eliminated in such a place.

The final way in which participants were grouped was according to the length of time having taught in a technology-rich environment (exposure). The significance of this variable is that it can be used to evaluate the impact of exposure on both use and concerns. Of the 69 participants, a full 60 (90%) had at least three years of experience in a technology-rich environment. This is a fairly significant number when one considers how few institutions currently fit the definition of technology-rich as defined by this research. However, the length of time (3+ years) may still be inadequate to witness substantive change in the levels of technology integration. According to the "slow revolution" explanation, more teachers will integrate technology over time, but this evolution could take decades (Cuban et al. 2001). Because of the lack of support and random nature of the professional development opportunities at the university, the dominance of lower order concerns is not unexpected. Exposure is obviously an important variable, but it does not facilitate integration on its own.

Relationships between Barriers and Emerged Groups

As previously mentioned, this research investigates concerns, use, and time constructs of technology integration. Within these constructs, participants were then grouped. The perception of barriers to technology integration were then measured according to these groups. The findings of this measurement answer the second research question. These results are herein discussed.

The first relationship to be investigated was that of the length of time having taught in a technology-rich environment in relation to barriers. The aspect of time is important because according to the "slow revolution" theory, levels of technology integration will increase gradually over time. Consequently, the weight given to barriers will decrease (Rogers, 2000). In this study, this decrease did not occur and whatever differences did appear were not statistically significant. This could be due to the fact that the adoption of an innovation could take far more years than was currently being measured. Although exposure did not alter the overall perception of barriers, once separated into components, some discrepancies emerged. It was found that those with less than one year teaching in a technology-rich environment still believed that there was a lack of evidence which demonstrated the benefits of integrating technology into teaching.

It could be that they have yet to buy into “teaching with technology” because of their lack of time at the institution. An appropriate professional development intervention here could be to have technology integrators showcase the ways in which they use technology. This may help to facilitate faculty buy in. Alternatively, providing release time to these faculty members to develop technology integrated materials could also be of benefit. Their peers, however, recognize its benefits because of the constant institutional rhetoric regarding its importance, and have witnessed its benefits firsthand. Some of these faculty members could showcase their work and accomplishments.

The association between concerns and barriers is the second relationship to be discussed. It appears that Stage of Concern is of consequence regarding the overall perception of barriers. The Concern groups’ findings seem to indicate that those at the Task stage notice or perceive more technology integration barriers than do the others. Perhaps since they are actively struggling to integrate technology, they are more able to identify barriers. In contrast, the Impact group may be so advanced that barriers are not nearly of as much consequence to them. Anderson et al. (1998) also found that the more sophisticated the user, the less concerned they are with barriers. At the same time, the Self group may be unaware of the impending barriers because they have not yet committed to the integration of the innovation. They still need to overcome negative attitudes towards technology integration before barriers become an issue (Rogers, 2000).

The relationship between the TISCM groups (level of technology integration) regarding overall perception of barriers to technology integration does not seem to be of consequence. However, when analyzed according to the components, one difference does exist. The least sophisticated users identified lack of time as the most overarching component, while the more sophisticated users identified general technology support. This demonstrates the dissimilar phases of implementation that the users are in. An explanation of this is that the advanced users find pedagogical and technical support an issue because they are actively attempting to integrate technology. They find or have found support to be problematic. The novice users do not have this problem because they have not yet needed to get support. They are simply wondering how to fit technology integration into their already hectic schedules. One way to overcome this barrier is to provide release time to the novice users targeted towards integrating technology into teaching since they have identified a lack of time as a dominant barrier.

Relationships Between Emerged Groups

This section attempts to answer the third and final research question which probed for relationships between the groups. Some relationships did emerge but only to a limited degree. With regard to the level of technology integration and Stage of Concern, a relationship did exist at the extremes. All nine of the least sophisticated technology integrators are also at the least advanced stage of concern. This is what would be expected. This data demonstrates an obvious correlation between the affective and behavioral domains. Adams (2003) also found that “those with higher integration levels also expressed higher-order concerns than those reporting lower integration levels” (p. 298). However, in this study, with the more sophisticated technology integrators, just under half (17/37, 45.9%) remained at the lowest stage of concern. These findings are counter intuitive and may be impacted by the technology-rich aspect of the environment. Because the institution is technology- rich, it may be that many of the participants are forced to perform many tasks identified in the TISCM even though they do not consider themselves to be sophisticated technology integrators. Their concerns have remained at the self stage, but the environment has forced them to become more advanced users. They are not committed and are probably reluctant about using technology.

To further explain the discrepancy between the SoC and TISCM results, one can turn to the recent history of the university for some context specific evidence. A recent survey conducted within the Readiness Program (a program that encompasses approximately 1/3 of the entire faculty), anonymously queried faculty about their level of technology skills. It was found that the overwhelming majority of the faculty had basic technology skills; that is, they were comfortable using resources such as the university network drives, email, and some standard productivity software. However, results from the current study seem to show that people remain very concerned with the integration of technology. This is key because it means that perhaps basic technology skills training is not that important, the type of professional development that is needed must revolve around showing ways in which technology can be effectively integrated into teaching with the goal of enhancing the learning environment.

The second relationship investigated is that of exposure to a technology-rich environment and level of technology integration. Again the concepts appear to be related. Thirty-five out of the 37 most advanced integrators have at least three years experience in a technology-rich institution and only one participant has remained a low level user after 5 years in a technology-rich environment. The data seems to support the hypothesis which states that the longer a person is exposed to a technology-rich environment, the more they will integrate technology. However, the change process does seem to be very long term. As Rogers (1995) claims, adoption periods can take from a few months to several years. One of the purposes of the current research is to identify methods to accelerate this process. The recommendations of this study attempts to do this.

Stage of Concern and exposure to a technology-rich environment was the final relationship examined. Hall et al.(1973) estimated that an adoption process would take between three to five years, so one would expect to find a significant relationship between these constructs. However, no important association existed. This is especially puzzling because the concepts of Stage of Concern and level of technology integration are related, and level of technology integration is related to exposure to technology.

Significance of the Research

The massive technology investments which are continuing to be made by institutions of higher learning should be examined. This is especially important since it now appears that the move towards laptop, or completely wired institutions, is inevitable. Nevertheless, the successful implementation of such programs is still in question. Having laptops for the purpose of enhancing the learning environment is very different than actually effectively integrating the technology into classroom teaching.

This fundamental commitment to a laptop learning environment has been made at the university under study. University President, Sheikh Nahayan Mabarak Al Nahayan, stresses the importance of using technology in teaching and learning to produce graduates prepared for the modern work environment (Zayed University, 2001). One of the requirements to achieve this goal is to have faculty capable of integrating technology into their classrooms. However, this can be difficult to achieve. For example, for the 2002 academic year, Duke University decided against requiring new students to purchase laptop computers because “faculty members aren't ready to use the technology in their classrooms”(Olsen, 2001, ¶ 1).

The significance of the current research is that more information as to what is occurring in a technology-rich environment can only enhance the likelihood of future successful technology integration programs or improvement to existing ones. Barriers are the stumbling blocks to achieving goals. By investigating barriers to technology integration, one can begin to plan for their eradication. This should enhance the chances of creating an environment in which technology is truly integrated into teaching and learning.

Limitations of the Present Study

This research has provided further insights into the role of technology integration barriers in a technology-rich environment. Obvious patterns emerged which demonstrate that technology-richness does alter the valuation of barriers. To a lesser degree, there also appears to be relationships between stage of concern and how barriers are perceived. However, many of the differences identified between the other research groups were not statistically significant. In addition, a number of limitations need to be considered when evaluating the research findings. The major limitations of the study were the sample size and selection of participants, generalizability, the data collection method, and interpretation of some of the questionnaire. This section will describe each of these limitations.

Sample Size and Selection

One of the major limitations to the present study is the small sample size. Despite following standard practice of sending an initial invitation followed by a number of follow-ups, the return rate remained fairly small (24%). This was not unexpected though since a foremost educational research company, Pearson NCS, generally attains a response rate between 15% and 25% for similar projects (NCS Pearson, 2004). Previous web-based research conducted into technology integration garnered a return rate of 31% (Beaudin, 2002).

Part of the explanation as to why such low return rates were achieved could be that approximately 1/3 of the faculty had been asked to participate in a very short (8 items) technology use questionnaire only 5 days prior to the commencement of this data collection. Additionally, during the previous term, an IT review team had visited both campuses to be able to provide recommendations as to how the university could increase levels of technology utilization. A number of faculty had met or had been interviewed by the team, so perhaps they had reached a saturation point regarding this topic. A final factor which may have negatively impacted participation rates is the fact that the university is in the midst of a restructuring. Positions may be lost. Obviously, this may affect a faculty members attitude towards the participation in an institutionally sanctioned project.

According to Gall, Borg, and Gall (1996), volunteer subjects are probably a biased sample of the population. Regarding the representativeness of this sample, the use of volunteers therefore makes it difficult to evaluate. Nevertheless, some estimations can be made because of what was found. A full 53.6% of the respondents were rated at the most sophisticated level of technology user which seems quite high. It could be that the very nature of this investigation, barriers to technology integration, was biased towards the more sophisticated technology user. That means that those with an interest in the topic participated, while the lower order users did not participate. While the data may be skewed towards the advanced user, it still provides some total group insights into the perception of barriers in a technology-rich environment. There did appear to be across the board consensus that certain barriers were not as significant in this type of environment.

Generalizability

Generalizability “amounts to nothing more than making predictions based on a recurring experience” (Colorado State University English Department, 1997, ¶ 1). However, it is the ability to generalize research findings that gives credence to much quantitative research. Unfortunately, the limited sample size used in this study dictates that the findings cannot be generalized to a larger, possibly more diverse population. The study was conducted at a small women’s university in the United Arab Emirates with fewer than 290 faculty. The more traditional form of secondary school education which presently dominates the U.A.E., may also act as an impediment to the ways in which faculty incorporate technology because they may find it difficult too move students away from traditional teacher-centered learning environments. The university was also selected because of the technology-rich nature of the institution. A large investment has been made to ensure that all faculty and students have laptop computers, that all rooms are equipped with high speed internet access, and that digital projectors and printers are in each classroom. Hence, it is not possible to generalize the results beyond the region or certainly to institutions that lack the wealth of technology.

Web-based Survey

Much consideration was given to the selection and implementation of a web-based survey instrument. Because the institution under investigation was technology-rich and had two separate campuses located in different cities, a web-based instrument was deemed the appropriate data collection method. Faculty are expected to communicate electronically, grades and attendance are entered online, and the faculty has participated in institutional web-based surveys prior to this investigation. All of these factors contributed to the belief that many of the limitations normally associated with conducting electronic research, primarily "the self-selection that occurs among respondents" (Anderson & Kanuka, p. 165, 2003), would be mitigated. Nevertheless, some faculty may have still been disconcerted by this data collection technique. The findings indicate that much of the sample are fairly advanced technology integrators. This may support the premise which states that mainly the more advanced users participated in the study. Even if this is the case, the study has still been able to identify some valuable relationships between the variables under question.

SoC and TISCM Interpretation

Other limitations of the study are related to two segments of the questionnaire. While the Stage of Concern questionnaire has a long history and is an empirically verified measurement tool. It can pose interpretation difficulties at Stage 0. Hall et al. (1986) state that

> Stage 0 has two very different meanings depending upon whether the respondent is a user or a nonuser of the innovation. For nonusers of the innovation, a high peak score on Stage 0 reflects awareness of and

> concern about the innovation, while for users of the innovation, a high Stage 0 indicates lack of concern about the innovation. (p. 31)

In order to properly address this shortcoming, one must look to the scores on Stages 1 and 2. Usually nonusers will also be high on these stages, while users will be low on these stages. Users can then be re-classified according to the next highest stage. Another possible way to determine the appropriateness of a peak Stage 0 score is to look at other evidence about the level of use. Since one of the research questions was trying to determine the relationship between Stage of Concern and level of integration through the TISCM, this cross referencing was kept to a minimum. Only Stage 0 users who were also classified as the most sophisticated integrators were re-categorized according the abovementioned technique. The high number of remaining Stage 0 subjects (16) opens the possibility that these interpretations are inaccurate, and that there are actually less users at Stage 0 than are being reported. However, this remains a minor limitation because it is only one stage out of seven.

The second possible limitation regarding the instrument involves the TISCM. Although the architects of the model, Mills and Tincher (2003), recommend that it be implemented in higher education, it may have produced high scores and classifications because of the technology-rich nature of the institution under investigation. The technology expectations of the institution may be so great that it is actually very difficult for a faculty member to be rated as a low end integrator, an operator. Nevertheless, this could simply be evidence for the belief that exposure to a technology-rich environment forces faculty to increase their level of integration.

Further Research

While this study has been able to answer the research questions, the limitations of the research and the few counter intuitive findings, or at least the lack of substantial relationships, suggests that further study is needed. Certainly, the overall perception of technology integration barriers in a technology-rich environment has been evaluated in detail. The types of barriers that have often been cited as the most prevalent, scarcity and unreliability of technology, are perceived to be of very little consequence in this environment. Nonetheless, many of the other questions provided cloudy or difficult to interpret results. This section provides two suggestions for further research.

One method to expand upon the current study is to replicate the study with a larger number of participants and to conduct interviews with some participants that have been ranked with a peak Stage of Concern 0. A larger number of participants would be able to supply the necessary number of subjects in each of the emerged sub-groups. This would better increase the chances of finding statistically significant results. The present study has identified only a limited number of significant relationships. However, this may be attributable to the small sample size. The same study replicated with more subjects, may find more significant relationships or confirm the present findings. Conducting interviews with some of the participants at peak Stage of Concern 0, could help to determine their actual stage. It is easy to re-categorize or confirm the peak Stage of Concern for some of these users by looking at their Stage 1 and 2 scores, but others may require more analysis. This could be achieved through the utilization of an interview. Stage 0 is the only stage that can have two interpretations; therefore, only participants at this stage may need to be interviewed.

The second suggestion for further research would be to attempt to replicate the findings of the reported perceptions of the barriers to technology integration. Replication is important to ensure that results are valid and reliable. The major focus here would again need to be on the technology-rich nature of the institution under investigation. Only in an environment where access to technology is not a concern would such a study be valid. The study would need to investigate whether or not similar components (like variables) from the barrier evaluations emerge and compare the rankings and weights given to each of the barriers.

Recommendations

One of the goals of this research was to be able to provide informed recommendations with regard to the development of a technology integration plan and the design of appropriate professional development. Information garnered from the results of the barrier evaluations in coordination with the behavioral, affective, and temporal aspects of technology integration makes this possible.

Technology Integration Plans

Research studies indicate that the implementation levels of technology into teaching and learning remain low (Cuban, 2001; Cuban et al. 2001; Ertmer, 1999; Olsen, 2001). The purpose of much of the technology-based barrier and CBAM research in education is to provide the foundation from which a technology integration plan can be started or evaluated. This is of the utmost importance because an ever increasing research pool (Anderson et al., 1998; Boe, 1989; Boyd, 1997; Caverly, Peterson, & Mandeville, 1997; Cuban et al.; Scheffler & Logan, 1999; Vaughan, 2002) is demonstrating that providing access to technology is not enough; faculty or teachers require guidance and need to be trained in methods to integrate technology into their teaching. This section will investigate essential components of a technology integration plan since it will form the basis for any intervention because "the purpose of technology planning… is to provide a foundation on which an effective curriculum of technology use in education can be built and maintained" (Blount, et al., 2002, p. 2).

Hence, the first major recommendation is to develop a technology integration plan for the institution. Researchers (Anderson et al., 1998; Fabry & Higgs, 1997; Rogers, 2000) recommend the creation of such a plan because it as an integral component of any attempt to increase the levels of technology integration. The findings from this research project indicate that faculty have a strong desire for curriculum integration, technology standards, and more effective professional development. Since these are the critical components of a technology integration plan, a technology plan which has facets of these should be created.

Curriculum Integration

An essential component of any technology integration plan is to integrate technology into the curriculum; hence, integrating technology into the university curricula is the second recommendation. There are two ways in which technology can be used in current teaching and learning practices. One method is to teach it as a course on its own, much like teaching a course on pencils. The other is to integrate it into the existing courses. At its most basic level, See (2001) claims that effective technology plans accentuate the integration of technology into the curriculum. This philosophy is echoed by the Alberta ICT Program of Studies Technology which states that "the ICT curriculum is not intended to stand alone, but rather to be infused within core courses and programs" (Government of Alberta, 2003, ¶ 1). This is the method that is best able to improve teaching and learning because it facilitates the move towards a constructivist learning environment. This is the method recommended for this university.

From this research project, the findings from the barriers to technology integration and concerns about technology integration sections indicate that teachers perceive the lack of formal technology curriculum integration as a barrier to their implementation, and that it is much easier to maintain ignorance towards an innovation without this guidance. Hence, integrating technology into the current curricula is paramount if real and sustainable integration is to occur. With the key barrier of lack of access removed, the institution is ready to add technology to the curricula.

To facilitate this integration, the university will need to provide adequate support. This means that the required technical training will need to be offered to faculty. As was previously mentioned, this could be accomplished by the IT trainer. In addition, the university will need to seek the guidance from their existing faculty members who are advanced technology integrators and from their educational technologists and instructional designer to help create the curricula which integrates technology. These same people along with the Center for Teaching and Learning will need to be charged with developing a structured professional development program aimed at teaching with technology, not teaching technology.

Technology Standards

Within this study, the lack of technology standards also proved to be a barrier to technology integration and limit implementation because teachers do not know what is expected from them. This needs to be addressed, so developing a set of technology standards is the third recommendation.

Instructors need to know what is expected of them with regard to technology standards. Fortunately, research demonstrates ways in which standards can be created. Scheffler and Logan (1999) conducted a survey of 437 teachers, technology coordinators, and teacher educators in order to establish technology competencies for teachers. Competencies of this sort can act as data for the creation of technology standards. They established that “making computers an integral part of the curriculum and instruction has the greatest importance for teachers” (p. 314). Another reflection of the importance of technology competencies for teachers is revealed in the Educational Technology Standards and Performance Indicators for All Teachers (see Appendix G) which are a set of six standards and 23 corresponding performance indicators (International Society for Technology in Education, 2000). These have been designed to guide teacher education programs and to provide guidelines for practicing teachers. They are broad enough to be open for jurisdictional interpretation, but they do establish a clear understanding of what teachers should be able to do with regard to technology. In the current environment, these standards can be used as a starting point from which to build context specific standards. Both curriculum integration and technology standards are essential components of a technology integration plan, but neither of these concepts are attainable without adequate professional development.

Professional Development

“Another important component of the technology plan is professional development and support for teachers. No plan, no matter how well conceived, will be of any value if it is not implemented at the building and classroom levels" (November, Staudt, Costello, & Huske, 1998, ¶ 12). The results of the current study provide effective guidance for designing targeted professional development. Fortunately, there is also significant research which offers suggestions as to how to design effective technology training. Therefore, the design of targeted professional development is the final recommendation from this study.

According to Vaughn (2002) "the key to successful intervention is to personalize the innovation by taking the concerns of those engaged in the change process and accepting those concerns as crucial components and legitimate reflections of the change process" (¶ Implications for Educational Practice). This echoes Hall and Hord (2001) who stated "interventions to facilitate change need to be aligned with the concerns of those engaged in the change" (p. 61). However, in interpreting research findings one must remember that both Hall and Hord (2001) and Rogers (1995), respective creators of the CBAM and the *Diffusion of Innovations* model recognize that the adoption of an innovation is a process that can take years before it has fully diffused, so patience is a virtue.

The major findings of this study emphasize the complexity of the variables involved in technology integration. Participants have been categorized into various groups that are sometimes related to other groups and sometimes are not. The key point from this is that any professional development program needs to be multi-faceted in order to meet the needs of the very diverse population (Bybee, 2001). For example, a teacher who claims that there is not yet enough evidence regarding the efficacy of integrating technology into teaching will require a very different intervention than a teacher who is convinced of the value of technology integration but is struggling to find the time to use technology in their lessons. The skeptical teacher may need to witness an effective lesson by another teacher who uses technology. This could be followed by a team taught lesson between the two. A convinced yet struggling teacher may need to work on a team with a number of other like-minded colleagues to generate ideas or create activities together. Both of these groups could benefit from release time to work learn to better integrate technology into their teaching. By taking into account the concerns of instructors, one is better able to design appropriate interventions and avoid a focus on generic technology training that is often “irrelevant to teachers’ specific needs” (Cuban et al., p.826).

There is one overarching finding that emerged from this research which must be used to guide the design of professional development opportunities. This finding is that while many faculty have technology skills and are rather sophisticated integrators, lower order concerns still dominate. Since faculty seem to have technology skills and yet remain anxious with lower order concerns, professional development needs to focus on the more advanced themes of technology integration. This means that rather than generic technology training, methods such as peer discussions, sharing sessions, peer coaching, and team teaching should be utilized (Boyd, 1997; Caverly et al., 1997; Garet, Porter, Desimone, Birman, & Yoon, 2001). Moreover, since fragmentation often plagues learning opportunities for teachers, courses, workshops, and institutes must be coordinated or sustained over time so that teachers get both depth and breadth in what they need to know and be able to do (Bybee & Loucks-Horsley, 2000). Long-term professional development programs, not just events, are required for technology integration to succeed.

Conclusion

While this study does provide some insights into the relationships between barriers to technology integration and the affective, behavioral, and temporal aspects within a technology-rich environment, it has only begun to explain the complex relationships between these variables. From this study, we have learnt that a technology-rich environment obviously does play a significant role in allowing faculty members to integrate technology into their teaching, but many barriers to technology integration remain. Knowledge as to the way in which these barriers are perceived according to the affective, behavioral, and temporal aspects can help to provide solutions as to how to overcome these barriers. This research will hopefully aid in the development of appropriate barrier eradication plans and, in turn, accelerate the integration of technology into teaching and learning.

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APPENDIX A

Technology-Integration Barriers in a Technology-Rich Environment: A CBAM Perspective

For the purpose of this research, technology refers to any computer-based technology such as email, Blackboard, word processors, PowerPoint, digital projectors, and laptops, etc.

Once you have completed the questionnaire, you must click the Submit button at the bottom of the page to finish the process.

Please make a selection or complete each item of the questionnaire.

Part 1- Stages of Concern

The purpose of this section of the questionnaire is to determine the concerns of people with regards to the integration of technology into their teaching. The items have been developed from typical responses of instructors, who range from no knowledge of technology integration to expert levels of knowledge. Therefore, some of the items may appear to be of little relevance to you at this time. If an item is completely irrelevant to you, select 0 on the scale. Other items will represent concerns that you do have to varying degrees of intensity and should be selected higher on the scale to the appropriate representation. You should select 7, which represents the highest stage of concern, if an item is very true of you at this moment.

Please remember that the term technology integration refers to the level of technology integration into your teaching.

1. I am concerned about students' attitudes towards technology integration.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
3	16	11	10	6	9	11	3

2. I know of some other approaches that might work better than integrating technology.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
5	12	12	10	14	8	7	1

3. I don't even know what the technology integration is.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
8	46	8	4	2	0	1	0

4. I am concerned about not having enough time to organize myself each day.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
2	22	9	6	9	2	10	9

5. I would like to help other faculty in their integration of technology.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
2	12	7	9	11	13	9	6

6. I have very little knowledge about technology integration.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
2	20	25	11	5	2	3	0

7. I would like to know the effect of the technology integration on my professional status.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
7	9	14	9	2	8	9	11

8. I am concerned about conflict between my interests and my responsibilities.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
8	20	14	3	9	6	6	3

9. I am concerned about revising my integration of technology.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7

3	12	12	9	8	16	9	0

10. I would like to develop working relationships with both our faculty and outside faculty integrating technology.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
1	9	8	11	9	10	9	12

11. I am concerned about how technology integration affects students.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
0	3	10	5	12	11	20	8

12. I am not concerned about technology integration.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
3	24	19	8	5	3	6	1

13. I would like to know who will make the decisions about technology integration in a new system.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
1	7	7	9	10	9	14	12

14. I would like to discuss the possibility of integrating technology.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
1	8	11	10	8	13	9	9

15. I would like to know what resources are available if we decide to integrate technology.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
2	4	7	3	11	13	14	15

16. I am concerned about my inability to manage all that technology integration requires.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
1	11	18	16	10	4	4	5

17. I would like to know how my teaching or administration is supposed to change.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
5	5	12	6	9	17	7	8

18. I would like to familiarize other departments or persons with the progress of technology integration.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
2	16	15	7	7	6	9	7

19. I am concerned about evaluating my impact on students.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
1	4	11	5	9	19	7	13

20. I would like to revise technology integration's instructional approach.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
10	7	11	8	9	11	7	6

21. I am completely occupied with other things.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
2	10	17	14	8	9	7	2

22. I would like to modify my integration of technology based on the experience of my students.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
1	3	9	12	8	19	10	7

23. Although I don't know about technology integration, I am concerned about other things in the area.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
22	15	17	8	2	3	2	0

24. I would like to excite my students about their part in the integration of technology.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
2	4	8	6	7	20	10	12

25. I am concerned about my time spent working with non-academic problems related to technology integration.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
3	9	6	17	8	10	10	6

26. I would like to know what the integration of technology will require in the immediate future.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
2	3	10	12	11	10	12	9

27. I would like to coordinate my efforts with others to maximize technology integration's effects.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
2	5	11	7	7	12	11	14

28. I would like to have more information on time and energy commitments required by technology integration.

Irrelevant	Not true of me now		Somewhat true of me		Very true of me now		

			now				
0	1	2	3	4	5	6	7
1	8	9	7	10	13	12	9

29. I would like to know what other faculty are doing with technology integration.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
0	3	6	6	7	12	18	17

30. At this time, I am not interested in learning about technology integration.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
7	35	13	8	4	1	1	0

31. I would like to determine how to supplement, enhance, or replace technology integration.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
11	5	4	14	11	12	9	3

32. I would like to use feedback from students to change the program of technology integration.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
5	7	4	13	12	11	11	6

33. I would like to know how my role will change when I am integrating technology.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
6	4	12	11	11	13	8	4

34. Coordination of tasks and people is taking too much of my time.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7

6	13	14	10	6	10	8	2

35. I would like to know how technology integration is better than what we do now.

Irrelevant	Not true of me now		Somewhat true of me now		Very true of me now		
0	1	2	3	4	5	6	7
7	7	6	11	6	13	8	11

Part 2- Exposure to a Technology-Rich Environment

The purpose of this section is to help determine if length of time having taught in a technology-rich environment will have an impact on an instructors' integration of technology. Technology-rich is defined as an environment in which access to computer-based technology is not a concern. As an instructor, the availability of technology for your teaching is not a concern because it is readily available.

Please select the most accurate length of time for which you have been exposed to a technology-rich environment.

36. I have taught in a technology-rich environment for:

Less than 1 year	1-2 years	3-4 years	5 years or more
2	7	27	33

Part 3- Technology Implementation Standards Configuration Matrix

The purpose of this section is to determine your actual level of technology integration. Each item represents a different component of technology integration which can be ranked from 0, no use, to 4, optimal use. For each item please select the only most advanced descriptor that most accurately describes your current level.

37. Operate common technology devices including computer keyboard, mouse, monitor, printer, video camera, digital camera, VCR, scanner, or projection device.

None of these	Use mouse and/or keyboard function keys to select a screen icon.	Connect keyboard, mouse, monitor, and printer to computer.	Connect a projection device to computer and project monitor image to a screen.	Create a picture with a digital or video camera OR scan an image with a scanner and transfer to a computer file.
0	1	2	3	4
0	0	2	8	59

38. Perform basic file management tasks on a computer and local area network.

None of these	Save an application file (word processing, spreadsheet, database) to a location on a local drive.	Search for a file by name, type, or date.	Create a folder on a local drive and copy/save files in the folder.	Locate, copy, or move files from a local computer drive to a network drive or folder.
0	1	2	3	4
1	0	0	3	65

39. Apply trouble-shooting strategies for solving routine hardware and software problems that occur in the classroom.

None of these	Properly shut down and restart computer when computer hangs or locks up.	Determine if a computer is logged-on to a computer network.	Remove a paper jam from a printer; install paper and ink cartridge in a printer.	Download and install software updates or install software updates from a local or network drive.
0	1	2	3	4
0	2	3	6	58

40. Use software productivity tools to prepare publications, analyze and interpret data, perform classroom management tasks, report results to students, parents, or other audiences, and produce other creative works.

None of these	Load application software (word processing, spreadsheet, database) and enter information.	Create a word processing document and format for printing.	Create a spreadsheet using calculations and computation functions and format for printing.	Prepare a report in a word processing document that includes a table that is imported or pasted from a spreadsheet or database file.
0	1	2	3	4
0	0	12	7	50

41. Use technology to communicate and collaborate with peers, parents, and the larger community to nurture student learning.

None of these	Send an email message to an existing name on the school network address book.	Add a name and address to an email address book OR set email program to apply a signature to all email messages.	Add and retrieve an attachment to/from and email message.	Prepare an email distribution list and send an email message to every contact on the list.
0	1	2	3	4
0	1	0	9	59

42. Use technology to locate, evaluate, and collect educational research/best practices information from a variety of sources.

None of these	Browse the Internet to locate useful information using specific URLs.	Perform a search using an Internet search engine OR perform a search of CD-ROM reference materials or on-line library catalog.	Subscribe to and read electronic newsletters or journals related to an area of education.	Subscribe to and participate in discussion groups or chat rooms of practitioners or subject-matter experts.
0	1	2	3	4
0	2	8	16	43

43. Practice and model responsible use of technology systems, information, and software.

None of these	Be familiar with school district acceptable use policy (have read it).	Read and discuss school district acceptable use policy with students at least once each semester.	Develop classroom guidelines and procedures for students for computer and network use based on school district acceptable use.	Develop classroom guidelines and procedures for students for computer and network use based on school district acceptable use policy and provide orientation on proper use of equipment and software.
0	1	2	3	4
23	5	6	13	22

44. Facilitate equitable access to technology resources for all students.

None of these	Some students use classroom computer or go to computer lab after completion of classroom learning activities.	Some students use classroom computer or go to computer lab to reinforce or supplement learning objectives.	All students use one or more educational software packages to reinforce or supplement learning objectives.	All students regularly use classroom computer or go to computer lab to perform learning activities related to specific learning objectives.
0	1	2	3	4
3	2	4	20	40

45. Manage student learning activities in a technology-enhanced learning environment.

None of these	Students use a classroom computer or computer lab on their own for	Students use a classroom computer or computer lab on their own as an	Conduct and facilitate student learning activities using educational	Conduct and facilitate student learning activities using educational

	activities unrelated to classroom learning objectives.	instructional supplement.	software on a classroom computer or in the computer lab occasionally.	software on a classroom computer or in the computer lab or on a regular basis.
0	1	2	3	4
1	1	11	23	33

46. Evaluate and select informational and educational resources based on the appropriateness to learning objectives, hardware requirements, and software features.

None of these	Describe one technology resource that teacher would like to use for instruction or classroom learning activities.	Describe two or more technology resources that teacher would like to use for instruction or classroom learning activities.	Develop a technology plan for classroom or lab including hardware requirements and software features.	Develop a plan with a budget to purchase technology for classroom or lab including hardware requirements, software features, and relation to learning objectives.
0	1	2	3	4
10	4	30	12	13

47. Demonstrate strategies to assess the validity and reliability of data gathered with technology.

None of these	Describe two or more criteria or strategies students should use for critically evaluating the quality, reliability, and validity of web page content.	Establish and communicate criteria and strategies to students for determining the quality, reliability, and validity of web page content.	Communicate criteria and strategies to students for determining the quality of web page content. Develop a list of appropriate web sites and search engines for use with classroom learning activities.	Communicate criteria and strategies to students for determining the quality of web page content; develop an electronic list or database (text or HTML document) of appropriate web sites and search engines for use with classroom learning activities.
0	1	2	3	4
13	7	10	20	19

48. Use multiple technology contexts and a variety of productivity tools to provide classroom instruction.

None of these	Use supplemental materials in teacher's manual to	Use word processing to create worksheets, handouts, and tests	Use a multimedia presentation application or web	Use a multimedia presentation application or web

	reinforce or supplement classroom instruction.	OR use videotapes and CD-ROMs to reinforce/supplement classroom instruction.	pages to create and present instruction on a single topic.	pages to create and present instruction on multiple topics.
0	1	2	3	4
1	3	16	15	34

49. Employ technology in classroom learning activities in which students use technology resources to solve authentic problems in various content areas.

None of these	Students use a classroom computer or go to computer lab after completion of classroom learning activities.	Students use a classroom computer or go to computer lab to reinforce or supplement learning objectives.	Integrate one technology-based learning experiences per semester into classroom instruction that is established for targeted curriculum themes or learning objectives.	Integrate two or more technology-based learning experiences per semester into classroom instruction that are established for targeted curriculum themes or learning objectives.
0	1	2	3	4
4	1	14	9	41

50. Use technology resources to provide learning contexts requiring the use of problem solving, critical thinking, informed decision-making, knowledge construction, and creativity by learners.

None of these	Students use a classroom computer or go to computer lab after completion of classroom learning activities.	Students use a classroom computer or go to computer lab to reinforce or supplement learning objectives.	Integrate one technology-based project per semester into classroom instruction requiring students to solve problems or formulate decisions.	Integrate two or more technology-based projects per semester into classroom instruction. requiring students to solve problems or formulate decisions.
0	1	2	3	4
4	1	16	15	33

51. Implement technology-based learning experiences that utilize a variety of grouping strategies to address the diverse learning needs of students (e.g. cooperative, project-based, collaborative, individualized, teams).

None of these	Allow students to work in pairs or small groups on the computer to learn or use educational	Occasionally use a team-learning (small group) strategy to complete a technology-based	Routinely use individual and cooperative learning strategies that result in the	Create an individualized learning plan for each student and track

	software.	learning activity.	completion of technology-based products of learning.	accomplishment of learning goals in the plan using a computerized productivity tool.
0	1	2	3	4
14	7	17	26	5

52. Apply multiple methods of evaluation and assessment to determine learners' use of technology for learning, communication, and productivity.

None of these	Evaluate student technology skills using objective tests only.	Evaluate student technology skills using objective tests and subjective evaluation of student-produced materials.	Evaluate demonstrations of student technology skills using checklists, rubrics, and benchmarks to assist students in assessing their performance.	Use action research methods to determine whether technology and classroom teaching methods are impacting student learning.
0	1	2	3	4
19	1	19	24	6

53. Engage learners in the development of electronic portfolios that document their technology-based educational experiences.

None of these	Maintain a cumulative folder of various student technology-based products of learning.	Maintain an electronic file of various student technology-based products of learning.	Students are required to maintain an electronic portfolio of technology-based products of learning using a word processing document.	Students are required to maintain an electronic portfolio of technology-based products of learning using web pages or a multimedia presentation application and demonstrate technology skills and experiences.
0	1	2	3	4
29	6	15	10	9

54. Use technology resources and productivity tools to collect, analyze, interpret, and communicate learner performance data and other information to improve instructional planning, management, and implementation of instructional/learning strategies.

None of these	Write evaluations of student work or progress and notes to parents using	Use an electronic gradebook (or spreadsheet or database) to keep	Use an electronic gradebook (or spreadsheet or database) to keep	Maintain and aggregate performance data for students in

	word processing and/or email.	track of student grades.	track of student grades and track student mastery of learning objectives.	electronic files. Modify classroom and individual instruction based on analyses of student performance data.
0	1	2	3	4
9	6	21	25	8

Part 4- Barriers to Technology Integration

The purpose of this section is to determine what instructors perceive to be the barriers to their integration of technology into teaching.

For each of the following 20 statements below regarding barriers to technology integration, please indicate the extent of your agreement or disagreement by selecting the most accurate response. The final open-ended question requires a typed response. This final item is looking for additional information concerning barriers to technology integration.

55. Faculty do not have sufficient time to integrate technology.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
23	19	7	17	3

56. There is inadequate financial support to develop technology-based activities.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
15	18	17	17	2

57. There is a lack of technical support regarding the technology.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
18	26	7	16	2

58. Technology training is offered at inconvenient times.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
12	21	17	17	2

59. Generic technology training is irrelevant to teacher needs.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
13	18	13	24	1

60. There is a lack of sufficient technology training.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
17	30	7	12	3

61. Technology is unreliable.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
2	17	20	26	4

62. There is a scarcity of technology for faculty.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1	5	5	38	20

63. There is a scarcity of technology for the students.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1	4	5	35	24

64. The curriculum does not allow enough time to integrate technology.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
11	19	9	25	5

65. Faculty unsure as to how to effectively integrate technology.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
19	39	6	5	0

66. Faculty lack basic technology skills.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
8	28	15	17	1

67. Technology does not fit well for the course I teach.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
4	9	7	33	16

68. Software is not adaptable for meeting student needs.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
0	7	22	32	8

69. Faculty is not interested in integrating technology.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1	23	18	22	5

70. The current reward structure does not adequately recognize those utilizing technology.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
23	22	17	7	0

71. There is a lack of support from administration.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
15	24	13	16	1

72. There is not enough evidence that using technology will enhance learning.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
5	13	19	28	4

73. Classroom management is more difficult when using technology.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
4	14	5	38	8

74. There are no program standards as to what is expected for teaching with technology.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
18	29	15	7	0

75. The following **additional barriers** prevent faculty from integrating technology.

APPENDIX B

Description

Directions for Using the SoCQ Quick Scoring Device

The Stages of Concern Questionnaire (SoCQ) contains 35 items. The scoring of the SoCQ requires a series of operations that result in an SoCQ profile. The following steps should be carried out on the Quick Scoring Device:

Step 1 In the box labeled A, fill in the identifying information taken from the cover sheet of the SoC Questionnaire.

***Step** 2* Copy the numerical values of the circled responses to statements 1 through 35 in the numbered blanks in the Table labeled B. Note that the numbered blanks in Table B are *not* in consecutive order.

Step 3 Box C contains the Raw Scale Total for each stage (0-6). Take each of the seven columns (0-6) in Table B, add the numbers within each column, and enter the sum for each column (0-6) in the appropriate blank in Box C. Each of these seven Raw Score Totals is a number between 0 and 35.

Step 4 Table D contains the percentile scores for each Stage of Concern. Find the Raw Scale Score Total for Stage 0 from Box C; locate this number in the left-hand column in Table D, then look in the Stage 0 column to the right in Table D and circle that percentile ranking. Do the same for Stages 1 through 6, only match the left-hand column raw score with the corresponding stage.

***Step** 5* Transcribe the circled percentile scores for each stage (0-6) from Table D to Box E. Box E now contains seven numbers between 0 and 99.

Step 6 Box F contains the SoC graph. From Box E, take the percentile score for Stage 0 and mark that point with a dot on the Stage 0 vertical line on the SoC graph. Do the same for Stages 1 through 6. Connect the points to form the SoC profile.

For interpretation of the SoC profile, refer to Hall, George, and Rutherford (1979), The SoCQ Manual.

SoCQ Quick Scoring Device

A

Date: ______________________________

Site: __________ SS#: ______________________

Innovation: ______________________________

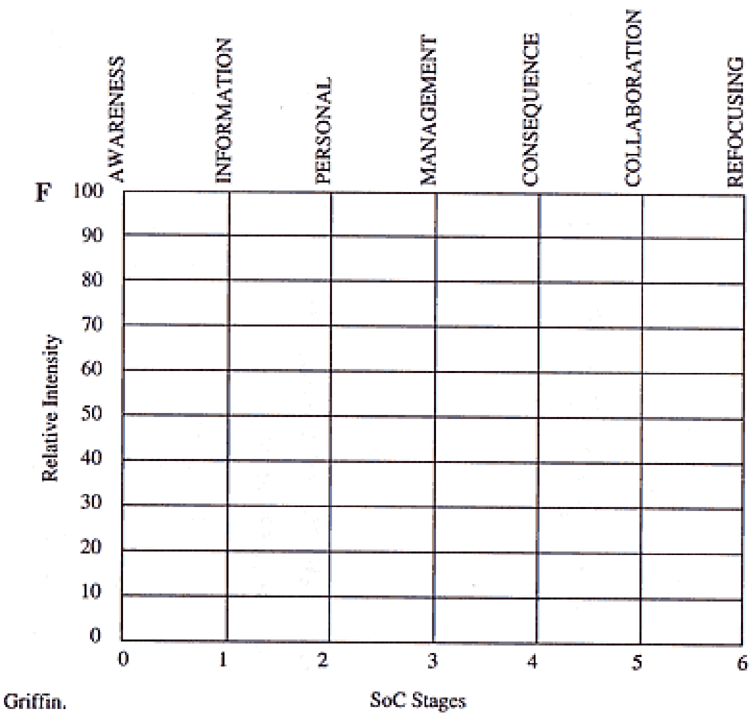
B

Stage 0	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
3___	6___	7___	4___	1___	5___	2___
12___	14___	13___	8___	11___	10___	9___
21___	15___	17___	16___	19___	18___	20___
23___	26___	28___	25___	24___	27___	22___
30___	35___	33___	34___	32___	29___	31___
Raw Score Totals **C** ___	___	___	___	___	___	___
Percentile Scores **E** ___	___	___	___	___	___	___

D

Five Item Raw Scale Score Total	Stage						
	0	1	2	3	4	5	6
0	10	5	5	2	1	1	1
1	23	12	12	5	1	2	2
2	29	16	14	7	1	3	3
3	37	19	17	9	2	3	5
4	46	23	21	11	2	4	6
5	53	27	25	15	3	5	9
6	60	30	28	18	3	7	11
7	66	34	31	23	4	9	14
8	72	37	35	27	5	10	17
9	77	40	39	30	5	12	20
10	81	43	41	34	7	14	22
11	84	45	45	39	8	16	26
12	86	48	48	43	9	19	30
13	89	51	52	47	11	22	34
14	91	54	55	52	13	25	38
15	93	57	57	56	16	28	42
16	94	60	59	60	19	31	47
17	95	63	63	65	21	36	52
18	96	66	67	69	24	40	57
19	97	69	70	73	27	44	60
20	98	72	72	77	30	48	65
21	98	75	76	80	33	52	69
22	99	80	78	83	38	55	73
23	99	84	80	85	43	59	77
24	99	88	83	88	48	64	81
25	99	90	85	90	54	68	84
26	99	91	87	92	59	72	87
27	99	93	89	94	63	76	90
28	99	95	91	95	66	80	92
29	99	96	92	97	71	84	94
30	99	97	94	97	76	88	96
31	99	98	95	98	82	91	97
32	99	99	96	98	86	93	98
33	99	99	96	99	90	95	99
34	99	99	97	99	92	97	99
35	99	99	99	99	96	98	99

F



Concerns-Based Systems International

The SOCQ Quick Scoring Device was developed by Eddie W. Parker and Teresa H. Griffin.

APPENDIX C

Invitation Email

Dear Zayed University Faculty Member,

My name is Kevin Schoepp and I am an instructor in the English Language Center at Zayed University. I am also in the process of conducting my thesis research in Educational Technology at the University of Calgary under the supervision of Dr. Gail Kopp. The thesis research will be conducted at Zayed University and has received ethical clearance from both Zayed University and the University of Calgary.

I am conducting a research study into the barriers to technology integration into teaching in a technology-rich environment. This will hopefully suggest reasons for the degree of faculty technology integration which could, in turn, guide future technology integration planning and professional development endeavors. To investigate these issues, I am asking for your participation. Your opinions and feedback are extremely important since you are the ones who ultimately control the integration of technology into your teaching.

If you decide to volunteer, you will be asked to complete a short web-based questionnaire. The questionnaire should take no longer than twenty-to-thirty minutes to complete. Information concerning the confidential and voluntary nature of this study are detailed on the **Consent to Participate in Research** webpage which is the initial webpage once you have cleared the password protection. However, essential highlights of the consent include:

- There are no known or anticipated risks from participating in this study.
- Participation in this study is voluntary.
- Any information that you provide will be confidential.
- Declining to participate or withdrawing from the study will have no impact on you or your job in any way.

If you are interested in participating, please click on the following link or copy and paste the link into your browser. Read the **Consent to Participate in Research** webpage carefully. Then, enter a Username of “elc” and a Password of “elc”.

http://www.ucalgary.ca/~kwschoep/

The questionnaire will remain accessible until March 9, 2004.

Thank you,

Kevin Schoepp

APPENDIX D

Technology Integration Barriers in a Technology-Rich Environment: A CBAM Perspective

Welcome to the Entrance Page for Kevin Schoepp's Thesis Research

If you have come to the right place, follow these directions to enter the main research website:

1. Enter the Username and Password you were provided with in the invitation email
2. Click the Enter button

You will then proceed to the consent form and to the main questionnaire. If you experience any problems, please contact me at: kevin.schoepp@zu.ac.ae

Username:	
Password:	

Thank you for participating!

APPENDIX E

Web-based Consent Form

University of Calgary

Consent to Participate in Research

This web-based consent form is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

This research has been approved by both the University of Calgary and Zayed University.

Research Project Title: Technology Integration Barriers in a Technology-Rich Environment: A CBAM Perspective

Investigator: Kevin Schoepp

Participants: Zayed University Faculty

I am enrolled in the Master of Arts program in Educational Technology in the Graduate Division of Educational Research at the University of Calgary. For my thesis, I am conducting an anonymous web-based survey to investigate the relationships between faculty's perceived barriers to technology integration, actual level of technology integration, concerns toward technology integration, and exposure- i.e., length of time having taught in a technology-rich environment. This will hopefully suggest reasons for the degree of faculty technology integration which could, in turn, guide future technology integration planning and professional development endeavors within Zayed University.

The anonymous web-based survey consists of four parts. The first part covers your concerns regarding technology integration. The second part asks about the length of time you have been exposed to a technology-rich environment. The third part identifies your actual level of technology integration. The final part examines what you perceive to be barriers to technology integration. The entire survey comprises 75 items and is expected to take approximately 20-30 minutes of your time. All but one of the questions are either multiple choice or Likert scale items. The final question is open-ended and requires a typed response.

Data will be stored electronically in a password protected environment on the private personal computer of the investigator. Only the researcher will have access to the research data stored on the personal computer. Following completion of the researcher's degree, all data will be burned onto a CD ROM, stored off campus, and permanently deleted from the researcher's personal computer. The CD ROM will be retained for the duration of the researcher's employment at Zayed University. It will be destroyed at the time of employment termination.

Your entrance into the survey through clicking on the I Agree button below indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to not participate in the study. All of the responses will remain strictly anonymous. Your continued participation will be regarded as you having provided informed consent. If you have further questions concerning matters related to this research, please contact:

Investigator	Supervisor
Kevin Schoepp	Gail Kopp
Instructor, ELC, Zayed University	Assistant Professor, University of Calgary
050-312-7102	001-403-220-7332
kevin.schoepp@zu.ac.ae	gkopp@ucalgary.ca

If you have any questions or issues concerning this project that are not related to the specifics of the research, you may also contact the University of Calgary Research Services Office at 001-403-220-3782 and ask for Mrs. Patricia Evans or email her at plevans@ucalgary.ca.

APPENDIX F

Technology-Integration Barriers in a Technology-Rich Environment: A CBAM Perspective

Thank you for participating!

The research results will be made available at the completion of this project.

If you have any questions or concerns please contact me at:

Kevin Schoepp
Instructor, ELC, Zayed University
050-312-7102
kevin.schoepp@zu.ac.ae

APPENDIX G

NETS for Teachers

Educational Technology Standards and Performance Indicators for All Teachers

Building on the NETS for Students, the ISTE NETS for Teachers (NETS•T), which focus on preservice teacher education, define the fundamental concepts, knowledge, skills, and attitudes for applying technology in educational settings. All candidates seeking certification or endorsements in teacher preparation should meet these educational technology standards. It is the responsibility of faculty across the university and at cooperating schools to provide opportunities for teacher candidates to meet these standards.

The six standards areas with performance indicators listed below are designed to be general enough to be customized to fit state, university, or district guidelines and yet specific enough to define the scope of the topic. Performance indicators for each standard provide specific outcomes to be measured when developing a set of assessment tools. The standards and the performance indicators also provide guidelines for teachers currently in the classroom.

1 TECHNOLOGY OPERATIONS AND CONCEPTS.
Teachers demonstrate a sound understanding of technology operations and concepts. Teachers:

- demonstrate introductory knowledge, skills, and understanding of concepts related to technology (as described in the ISTE National Education Technology Standards for Students)
- demonstrate continual growth in technology knowledge and skills to stay abreast of current and emerging technologies.

2 PLANNING AND DESIGNING LEARNING ENVIRONMENTS AND EXPERIENCES.
Teachers plan and design effective learning environments and experiences supported by technology. Teachers:

- design developmentally appropriate learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners.
- apply current research on teaching and learning with technology when planning learning environments and experiences.
- identify and locate technology resources and evaluate them for accuracy and suitability.
- plan for the management of technology resources within the context of learning activities.
- plan strategies to manage student learning in a technology-enhanced environment.

3 TEACHING, LEARNING, AND THE CURRICULUM.

Teachers implement curriculum plans that include methods and strategies for applying technology to maximize student learning. Teachers:

- facilitate technology-enhanced experiences that address content standards and student technology standards.
- use technology to support learner-centered strategies that address the diverse needs of students.
- apply technology to develop students' higher order skills and creativity.
- manage student learning activities in a technology-enhanced environment.

4 ASSESSMENT AND EVALUATION.

Teachers apply technology to facilitate a variety of effective assessment and evaluation strategies. Teachers:

- apply technology in assessing student learning of subject matter using a variety of assessment techniques.
- use technology resources to collect and analyze data, interpret results, and communicate findings to improve instructional practice and maximize student learning.
- apply multiple methods of evaluation to determine students' appropriate use of technology resources for learning, communication, and productivity.

5 PRODUCTIVITY AND PROFESSIONAL PRACTICE.

Teachers use technology to enhance their productivity and professional practice. Teachers:

- use technology resources to engage in ongoing professional development and lifelong learning.
- continually evaluate and reflect on professional practice to make informed decisions regarding the use of technology in support of student learning.
- apply technology to increase productivity.
- use technology to communicate and collaborate with peers, parents, and the larger community in order to nurture student learning.

6 SOCIAL, ETHICAL, LEGAL, AND HUMAN ISSUES.

Teachers understand the social, ethical, legal, and human issues surrounding the use of technology in PK-12 schools and apply those principles in practice. Teachers:

- model and teach legal and ethical practice related to technology use.
- apply technology resources to enable and empower learners with diverse backgrounds, characteristics, and abilities.
- identify and use technology resources that affirm diversity
- promote safe and healthy use of technology resources.
- facilitate equitable access to technology resources for all students.