Assessing Problem Solving Strategy Differences within Online and Face-to-Face Courses and Their Relationship to Pre-Service Teachers’ Competence and Confidence for Integrating Technology into Teaching

Sharon L. Peterson
Western Michigan University

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ASSESSING PROBLEM SOLVING STRATEGY DIFFERENCES WITHIN ONLINE AND FACE-TO-FACE COURSES AND THEIR RELATIONSHIP TO PRE-SERVICE TEACHERS' COMPETENCE AND CONFIDENCE FOR INTEGRATING TECHNOLOGY INTO TEACHING

by

Sharon L. Peterson

A Dissertation
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
Degree of Doctor of Philosophy
Department of Educational Leadership, Research and Technology
Advisor: Louann Bierlein Palmer, Ph.D.

Western Michigan University
Kalamazoo, Michigan
August 2010
This quantitative research study identifies the problem solving strategies pre-service teachers use in learning specific technology skills within an educational technology methods class which is offered both online and face to face. It also examines how such strategies differ by the format of this course, and to what extent these strategies and/or course format correlate with the students' expressed level of confidence and competence to integrate technology into their future classroom settings. The study utilizes data extracted from surveys of over 1,500 students who had taken the educational technology methods course via online or face-to-face format during one of nineteen (19) different semesters at Western Michigan University.

Results revealed more than 85% of the students in both the face-to-face and online sections felt, after completing EDT 3470, the technology methods course, believed they are competent to either integrate technology into their teaching or teach technology to others. However, a significant difference was found with more online students feeling they were able to teach others each of the technology skills, while more face-to-face students felt they would integrate those skills into their teaching. Eight-five percent
(85%) of both the face-to-face and online students left EDT 3470 with technology confidence. A small difference was found between course formats with face-to-face students slightly more confident than the online students. In reporting overall problem solving skills used while taking the course, students in the face-to-face course either waited for assistance from their instructor or went to a peer for assistance, and online students chose to discover an answer through the trial and error method or through further reading. However, when asked what problem solving skills was used for specific tasks, results reveal the majority students from both formats used the trial and error method. Further investigation revealed the use problem solving skills, especially using the trial and error method, can predict whether a student will feel competent or confident to integrate technology into their curriculum or teach it. Moreover, course format, online or face-to-face can predict whether more students will feel competent or confident after completing the course.
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CHAPTER I
INTRODUCTION

Today's educational environments include technology as an integral component (Tuzzio, 2007). Educational researchers have discovered that the adoption of technology not only fosters student learning but also has a positive impact on achievement when used appropriately (Gray, 2002; Kulik, 2002; Mc Lester, 2002; National Center for Education Statistics [NCES], 2001; U.S. Department of Education [DOE], 2005; Willis & Cifuentes, 2002). Technology-based tools can enhance student performance when they are integrated into the curriculum and used with knowledge about learning. In a review of existing evidence of technology's impact on learning, Marshall (2002) found strong substantiation that the use of educational technology complements teachers' curriculum, extending their reach and broadening their students' experiences beyond the classroom.

Yet, given ever-expanding content and technology choices, from video to multimedia to the Internet to Internet video, there is an extraordinary need to understand how to achieve success, involving learner, teacher, curriculum, and school environment in which technology is used (Marshall, 2002). Bransford, Brown, and Cocking (2000) express the importance of technology tools being an integral part of education, not just merely equipment existing in a classroom. According a DOE report on teacher quality, only 52% of the 4.0 million teachers working in public schools feel comfortable using the technologies available to them (NCES, 2009).

Teacher education programs in the United States have increased their emphasis on technology integration while attempting to insure that graduates meet standards in
order to achieve computer competence (International Society for Technology in Education [ISTE], 2000). ISTE has developed performance assessment standards for initial and advanced educational computing and technology programs (National Council for the Accreditation of Teacher Education [NCATE], 1997; ISTE, 2000). These technology standards have been adopted by NCATE as a required component of pre-service teacher (i.e., those studying to become teachers) programs. To meet these technology accreditation requirements and performance standards, most colleges and universities have established a required technology course in their teacher preparation programs (Tanguma, Martin, & Crawford, 2002). The universities' goal for these programs is that, upon graduation, all pre-service teachers will be proficient in such ISTE technology performance standards.

According to Kuiper, Volman and Terwel (2005), teacher preparation programs that incorporate technology are imperative because tech-savvy teachers can assist their students to convert information into meaningful knowledge, develop technological competencies, and participate in meaningful activities using advanced technologies. But, while it is important for pre-service teachers to graduate with proficient technology skills, it is not enough. Studies have found those who lack competence and/or confidence in technology will not use it (Gulbahar, 2008; Hew & Brush, 2007). Yet, both, and thus may not seek to integrate technology into their future teaching practices.

Statement of the Problem

With over half of public school teachers feeling uncomfortable with the integration of technology (NCES, 2009), and teachers reporting moderately low levels of
computer competence (Russell & Bradley, 2004), more research is needed to help find ways to improve confidence and competence of teachers. One way to build the acquired confidence and competence in computer skills is to ensure students understand the course material and are able to complete assignments in technology courses (Karabenick & Newman, 2006). As students are introduced to new technologies, some may also be introduced to new problems associated with such technologies. For example, when a student is introduced to a new software program needed to complete an assignment, that student might have difficulties mastering the organization and command options of a software program or one of the program’s components. Previous research has revealed that many learners when faced with such problems hesitate to participate in the learning process because they lack confidence to solve the problems (Keller, 1983). Having confidence basically means being comfortable with whom you are and feeling secure in your abilities to plan and do assignments (Merriam-Webster, 2009). Confident people feel they are able to tackle things or start new things and finish them, even though there may be learning challenges along the way (Miller & Fuller, 2006).

Until recently, the notion of seeking help from others (i.e., problem solving) was considered of little value with the idea that truly independent learners are not supposed to need others to succeed (Karabenick & Newman, 2006). However, problem solving has been listed among the most important activities that contribute to university student success (McGee, 2005). Seeking help, or getting only the assistance necessary to accomplish tasks independently (Karabenick 1998), is an important self-regulation strategy that has been linked to high academic achievement and learner satisfaction in
higher education (Karabenick 2003, 2004; Karabenick & Newman 2006; Kitsantas 2002; Zusho et al, 2007). Note: In the literature on this topic, the concept of seeking help to solve problems is referred to in multiple ways in the literate (e.g., help seeking strategies, problem solving); however for consistency in the construct of this research, it is referred to as problem solving strategies.

DePaulo, Nadler and Fisher (1983) published an important edited series of research studies that examined how learners seek help and several aspects of the problem solving process. One area of the problem solving process, the (meta) cognitive aspect, refers to those studies which focus mainly on the question-asking behavior or strategies used by students (Graesser & Person, 1994; Karabenick & Knapp, 1998; Puustinen, 1998). Of these question-asking behaviors, four primary strategies to solve problems were found: (1) seeking instructor assistance, (2) seeking peer assistance, (3) further reading, and (4) trial and error.

In reference to students seeking instructor assistance, Newman and Goldin (1990) found that students often seek such assistance because they believe the teacher is more competent and better able to instruct. Students believe help from the teacher is more likely to foster learning (Newman & Goldin; Newman & Schwager, 1993). Also, students who seek help from instructors have a tendency to be more successful and master the task at hand (Bembenutty, 2006).

In reference to the second problem solving strategy, there is evidence that peer assistance is extremely effective for a wide range of course goals and content, and for students with different levels and personalities (Johnson & Johnson, 1999; Johnson,
Johnson, & Smith, 1991). According to Karabenick and Knapp (1998), students view their peers as a fruitful source and often turn to them for assistance.

However, some students report they cannot find time to even meet with peers in that many students are now working full time or part time while going to college (McNeely, 2005; Palloff & Pratt, 2003). This leads to the third major type of problem solving, that of doing further reading on their own, and then working independently to solve their own course assignment problems (Karabenick & Newman, 2006). One of the ways in which students work independently is to review information given in class along with any extra reading materials for assistance in how to complete an assignment. Another reading source is the “Help” link in a software program to find the answer they are looking for on how to do something. They feel this help option is available to them when and if they need it without the worry of time constraints (Whitesel, 2002).

The fourth major problem solving strategy is that of students solving problems via a “trial and error method” to complete a task. They just keep trying different things until they find the correct way to complete an assignment or a project (Johnson & Johnson, 1999). It has been found that using the trial and error method creates a meaningful learning experience, which may result in finding several solutions to a problem (Pavlina, 2005).

While previous research has identified major types of problem solving strategies, little is known regarding how such strategies are used in various learning environments for teaching technology to pre-service teachers. One key learning environment is the face-to-face computer lab classroom, whereby people physically come together in one
place to exchange information and knowledge (Arnold, 2005). Another key learning
environment is that of online learning, where students are being connected via computers
to exchange information and knowledge. Online learning has gained momentum due to
ever-changing technologies (Institute of Educational Sciences [IES], 2002), and colleges
and universities are accommodating new generations of students with such classes.
During the 1997-98 academic year, 80% of all 4-year institutions offered some type of
online learning to students (Perreault, Waldman, Alexander, & Zhao, 2002), while by
2003 over 95% reported they offered online courses (Willis, Tucker & Gunn, 2003).

Within a face-to-face computer lab classroom environment, students can orally
and in real time ask their instructor for assistance with any problems they may have.
Within an online environment, such assistance must take a different format, relying on e-
mail and some delayed response from the instructor, who may not be available for real
time chats or other forms of synchronous communications (where parties are present at
the same time, such as a telephone conversation, or instant messaging).

Some research has been conducted on problem solving issues within online
environments. For example, Kitsantas and Chow (2007) found that students in an online
environment are more comfortable seeking help than in a traditional classroom. In
another study comparing problem solving in an online environment to problem solving in
a traditional classroom, Kumrow (2007) found more students in the online course
engaged in problem solving. These online students also had higher final grades than those
in the face-to-face classroom. Yet, another study on academic problem solving by
Oberman (2006) found that physical proximity was an important factor of problem solving behaviors in a high school computer lab.

Given differences in research to date, the fact that little research overall has been done to examine how student’s problem solving strategies differ within such environments, and that no work could be found which examined the impact of such strategies on students’ resulting competence and confidence with technology, more research is clearly needed.

This quantitative study, therefore, explores the problem solving strategies used by students in learning specific technology skills and whether those strategies used are influenced by the format of a course (i.e., face-to-face computer lab vs. online). In addition, it examines to what extent the type of problem solving strategies and/or course format is correlated with students’ expressed level of confidence and competence to integrate technology into their future classroom settings.

Research Questions

The following research questions guide this study:

1. To what extent are there differences between pre-service teacher education students within an online technology course compared to those within a face-to-face computer lab course, in reference to their self-reported:

   (a) technology competence; and

   (b) technology usage confidence?
2. Within each course format, to what extent are there differences in the degree such students use problem solving strategies, before and within the course, and for specific technology skills, in reference to:

(a) seeking instructor assistance and waiting for a response;
(b) finding out the answer from a peer;
(c) discovering the answer via their own reading; and
(d) discovering the answer via their own investigation using trial and error?

3. Within each course format,

(a) what relationships exist between students' self-reported technology competencies, self-reported technology usage confidence, and their use of any given problem solving strategies; and
(b) what differences within these relationships exist between the two course formats?

Conceptual Framework

The conceptual framework for this study has three components: (1) the two types of common learning environments for pre-service teachers (a face-to-face computer lab course and an online course); (2) the problem solving strategies used to solve problems; and (3) the acquired confidence for technology and perceived development of competence for technology skills. Understanding these components can be of significant value to assess whether pre-service teachers who use various problem solving strategies acquire different levels of perceived confidence and competence regarding technology integration within their future classroom curriculum. A descriptive conceptual framework
for my study is provided in figure 1. Let us briefly examine some research findings and underlying theory for each of these components to demonstrate known and potential connections in support of this study.

Figure 1. Conceptual model for study.

First, previous research has established that students encounter different experiences within various course formats. In a face-to-face course, students have a
specific time to be in the classroom for such course, and are able to receive one-on-one instruction, give and receive visual cues, interact socially and personal with peers, view modeling and demonstrations, and have spontaneous discussions (Tamashiro, 2003; Tutty & Kline, 2008). Whereas, in the online environment, students are able to schedule study time around a work or social schedule, and can join discussions and revisit instructions at any time (Kalathur et al, 2007; Palloff & Pratt, 2007).

Second, past studies have found that students use problem solving skills to resolve difficulties they run into as they learn new concepts. The standard theory on problem solving, initially outlined by Newell, Shaw, and Simon (1958), focuses on how humans respond when they are confronted with unfamiliar tasks. They found that problem solving is a social behavior grounded in the values and role structures of a given group or culture. Building on these ideas, Nelson-De Gall (1986) focused on the analysis of every day learning and problem-solving situations, whereby learners use resources external to them. Indeed, learners’ use of others to acquire information and master skills plays a central role in theories of development and learning (Brown, 1982; Vygotsky, 1978). Ames (1983) conceptualized problem solving as an activity that permits the learner to create an environment that is supportive to progress, and yet challenging so it remains interesting. By seeking help from others when necessary, the learner has the ability to take on more challenging tasks. Seeking help when one cannot solve a problem is preferable to giving up (Butler, 1998). Overall, research on problem solving has clearly established the importance of problem solving for students’ learning and mastery (Ames).
Third, previous research has established that problem solving allows the learner to acquire and master complex skills, thereby supplying the learner with confidence and competence. Studies tell us that if a teacher does not feel confident or competent with a concept, they will not use it (Lin, 2008; NCES, 2005; Wingenbach et al, 2007). A principle emerging from research which compares the performance of experts and novices, and from research on learning and transfer, establishes that in order “to develop competency in an area, learners must have a deep foundation of knowledge and be able to organize that knowledge in ways that facilitate retrieval and application” (Bransford, Brown, & Cocking, 2000, p. 16).

Finally, Van Braak and Goeman (2003) conducted a study that identified determinants of self-perceived computer confidence. Students’ attitudes toward computers were found to be the strongest determinant of self-perceived computer competency. Positive attitudes toward computers, in turn, seemed to be mainly influenced by computer experience and intensity of computer use. Computer experiences and students’ attitudes toward computers were also found to directly impact computer competence. Therefore, problem solving is seen as a task-relevant effort and an investment that increases competence and confidence (Ames, 1983).

Overall, the conceptual model for this study includes three major foundational points which support this study: (1) prior research has shown there are differences in what students experience depending on the way a course is put together; (2) it has been established that problem solving is a major factor when it comes to student learning; and (3) mastery learning and skills creates competence and confidence.
Overview of Methodology

Western Michigan University (WMU) is one of many universities that has been assisting pre-service teachers to learn technology skills and concepts. Technology for Elementary Education (EDT 3470) is a required 2-credit course for all elementary, pre-service teachers at WMU, based on the ISTE standards, and is offered in two different formats, (1) online and (2) within a face-to-face computer lab.

This research study identifies the problem solving strategies pre-service teachers use in learning specific technology skills within this EDT 3470 course; how strategies used differ by the format of this course; and to what extent the type of problem solving strategies and/or course format correlate with the students’ expressed level of confidence and competence to integrate technology into their future classroom settings. Given the need to determine which factors influence perceived technology integration competence and confidence at the end of the EDT 3470 course, a quantitative methodology is used for this study. Data is extracted from surveys of over 1500 students who had taken the EDT 3470 course during nineteen (19) different semesters at Western Michigan University.

Two sources of existing data are used in this investigation: a ProfilerPRO survey, taken at the beginning and the end of the EDT 3470 course, and the End-of-Course Evaluation Survey for the course. The ProfilerPRO measures self-perceived technology skills before and after taking the course. The End-of-Course Evaluation Survey measures the problem solving strategies reportedly used by students when technology problems occurred, both before and while taking the course. Detailed descriptions of each survey are available in Chapter 3.
Delimitations and Limitations

A major delimitation of this study is that the data comes from one Midwestern university, and one course within that university. The study is further delimited to only those students out of all students at that Midwestern university in elementary education who had elected to enroll in the semesters being studied, gave permission to use their information in research studies, and completed both surveys. Thus, the conclusions are delimited to only Western Michigan University Elementary Education major students with complete data for the specific semesters of EDT 3470 used in this study.

One major limitation for this study is the fact that students’ problem solving strategies, and computer competencies and confidences are self-reported. The study is also limited by the validity and reliability of the instruments used to collect the data. The End-of-the-Course Evaluation Survey was developed by the course management staff of the EDT 3470 course and to date has been used and refined over a nine-year period (1999-2008). The ProfilerPRO instrument is a comprehensive survey tool developed by Advanced Learning Technologies (ALTec), a division of the University of Kansas Center for Research on Learning, and is based upon the International Society for Technology Education’s (ISTE) standards (ALTec, 2004). Another limitation is the secondary language in the ProfilerPRO survey. The questions on the survey are asked as if participants are already teachers, even though this is explained by instructors beforehand.

Chapter I Conclusion

This chapter has profiled a research problem including detailed research questions to gather information regarding the problem. Chapter 2 offers perspectives brought by
other studies via a review of literature review presenting a more comprehensive background for this study, including the role of technology in education as well as the importance of technology in teacher preparation programs. Findings from previous research comparing two types of learning environments are presented as well as issues relating to problem solving strategies.

Chapter 3 provides an overview of research methods used for this study. Information on the context of where the study takes place is presented as well as the institutional setting, the participants, and the intervening dependent and independent variables. The process for collection and organization of the data are discussed as are the statistical analysis methods used to address the research questions posed for this research study. Descriptions of the surveys (Pre ProfilerPRO, Post ProfilerPRO, and Zoomerang surveys) used for this study along with explanations of the ISTE and NCATE organizations are also provided. Chapter 4 presents the findings, while Chapter 5 offers discussion and conclusions.
CHAPTER II
REVIEW OF LITERATURE

After graduation, most pre-service teachers move on to become “first year”
teachers. With this move, they face many new challenges, including how to use and
integrate technology into their curriculum. Technology has become an essential
component in today’s educational environment (Chertavian et al, 2008; DOE, 2008).
Using educational technology not only complements teachers’ curriculum, but also
broadens students’ experience beyond the classroom (Marshall 2002). Yet, in a report on
teacher quality, only half of the 4.0 million teachers working in public schools feel
comfortable using technology (NCES, 2009).

This chapter presents the literature on the impact of technology into the
educational environment, teacher preparation programs in higher education, learning
environments and comparisons between them, problem solving strategies, and how to
achieve computer confidence and competence. The review begins by discussing the use
of technology in education and the impact it has had. It then focuses on teacher
preparation programs, emphasizing the technology requirement component. The review
continues by discussing both the face-to-face and online formats, focusing on
comparisons between such environments. It continues with a discussion on the different
types of problem solving strategies used by students. The review ends with a discussion
on how to build technology confidence and competence.
Background on Educational Technology and Teacher Preparation Programs

Computers have changed the way the world works and individuals are expected to be competent in the use of technology for a variety of purposes. Today's student population has been referred to as digital natives who “think and process information fundamentally differently” (Pensky, 2005, p. 1) from their predecessors, who are influenced dramatically by the technological shifts occurring within contemporary society. According to the U.S. Department of Labor (2005), computers play an integral role in the education teachers provide to their students. Most students are engaged in technology outside of the school environment; therefore, to keep such students engaged in the school environment, technologies need to be integrated into the curriculum (Christensen, 2008; Pensky). Educators need to ensure students have the skills to compete in the 21st century, by adapting their learning and teaching practices in response to the challenges of students being socially networked (DOE, 2008; Pensky).

To meet the technology needs of students, many states have mandated the integration of technology into their PK-12 classrooms. They have aligned their state technology standards to the National Educational Technology Standards (NETS), which were developed by the International Society for Technology (ISTE) (Bryant, 2008; Strickland et al, 2001). The NETS include three sets of standards: NETS for students originally released in 1998 with a revised version released in 2007; those for teachers released in 2000; and those for administrators released in 2001.

The 1998 NETS for students include standards in the areas of basic operations and concepts, social, ethical, and human issues, technology productivity tools, technology
communications tools, technology research tools, and technology problem-solving and decision-making tools. In 2007 changes were made to the NETS for students, whereby the same concepts are covered but the terms in the standards were changed to the following: creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem-solving, and decision-making; digital citizenship; and technology operations and concepts.

NETS for teachers includes standards in the areas of technology operations and concepts; planning and designing learning environments and experiences; teaching, learning, and the curriculum; assessment and evaluation; productivity and professional practice; and social, ethical, legal, and human issues (ISTE, 2000). It is imperative that educators meet those required standards in order for students to succeed in the 21st century (DOE, 2008). The EDT 3470 class taught at WMU, the focus of this study, incorporates these standards.

Given such standards, the field of education has high expectations for technology-competent individuals. Educational researchers have discovered that the adoption of technology fosters student learning and, when used appropriately, has a positive impact on achievement (Boster, Meyer, Roberto, & Inge, 2002; Gray, 2002; Kulik, 2002; McLester, 2002; Murphy et al, 2001; O’Dwyer, Russell, Bebell, & Tucker-Seeley, 2005; Wenglinsky, 2005).

Although my study does not assess student outcomes as a result of technology usage, let us briefly look at some individual studies as illustration examples of the successes accomplished with the use of technology. Boster, Meyer, Roberto, and Inge
(2002) examined the integration of standards-based video clips into lessons developed by classroom teachers and found increases in student achievement. Their study of more than 1,400 elementary and middle school students in three Virginia school districts showed an average increase in learning for students exposed to the video clip application compared to students who received traditional instruction alone. In another study of how technology increases learning, O'Dwyer, Russell, Bebell, and Tucker-Seeley (2005) found that fourth-grade students who reported greater frequency of technology use at school to edit papers were likely to have higher total English/language arts test scores and higher writing scores on fourth grade test scores on the Massachusetts Comprehensive Assessment System (MCAS) English/Language Arts test. Also, in Wenglinsky’s (2005) study on computer use and achievement in History, it was found that students who used technology for academic tasks scored high on the National Assessment of Education Progress (NAEP).

A Michigan's Freedom to Learn (FTL) initiative, an effort to provide middle school students and teachers with access to wireless laptop computers, has been recognized for improving grades, motivation and discipline in classrooms across the state (Michigan Department of Education [MDOE], 2006). One exemplary school reported reading proficiency scores on the Michigan Education Assessment Program (MEAP) test, administered in January 2005, increasing from 29 percent to 41 percent for seventh graders and from 31 to 63 percent for eighth graders.

Also, Gray (2002) reports on studies presented at the Community Tools workshop at the CILT2000 conference. One of the presentations included an investigation of how
educators collaborate on-line to develop both technology and pedagogy to support classrooms as interconnected learning communities and the positive effects on achievement. Another presentation explained the experimental studies of computer-mediated communications and how they contribute to higher levels of learning. Another important presentation was a well-tested approach to high achievement and fostering constructivist learning through on-line dialogue.

To further reinforce the technology and achievement relationship, we can look at meta-analyses studies. Kulik (2002) reviewed 36 evaluation studies to examine the effects of instructional technology on mathematics and science learning. Four types of computer applications were explored and discussed with positive results: (1) integrated learning systems in mathematics; (2) computer tutorials in science; (3) computer simulations in science; and (4) micro-based laboratories. In their meta-analysis review of research conducted on the effectiveness of educational software, Murphy et al (2001) found evidence of a positive association between use of educational software products and student achievement in reading and mathematics in a Midwestern school district. Students in the early grades, from pre-K to grade 3, and in the middle school grades appear to benefit most from educational software applications for reading instruction, as do students with special reading needs.

As these examples studies reveal, the research community has provided empirical evidence that technology integration can benefit K-12 students and can impact reform efforts. As educators prepare students to manage technology in socially just ways, and as researchers focus attention on equity issues related to technology integration, students
and society will reap the rewards (Franklin & Bolick, 2007). This information is important for my study because it shows the relationship between technology integration and K-12 student success.

Technology Integration into Teacher Preparation Programs

Now, we can review studies on the importance of integrating technology into teacher education. To live, learn, and work successfully in an increasingly complex and information rich society, students and teachers must use technology effectively. Teacher education programs in the United States have increased their emphasis on technology integration to insure that graduates meet computer competence standards (ISTE, 2000). ISTE has developed performance assessment standards for initial and advanced educational computing and technology programs (National Council for the Accreditation of Teacher Education [NCATE], 1997; ISTE, 2000).

Previously, technology training was targeted as professional development efforts for current teachers. For the past decade, the focus on the technology competency of new teachers is in state-approved teacher education programs (Burke, 2000). Many colleges and universities elect to go through an accreditation process to be state-approved and to receive state assistance (DOE, 2005). NCATE (1997) is the official body for accrediting teacher preparation programs and constantly works at making a difference in the quality of teaching and teacher education. NCATE relies on ISTE to recommend guidelines for accreditation in educational computing and technology teacher preparation.

According to Kuiper, Volman and Terwel (2005), teacher preparation programs that incorporate technology are imperative because tech-savvy teachers can assist their
students to convert information into meaningful knowledge, develop technological competencies, and participate in meaningful activities using advanced technologies. In a meta-analysis of studies, the authors analyzed what research has said about the demands that the use of the Web as an information resource in education makes on the support and supervision of students' learning processes. They concluded that students need support in searching on the Web as well as in developing "information literacy."

Learning Environments

This section offers more details regarding the learning environments used for this research. Over the past two decades American higher education has undergone a dramatic transformation as technology has moved into every element of the institution. Colleges and universities are shifting from traditional pedagogical constructs based largely on face-to-face instruction to educational paradigms that increasingly incorporate online courses and Web-based instructional activities (Lynch, 2009).

Issues regarding environment impact on learning have been researched since the 1930's (Goh & Fraser, 1997). Such research explores the nature of various teaching and classroom environments on students and their learning. In writing about learning environments in the college setting, Strange and Banning (2001) explain how environments influence students' attraction, satisfaction, and stability within said environment. For the purpose of this research, previous knowledge regarding face-to-face and online learning environments are discussed.

Pitch (2004) acknowledged that even though computer-assisted teaching has radically increased, many higher education courses are still classroom-based, and some
indicate there will always be a need for face-to-face learning (Arnold, 2005). In a face-to-face course, students have a specific time to be in the classroom for such course. Students in face-to-face classrooms are able to receive one-on-one instruction, to give and receive visual cues, interact socially and personal with peers, view modeling and demonstrations, and have spontaneous discussions (Tamashiro, 2003; Tutty & Kline, 2008). And therefore, previous research reports that traditional students (age 18-24) believe they learn more in face-to-face courses (Stern, 2004). However, there are time constraints in a face-to-face class. For instance, when having a class discussion, usually a relatively small percentage of students can actually participate in such a discussion during one class session (Smith, Ferguson & Caris, 2001). Whereas, in an online course, the quality of students’ contributions increases due to the fact that they have more time to think about a concept before responding. They are also able to schedule study time around a work or social schedule. Students in the online course are also able to join discussions at any hours and revisit instructions and discussions at any time (Kalathur et al, 2007; Palloff & Pratt, 2007).

Online learning has a long history in American higher education. Its roots can be traced back to correspondence courses in the early 1900’s (Morabito, 1997). From this early beginning, educators have searched for ways to use new tools and technologies to break down time and space barriers that limit student access to higher education. These have included not only courses by mail, but also by radio, television, telephone, and video-teleconferencing (Farahani, 2003). Online courses can be either asynchronous
(i.e., interacting at different times) or synchronous (i.e., interacting at the same time) and usually do not require any face-to-face time in the classroom (Farahani).

As personal computers have become more affordable and ever-present over the past two decades, more colleges and universities have begun to develop and offer online courses and degrees. Online learning accounts for the fastest growing segment of the educational marketplace (Conhaim, 2003; Waits & Lewis, 2003). During 2008, online enrollment grew by 12.9%, which far exceeded the 1.2% growth rate for overall higher education student enrollment (Allen & Seaman, 2008). A study by the Sloan Foundation found that a vast majority of colleges and universities are now offering online courses. According to a recent national survey, over 3.9 million people took at least one online course during the fall 2007 term and over 20% of all U.S. higher education students were taking at least one online course during the same period (Allen & Seaman). The growth in online education has resulted from two main factors: (1) students like the flexibility and access online classes provide (Marquand, 1998; Sener, 2004); and (2) faculty and academic leaders are becoming more comfortable with this new instructional delivery method and are increasingly accepting it as a quality alternative to traditional face-to-face instruction (Conhaim, 2003; Sloan, 2003). In a national survey of chief academic officers, Allen and Seaman found that 52.6% of them viewed online learning as critical to their institution’s strategic success.

Significant previous research has compared online courses to equivalent courses taught in a traditional face-to-face format. The comparisons have examined variables such as learning styles, student achievement, student satisfaction, instructor satisfaction,
interactions between students and instructors, instructor support, and quality of instruction. Some results reveal there are no significant differences between the two course formats comparing any of the above-mentioned (e.g., Aragon, Johnson, Palma-Rivas & Shaik, 2000; Dominguez & Ridley, 2001; Hyllegard & Burke, 2002; Johnson et al, 1999; O’Neal et al, 2007; Topper, 2007). On the other hand, some studies found a higher quality of instruction in online course than in the traditional classroom, and higher levels of student achievement in the online course compared to the face-to-face version of the same course (e.g., Ioakimidis, 2007; Lim et al, 2008).

Although there have been many studies on comparing online courses to face-to-face courses, little research has been done to examine how students’ problem solving strategies differ with such environments. Nor could any studies be found to examine the impact of such strategies on the students’ resulting competence and confidence with technology.

Problem Solving

When a course is offered online and face-to-face, in both course formats, students complete the same assignments as in the using the same technology software, some of which is new to them. As students are introduced to new technologies, some may also be introduced to new problems associated with such technologies. Students in both formats look for assistance necessary to accomplish tasks (i.e., problem solve). Problem solving is one of the major behaviors strategies used by students while participating in the learning process (Keller, 1983).

At one time, problem solving was considered to be a form of dependency and an
invaluable behavior associated with low levels of achievement (Beller, 1957; Winterbottom, 1958). Generations of students grew up on the philosophy of the Little Engine That Could message that they could overcome obstacles in learning if they only tried hard enough (Butler, 2006).

However, in recent years, several researchers have explored problem solving as an important predictor of student learning and achievement (Butler, 2006; Kempler & Linnenbrink, 2006; McGee, 2006; Ryan, Patrick & Shim, 2005). Other research indicates that problem solving is an important self-regulated learning strategy and an essential part of the learning process (Karabenick & Newman, 2006; Nelson-De Gall & Resnick, 1998). Credit for this change is attributed to the work of Nelson-Le Gall (1991) that described problem solving as an important developmental skill. This change in attitude towards problem solving has been evidenced in its inclusion in elementary school report cards (e.g., seeks help when needed), in literature advising parents about ways to foster their children’s motivation and involvement in learning (e.g., Edwards, 2003), and in college students’ study skills curricula (e.g., Collins-Eaglin & Karabenick, 1991; Vanderstoep & Pintrich, 2003).

*Problem Solving and Achievement*

In order to understand the effects of problem solving and achievement, it is important to recognize the relationship between problem solving and need (Karabenick & Nelson, 2006). Need is a critical stage of the problem-solving process (Gross & McMullen, 1983). The process is set in motion by some sort of event (i.e., not comprehending steps in an assignment) where the learner decides whether to ask for help.
Once the learner decides that help is needed, the next step is to figure out the source of that help. In a study that examined the relationship between need and problem solving, 593 college students reported both the incidence of their problem solving from a variety of sources (e.g., teachers, advisors, peers) and the level of help they needed (Karabenick & Knapp, 1998). At the end of the course, a questionnaire was appended to the final exam with participation voluntary. The results of this study revealed that those who need help the most are often the least likely to seek it. Not only are poor performers burdened with negatively valued outcomes, but they also face obstacles to obtaining the help they need. In another study conducted by Karabenick (2004), 1600 college students reported their need for help during a course and how often they had sought help from a variety of sources. The results of a questionnaire given at the end of the term showed more engaged and successful students sought the help they needed. And, again, students with the most need did not seek help.

Karabenick and Knapp (1991) reported on three separate studies that were designed to examine the way in which problem solving relates to learning. In the first study, 612 college students, who were enrolled in an Introductory Psychology at a large midwestern comprehensive university, were given a survey to determine the relationship between problem solving and poor performance. In the second study, 541 college students, who were enrolled in either biology, English literature, and social science (sociology and psychology) classes at a comprehensive state university, a small liberal arts college, and a community college, all in the southeastern Michigan area, were surveyed to examine the relationships between help seeking and a specific set of learning
activities. In the third study, 386 students from the same colleges as in study 2 were surveyed to determine the relationship between problem solving and poor performance. One portion of the results for each of the three studies showed that students who engage in a variety of achievement-oriented activities were more likely, rather than less likely to seek help when it is necessary.

From the aforementioned studies, it has been found that the need for help and the ability to go to someone for that help has a positive relationship to achievement. Indeed, according to a research study conducted by McGee (2005), one of the most important activities that contribute to college students’ being successful is problem solving. The study examined over 2,000 undergraduate students enrolled in eight randomly selected courses at Texas A&M University. Students were requested to complete an online survey. Data was also collected on demographics, attendance, and final grades. The results found that students who used problem solving skills were more successful than students who did not. In another study (Ames, 1983), the importance of problem solving on students’ learning and mastery was clearly established. A questionnaire, which was established for this study by Ames and Lau (1982) was given to students in an Introductory Psychology course. Ames discovered that problem solving as an activity permits the learner to create an environment that is supportive to progress and yet challenging so it remains interesting. In other words, by seeking help from others when necessary, the learner has the ability to take on more challenging tasks.

In a review of literature on problem solving completed by Nelson-De Gall (1986), it was established that problem solving is based on the development of skills in every day
learning and by obtaining solutions to problems encountered in everyday life. The review concentrated on problem solving studies focusing on the learning context and was prepared for the American Educational Research Association. When learners have trouble understanding information and/or completing assignments, they turn to external sources for help. Brown (1982) and Vygotsky (1978) both found in studies completed on problem solving that when learners use outside sources to acquire information and master skills, they are developing positive learning skills. For Brown’s research, 132 participants from a northeastern university were interviewed regarding their perceptions of their problem solving skills. For Vygotsky’s study, 87 preschool children were observed while problem solving during play.

Now we will look at a study that shows how high-quality problem-solving skills are related to learning and achievement. This study was conducted by Ryan, Patrick, and Shim (2005) and looked at seeking help in the classroom. Teachers from one rural and four suburban elementary schools reported on the problem-solving skills used by eight hundred forty-four 5th and 6th grade students. This information was used with concurrent and longitudinal achievement data to examine whether there were any findings that linked problem solving behavior and performance. The results concurred that problem solving behaviors were definitely associated with achievement “both concurrently and longitudinally” (p. 283), providing strong evidence that problem solving is a critical strategy for learning and achievement.

In several studies on students’ behaviors and problem solving, it was found that good students and good self-regulators know when, why and from whom to seek help
(Karabenick & Sharma, 1994; Newman, 1998; Ryan & Pintrich, 1997). And, according to Newman (1998), the help seeking process includes being aware of task difficulty, considering all available information, expressing the request for help, and processing the help that was received. Self-regulated students possess the strategies and routines to deal with academic problems as well as the will and mean to deal with situations in which skills or knowledge is absent. In a study completed by Ryan and Pintrick (1997) that investigated motivational influences on help-seeking behaviors, two hundred and three 7th and 8th graders responded to a questionnaire on perceptions of competence, achievement, and attitudes. The results found that help-seeking behaviors are important factors in perceived competence and achievement. Another study, which was conducted by Ryan and Pintrich (1997), explored children’s intentions to seek help with schoolwork. One hundred seventy-seven 3rd, 5th, and 7th graders were administered questionnaires assessing perceived academic competence, preference for challenge and striving for independent mastery, and attitudes and intentions regarding help-seeking in math class. The results confirmed that help seeking behaviors are important factors in perceived competence and achievement.

**Problem Solving Strategies**

The problem solving process includes some specific problem solving behaviors. In an important edited series of research studies, learners were examined to see how they seek help. From that research, several aspects of the problem solving process was published by DePaulo, Nadler, and Fisher (1983). One area of the problem solving process refers to the studies that focus mainly on the question-asking behavior or
strategies (Graesser & Person, 1994; Karabenick & Knapp, 1988; Puustinen, 1998). Of these question-asking behaviors, four primary strategies to solve problems were found: (1) instructor assistance, (2) peer assistance, (3) further reading, and (4) trial and error.

Instructor assistance. One of the strategies used to solve problems is asking an instructor for assistance. A study conducted by Karabenick and Sharma (1994) examined students' perception of teacher support of student questioning. Two hundred eighty-eight students from 33 classes in a variety of disciplines at a large, public, midwestern university participated in a survey. The results established that when the teacher has a positive attitude towards students asking questions the more likely students would ask questions when necessary. In another study, Newman and Goldin (1990) concluded that students who perceived that the teacher positively supported getting help would ask an instructor questions and also implicated that students often seek instructor assistance because they believe the teacher is more competent and better able to instruct. Sixty-five children from 1st, 2nd and 3rd grades in a middle-class elementary school in Riverside, California, were given a questionnaire, containing items measuring various attitudes and beliefs about help-seeking.

And, yet in another study, Newman and Schwager (1993) interviewed one hundred seventy-seven 3rd, 5th, and 7th grade students from two elementary and one middle school in southern California. The interviews were conducted to assess who, why, and in what situations students ask for help when they have problems in math and discovered that students believed that help from the teacher is more likely to foster learning. Bembenutty (2006) examined the associations between pre-service teachers’
help seeking tendencies, homework beliefs and behavior, and their individual characteristics such as academic delay of gratification, self-esteem, and self-handicap behavior. Sixty-three secondary education pre-service teachers enrolled in a required classroom management course at an urban college in New York responded to a survey on seeking help. The results indicated that students who seek help from instructors have a tendency to be more successful and master the task at hand.

Peer assistance. Peer learning is a form of cooperative learning that enhances the value of student-student interaction and results in various advantageous learning outcomes. There is evidence that peer assistance is extremely effective for a wide range of course goals and content, and for students with different levels and personalities (Johnson & Johnson, 1999; Johnson, Johnson, & Smith, 1991).

In an observational study that investigated the relationship between peer relations and problem solving behaviors, Nelson-Le Gall and Glor-Scheib (1985) found that 83% of students went to peers to get help. Naturally occurring problem solving interactions of 60 students were observed in seven different elementary classrooms at a parochial school.

In a section of the results of three studies conducted by Karabenick and Knapp (1991), the correlates of problem solving among college students were examined. They found that students view their peers as a fruitful source and turn to them for assistance. As described earlier in this paper, 612 college students, who were enrolled in an Introductory Psychology at a large midwestern comprehensive university, were given a survey for the first study to determine the relationship between problem solving and poor performance. In the second study, 541 college students, who were enrolled in either
biology, English literature, and social science (sociology and psychology) classes at a comprehensive state university, a small liberal arts college, and a community college, all in the southeastern Michigan area, were surveyed to examine the relationships between help seeking and a specific set of learning activities. In the third study, 386 students from the same colleges as in study 2 were surveyed to determine the relationship between problem solving and poor performance.

*Reading for assistance.* Some students report they cannot find time to meet with peers in that many students are now working full time or part time while going to college (McNeely, 2005; Palloff & Pratt, 2003). These students often solve problems by further reading on their own and working independently (Karabenick & Newman, 2006). One of the ways in which students work independently is to review information given in class along with any extra reading materials for assistance in how to complete an assignment.

Note taking and note reviewing are essential college student learning activities. A large number of carefully controlled studies have evaluated student effectiveness in implementing each of these skills (Grabe, 2005). A meta-analysis of 33 studies was conducted to examine how much the combination of taking and reviewing notes contributes to school learning. Studies included in the meta-analysis had to include a comparison between outcomes for groups that were instructed or allowed to take notes as usual during class and review the notes before a test, and those for groups that were not allowed to take notes or to review others' notes; a comparison between outcomes for note taking and note reviewing groups and groups that were not allowed to take notes but could review the presented material mentally before a test; and comparison between
outcomes for note taking and note reviewing groups that received interventions in note-taking and/or reviewing procedures and those of groups that did not receive any special intervention. Then the studies had to measure how much the participants learned from a lecture or text. This meta-analysis revealed that the overall effects on learning of students' note-taking and reviewing of those notes are substantially positive (Kobayashi, 2006).

Another reading source is the “Help” link in a software program to find the answer they are looking for on how to do something. Two hundred and fifty students participated in a study that investigated the impact of instruction on the use of on-line help on computer novices' ability to complete unfamiliar computer tasks (Whitesel, 2002). These students were enrolled in a beginning computer course at a northeastern university. They were exposed to a brief instructional package, and then tested on their ability to develop keywords for use in accessing on-line help and on their ability to complete unfamiliar computer problems. An exit questionnaire was used to see if the participants had made use of help when working on the unfamiliar tasks. Students felt this help option is always available to them when and if they need it without the worry of time constraints (Whitesel). In another study, 92 undergraduate and graduate students with various academic backgrounds at a major Canadian university volunteered to participate in the experiment. The students were equally divided into two groups to be trained on how to use a database management software program. One of the groups was taught by an experienced technology instructor. The other group learned to use the software program using the online task support (help link) in the program. Analysis
showed that users of the online task support tended to outperform the instructor-led individuals (Mao & Brown, 2005).

*Trial and error.* Edward L. Thorndike formulated the law of effect theory, otherwise known as the "trial and error" theory (Encyclopedia Britannica, 2010). This theory states that humans learn by doing and the more satisfying the result of a particular action, the better the action is learned. Some students solve problems via "trial and error method" to complete a project. They just keep trying different things until they find the correct way to complete an assignment or a project (Johnson & Johnson, 1999).

It has been found that using the trial and error method creates a meaningful learning experience, which may result in finding several solutions to a problem (Pavlina, 2005). Trial-and-error practice is part of the natural learning process, which means repeating something and making adjustments until one is able to imitate the model effectively or reproduce the mental image (Criss, 2008). Trial-and-error practice is also an integral part of learning, according to Kohut (1985), who states that learners simply have to train and educate the ability to do something over and over again until it feels natural, simple, and easy.

Other examples include a study by Cyr (2008), whereby 54 adult volunteers participated in individual examining contributions of recollection and familiarity to preventive-errorless learning (process of giving the answer to help prevent any error) and trial-and-error learning. These adults were found at a university in Canada either through a volunteer research pool or by responding to flyers posted at the university. The results of this testing indicated that participants had better recollection through trial-and-error
method than through preventive-errorless learning. Finally, Plowman, McPake, and Stephen (2008) conducted a two-year investigation of three- and four-year-old children's uses of technology at home. Based on a survey given to 346 families and 24 case studies, children used the trial-and-error method to figure out how to use software programs on the computer more than learning from their parents.

Problem solving is an essential part of the learning process, is a critical strategy for learning, and has a positive relationship with achievement (Karabenick & Newman, 2006; Ryan & Pintrich, 1997). According to Keller (1983), students who participate in the learning process have the confidence to solve problems. The problem solving process includes some specific problem-solving behaviors, one of which is question asking (Graesser & Person, 1994; Karabenick & Knapp, 1988; Puustinen, 1998). Four primary strategies of question asking to solve problems include: (1) instructor assistance, (2) peer assistance, (3) further reading, and (4) trial and error. These strategies are examined in my study.

Building Computer Confidence and Competence

While it is important for pre-service teachers to graduate with proficient technology skills, it is not enough. Studies have found those who lack competence and/or confidence in technology will not use it (Gulbahar, 2008; Hew & Brush, 2007).

*Computer Competence*

Let us begin by reviewing some studies that examined computer competence. In an exploration of computer competence, Gulbahar examined the level of technology usage of pre-service and in-service teachers at a school of education in a private
university. The data from two questionnaires given to 25 in-service teachers and 558 pre-service teachers was used for the case study. The instructors felt that using technology was an important aspect of teaching but there was not enough professional development or support for such. The pre-service teachers were willing to use technology but felt that there was an inadequate amount of technology integration within their courses to give them the necessary skills for being technology-competent teachers. In another example, Hew and Brush (2007) conducted a meta-analysis of existing studies on general barriers affecting computer usage in K-12 schools. Forty-eight studies found that one of the major barriers of technology integration is the lack of technology knowledge and skills.

A large body of literature supports the idea that technology training is the major factor that could help teachers develop positive attitudes toward technology and integrating technology into curriculum (DOE, 2005; Reynolds & Morgan, 2001; Russell & Bradley, 2004; Zhao & Bryant, 2006). Zhao and Bryant conducted a study that investigated the impact of technology integration training on teachers’ use of technology. Seventeen social studies teachers and five elementary teachers were drawn from Georgia schools that participated in state-mandated technology integration training with follow-up support. After interviewing participants and observing in each classroom, data analysis revealed that teachers were more willing and comfortable to integrate technology into their classroom to enhance student learning.

In another study, Russell and Bradley found that both pre-service and in-service teachers report moderately low levels of such computer competence and confidence, and thus may not integrate technology into their future teaching practices. These results were
discovered after examining the nature, extent, and implications of computer anxiety of teachers in a government schools in Australia. Three hundred and fifty primary and secondary teachers responded to a questionnaire asking about sources of computer anxiety. Approximately 70% of the teachers that participated in the study expressed real concern over their school computer use, the need for more intensive professional development on technology integration, and their low levels of computer competence. With only half of the teachers in the public school feeling comfortable (i.e., confident and competent) using technology to enhance their future students’ learning, teacher education programs need to look further into the development of technology skills competence and technology use confidence (NCES, 2005).

One way to build the acquired confidence and competence in computers skills is to ensure that students understand the material and are able to complete assignments (Karabenick & Newman, 2006; Nord, 2002). In order to gain such computer usage confidence and competence, students need computer experience and intense computer use (Cretchley, 2007). In a study conducted to assess the level of computer competence among university students, computer competencies among students increased visibly within one year (van Braak & Goeman, 2003). Two hundred and eleven undergraduate students in social sciences at a midwestern university responded to a self-report questionnaire at the beginning and end of the year. The survey assessed computer experience (length of time experienced with computing); intensity of computer use (hours/week); computer attitudes; and two computer competence scales: diversity of computer applications used and in-depth knowledge of basic computer applications. Computer attitudes were found to be the
strongest determinant of self-perceived computer competency and positive attitudes towards computers were influenced by computer experience and intensity of computer use.

In another study, one hundred thirty-five pre-service teachers in educational computing courses at a Taiwan teacher's college were assessed on project outputs and a self-evaluation questionnaire. The purpose of the study was to compare competence as well as achievement to design and development of computer integration projects into the elementary classroom (Jih, 2004). The results of the study show that action learning projects are an effective approach in preparing pre-service teachers to feel competent in creating a curriculum that integrates technology.

**Technology Confidence**

We will now look at some studies on confidence. Previous research has revealed that many learners faced with problems hesitate to participate in the learning process because they lack confidence to solve the problems (Keller, 1983). Having confidence basically means being comfortable with whom you are and feeling secure in your abilities to plan and do things (Merriam-Webster, 2009). Confident people feel they are able to tackle things or start new things and finish them, even though there may be learning challenges along the way. Albion (2007) investigated the confidence of beginning university students for conducting searches on the World Wide Web (WWW). Data was collected from a self-report questionnaire given to 569 students enrolled in an introductory professional communications course. This course is part of the first year program all undergraduate teacher education students at a provincial Australian university (Albion). The researcher also observed a small sample of participants as they
performed searches on which the questionnaire was based. The high levels of self-reported confidence discovered in this study were consistent with the familiarity of these students with technologies that have been part of their everyday experience for as long as they can recall.

Another study explored technology confidence when studying pre-service teachers' use of technology at a midwestern university's single technology course. The results showed lack of confidence as a significant factor in the level of technology use (Lambert, Gong, & Cuper, 2008). The year-long study was conducted to explore the relationships between 62 pre-service teachers' perceived computer ability and attitudes. Pretests were given before in-class demonstrations on some applications to identify the technical proficiency levels of students. Homework was assigned each class period and usually included a reading, technology exercise, video case study analysis, or reflections on learning. Five assignments involving the use of internet resources were completed as online activities to give students experience in distance learning. Final exams consisted of large-scale, collaborative, multimedia projects. Questionnaires on computer ability and attitude were administered at the beginning and the end of the course. Students who rated themselves as more knowledgeable in using technology were more confident about using computers and believe them to be useful tools for their future classrooms.

According to Cretchley (2007) in order to gain computer usage confidence, students need computer experience and intense computer use. These results were found after capturing data in an investigation of a technology-enriched Australian learning environment in which early undergraduate students were introduced to the use of
powerful software package for learning and doing mathematics. The investigation began in 1998; however most of the data reported here was captured over the period 2000 to 2004.

And in another study, Van Braak and Goeman (2003) identified determinants of self-perceived computer confidence. Students’ attitudes toward computers were found to be the strongest determinant of self-perceived computer competency. Positive attitudes toward computers, in turn, seemed to be mainly influenced by computer experience and intensity of computer use. Computer experiences and students’ attitudes toward computers were also found to directly impact computer competence. Therefore, problem solving is seen as a task-relevant effort and an investment that increases competence and confidence (McGee, 2005).

Consequently, research has established that problem solving allows the learner to acquire and master complex skills, thereby supplying the learner with confidence and competence. Studies tell us that if a teacher does not feel confident or competent with a concept, they will not use it. Research has established that problem solving allows the learner to acquire and master complex skills, thereby supplying the learner with confidence and competence. Studies tell us that if a teacher does not feel confident or competent with a concept, they will not use it (Lin, 2008; NCES, 2005; Wingenbach et al, 2007. A principle emerging from research that compares the performance of experts and novices and from research on learning and transfer establishes that in order “to develop competency in an area, learners must have a deep foundation of knowledge and
be able to organize that knowledge in ways that facilitate retrieval and application”
(Bransford, Brown, & Cocking, 2000, p. 16).

Over half of public school teachers feel uncomfortable with the integration of technology (NCES, 2005), and these teachers report moderately low levels of computer competence (Russell & Bradley, 2004). Those who lack competence and/or confidence in technology will not use it (Gulbahar, 2008; Hew & Brush, 2007). According to Karabenick and Newman (2006), in order to build confidence and competence in computer skills, students need to understand the course material and be able to complete assignments in technology courses. The more learners use technology, the more comfortable they become with technology. According to Miller and Fuller (2006), confident people feel they are able to tackle things or start new things and finish them, even though there may be learning challenges along the way. These issues are examined further in this study.

Chapter II Summary

Today’s educational environment includes the use of technology as a vital tool (Chertavian et al, 2008; Christensen, 2008; DOE, 2008; Pensky, 2005). In fact, the education departments of most states have mandated the integration of NETS technology standards as part of the PK-12 curriculum. Also, with most students are engaging in technology outside of the school environment, it is imperative to keep such students engaged in technology within the school environment (Christensen, DOE, Pensky). There is a wealth of evidence that technology integration benefits both students and teachers (Franklin & Bolick, 2007).
Yet, in a DOE study on teacher quality, it was discovered that only 52% of the 4.0 million teachers working in public schools feel comfortable using the technologies available to them (NCES, 2005). Therefore, teacher preparation programs that include technology are crucial (Kuiper, Volman, & Terwel, 2005). It has been found that teacher education programs in the United States have increased their emphasis on technology integration while attempting to insure that graduates meet standards in order to achieve computer competence (ISTE, 2000).

Some of these programs are taught in the traditional classroom and others in an online learning environment. Numerous comparisons of online courses to the equivalent course taught in a traditional face-to-face format have been conducted, and many found there is no significant difference between the two course formats when comparing several different characteristics (e.g., Aragon, Johnson, & Shaik, 2000; Dominguez & Ridley, 2001; Hyllegard & Burke, 2002; Johnson et al, 1999; O’Neil et al, 2007; Topper, 2007). Other meta-analyses compared online and face-to-face instruction and discovered that there was an advantage to online learning (e.g., Aragon, Johnson, & Shaik, 2000; Dominguez & Ridley, 2001; Hyllegard & Burke, 2002; Ioakimidis, 2007; Johnson et al, 1999; Kalathur et al, 2007; Lim et al, 2008; O’Neil et al, 2007; Palloff & Pratt, 2007; Stern 2004; Topper, 2007). Although there have been many studies on comparing online courses to face-to-face courses, little research has been done to examine how student’s problem solving strategies differ within such environments.

Anytime a new technology is introduced, there is a good chance that new problems associated with such technology will appear. Whether students are in enrolled
in an online course or a face-to-face course, such students will find it necessary to seek assistance, or problem solves, in order to accomplish tasks. Problem solving is one of the major behaviors strategies used by students while participating in the learning process (Keller, 1983), and has become an important activity that contributes to success (McGee, 2005). According to Nelson-DeGall (1986), problem solving behaviors assist in learning and achievement.

There are four major problem solving strategies that can be helpful to students. Newman and Goldin (1990) found that students often seek assistance from their instructor because they believe the teacher is more competent is more likely to foster learning (Bembenutty, 2006; Newman & Goldin; Newman & Schwager, 1993). In other studies, students view their peers as a fruitful source and often turn to them for assistance (Karabenick & Knapp, 1998). Yet, additional studies conducted found further reading, note taking, and note reviewing as essential learning activities (Karabenick & Knapp, 1991). And, it has also been established that when students solve problems via “trial and error method,” a meaningful learning experience is created (Johnson & Johnson, 1999; Pavlina, 2005).

Previous research has revealed that many learners lack confidence to solve the problems (Keller, 1983). In order to gain such computer usage confidence and competence, students need computer experience and intense computer use (Cretchley, 2007). Studies have revealed that the integration of technology into pre-service teacher education programs assists in participants becoming more familiar with technology and increases their confidence in using technology in their classroom (Balli & Digs, 1996;
Thurston et al., 1998; Chisolm & Wetzel, 2001). Computer experiences and students’ attitudes toward computers were also found to directly impact computer competence.

This study attempts to build on previous research and add another element to the body of knowledge in this area. It examines information on the problem solving strategies students used in both online and face-to-face sections of a pre-service teachers’ educational technology methods course, EDT 3470. The problem solving strategies are used to see if there is any relationship between the course format and the problem solving strategy used, and whether a relationship exists between students’ self-reported technology competencies, technology usage confidence, and their use of any given problem solving strategies.

Now, let us turn to Chapter 3 in which the methods used in this research are offered.
CHAPTER III

METHODOLOGY

The purpose of this study is to explore the problem solving strategies used by students in learning specific technology skills and whether those strategies used are influenced by the format of a course (i.e., face-to-face computer lab vs. online). In addition, it examines to what extent the type of problem solving strategies and/or course format is correlated with students’ expressed level of confidence and competence to integrate technology into their future classroom settings. Included in this chapter, respectively, are the research design, the description of the sample and participants, setting where the study occurred, an explanation of the instruments used in the study, the data collection procedures, and the data analysis processes.

Research Design

This study used a casual comparative approach which is called ex post facto research design (Gay & Airasian, 2003). Ex post facto research designs use data after the fact, and the data base used for this study came from EDT 3740 courses that had previously been taught and data collected from the students. Data for the independent variables were therefore already collected and were not controlled by the researcher. Some researchers assert that ex post facto research designs are inferior to true experimental design (Phillips, 1981). However, ex post facto research often allows examination of multiple years of data, which in the case of my study, involved five years of data for over 1500 students.
Ex post facto research does not allow causal comparison of the independent and dependent variables. Instead, it was my intention to examine the relationship through ex post facto research, but not causation. In order to demonstrate a causal relationship, the dependent variable and its effects must be controlled for by the manipulation of the independent variables, and that was not possible within this study.

Although the population for this study was large (over 1500 students), it still cannot be generalized to all other institutions and teacher education programs that have technology courses for elementary education teacher educators. In this case, participants in the study were students enrolled in the educational technology teacher preparation methods course (EDT 3740) at Western Michigan University. While there are technology courses for teacher educators, it did not represent the populations of students in those programs.

Research Questions

Since I compared the differences between the online and face-to-face course formats of EDT 3740 class sections, the following research questions were used:

1. To what extent are there differences between pre-service teacher education students within an online technology course compared to those within a face-to-face computer lab course, in reference to their self-reported:

   (a) technology competence; and

   (b) technology usage confidence?
2. Within each course format, to what extent are there differences in the degree such students use problem solving strategies, before and within the course, and for specific technology skills, in reference to:

   (a) seeking instructor assistance and waiting for a response;
   (b) finding out the answer from a peer;
   (c) discovering the answer via their own reading; and
   (d) discovering the answer via their own investigation using trial and error?

3. Within each course format,

   (a) what relationships exist between students' self-reported technology competencies, self-reported technology usage confidence, and their use of any given problem solving strategies; and
   (b) what differences within these relationships exist between the two course formats?

EDT 3740 Course at Western Michigan University

The focus of this study was data collected from students who participated in an educational technology teacher methods course, EDT 3470, offered at WMU in both the online and face-to-face formats. This educational technology course was created to assure that all pre-service teachers are proficient in required technology skills, and is based on ISTE Technology Standards. The goal of EDT 3470 is to familiarize elementary, pre-service teachers with the technologies that are used in many of today's elementary education classrooms. Both sections of this course use Blackboard as its management program. The online sections of EDT 3470 are taught completely online.
The face-to-face sections are taught in a computer lab in the College of Education and 
Human Development at Western Michigan University and include links to online 
resources.

- Use the EDT 3470 course management system provided by Blackboard. Therefore, 
  students will gain a working knowledge of the course management options within 
  Blackboard through the modules. Students will communicate via discussion boards and 
  email and use the links through the modules for submission of assignments. Evaluations 
  scores (points) for assignments are posted by instructors for students to view in 
  Blackboard through The Gradebook. Students are required to log in to the EDT 3470 
  web site on a regular basis to review regular announcements about the course activities 
  and changes.
- Use their University Unified email account during the course as part of course 
  communication activities. The email address is needed for communications with the 
  EDT 3470 instructors. Students are required to obtain their own email account through 
  the University Unified Computer Accounts.
- Use the Internet on a weekly basis for course related discussion, communications, 
  materials, and resources.
- Create a simple data collection spreadsheet on Microsoft Excel. The assignment requires 
  a working knowledge on introductory spreadsheet formatting and printing commands, 
  use of formulas for spreadsheet calculations, and the creation of a spreadsheet chart.
- Use a software program, called Inspiration, which is a visual learning tool used to assist 
  with the development of ideas and to organize thinking by individuals and small groups.
- Demonstrate skill and confidence in using technology related equipment commonly 
  found in elementary education classrooms including desktop computers, laptop 
  computers, wireless computers, video projection equipment, digital cameras, scanners, 
  video conferencing equipment and other forms of digital electronics.
- Create rubrics for assessment.

Figure 2. EDT 3470 learning outcomes.

During the course, students learn to use several computer applications and are 
required to demonstrate their competency in using the application as part of class 
communication and as part of class assignments. The topics for these assignments must
meet the ISTE Standards for Teachers (ISTE 2002). It should be noted that even though in 2007 changes were made to the NETS for students, this study is used data from courses based on the 1998 NETS. One of the major components of the class is for students to create two different lesson plans that integrate technology into academic subjects using Michigan Academic Benchmark Standards and ISTE Technology Standards for Teachers. These assignments require use of the TaskStream (2002), an online lesson planning tool. Another component of the class is developing a classroom web site that includes six different pages (home, student, parent, teacher, professional, and personal). Finally, at the end of the course, the final project is the development of a collaborative professional development or curriculum area web site for integrating technology into elementary education. The learning outcomes, as extracted from the course Syllabus, for EDT 3470 are shown in Figure 2.

The instructors for EDT 3470 at Western Michigan University not only cover the technology standards throughout the course with discussions, demonstrations, and hands-on experiences, they also offer an open “help” lab every Friday afternoon. This lab is conducted by two to four EDT 3470 instructors. Any student that is enrolled in EDT 3470 (online or face-to-face) is allowed to attend this open 3-hour session for any type assistance from these instructors (EDT 3470, 2006). The instructors also offer office hours and/or assistance by appointments. Students are allowed to walk in to the office hours or set up an appointment time with the instructors for any help they may need.
Participants

Students that enroll in EDT 3470 do so because it is a required class for all elementary pre-service teachers at this university. Such elementary pre-service teachers are all students who have been admitted to the elementary education program after the completion of 35 hours, which includes completion of Western Michigan University Intellectual Skills Developments (an approved college level writing course called ED 2500, Human Development), and have achieved a cumulative grade point average of 2.5 or better at the time of application. Before being accepted into the Elementary Education Teacher Education program, applicants must also meet WMU’s College of Education Entry Level Technology Standards, which includes using word processing software to create professional documents, communicating through electronic mail, researching on the World Wide Web, using computer-based-library tools and accessing, integrating and/or transferring information between files (WMU, 1999).

For this study, pre-existing surveys were used. These surveys were completed by students who took the EDT 3470 course during the following terms at Western Michigan University: Summer I, Summer II, and Fall of 2005; Spring, Summer I, Summer II, and Fall of 2006; Spring, Summer I, Summer II, and Fall of 2007; Spring, Summer I, Summer II, and Fall of 2008; and Spring, Summer I, Summer II, and Fall of 2009. Data was extracted from surveys of over 1500 students who had taken the EDT 3470 course during these nineteen (19) different semesters at Western Michigan University.
Instruments

Data extracted from two instruments were used in this investigation. The instruments used include the ProfilerPRO survey and the Course Evaluation used for the EDT 3470 course. The ProfilerPRO survey was taken at each beginning of the semester and the end of each semester for measurement of improvement of technology skills from taking EDT 3470.

*Pre ProfilerPRO.* The Pre Profiler Pro is an instrument that measures prospective teachers’ perceived ability to use technology in the classroom environment. ProfilerPRO was created and is maintained by Advanced Learning Technologies (ALTec), a division of the University of Kansas Center for Research and Learning. This development of this program was partially funded by the U.S. Department of Education (ALTec, 2004). All questions on the Pre ProfilerPRO survey are based on the International Society for Technology in Education (ISTE) NETS for Teachers. Data from four identical Pre ProfilerPRO surveys are used – one for the beginning and one for the end of the face-to-face courses, and one for the beginning and one for the end of online courses.

In the EDT 3470 course, the PreProfilerPRO was given to students prior to course instruction. The survey measures what a student leaving a teacher education program should know and be able to perform according to national standards and performance indicators. The instrument is in Appendix B. The instrument has 17 forced choice, likert-scale items divided in five sections. Those sections are: technology operation and concepts, teaching learning and the curriculum, productivity and professional practice and social, ethical and human issues. At the beginning of the instrument, a paragraph
explains to answer the questions as if you were teaching right now. The forced choice selections for participants are as follows: (a) no opportunity or exposure, (b) I am aware, but I do not use this in my practice, (c) I am literate and integrate some of the indicators, (d) I integrate this into my teaching and (e) I am able to teach others.

Post ProfilerPRO. At the end of the semester, all students are requested to take a Post course ProfilerPRO survey (see Appendix B). This survey is identical to the Pre ProfilerPRO survey in that the instructors receive an indication of the gains acquired by the students throughout the course.

Zoomerang EDT 3470 course evaluation. The second data set used in this study was from the end-of-course evaluation instrument developed for the EDT 3470 course. This survey is given online using Zoomerang software, where students go to the website, complete the instrument, and the responses are stored until retrieved for evaluation. This instrument has 14 items likert-scale forced choice items, and measures a number of items related specifically to the EDT 3470 course. Those items are as follows: (a) text and other resources, (b) the value of assignments in the measurement of learning, (c) course benefit to the academic program, (d) problems and concerns using technology before taking the course, (e) problems with technology during taking the course, (f) evaluation of class format, and (g) estimates of time outside class to complete assignments. There are also two demographic questions that assist course developers. These questions request the name of the course instructor and the current class standing of the participants. This survey is in Appendix C.
Data Collection

For the purpose of this study, existing data was used. The results of the Pre-ProfilerPRO and Post-ProfilerPRO are stored in ProfilerPRO and are available for EDT 3470 instructor review at the end of each semester. For this study, the course management person for Educational Technology collected the surveys after grades were posted in each semester: for Summer I, Summer II, and Fall of 2005; Spring, Summer I, Summer II, and Fall of 2006; Spring, Summer I, Summer II, and Fall of 2007; Spring, Summer I, Summer II, and Fall of 2008; and Spring, Summer I, Summer II, and Fall of 2009. The course management person cleaned and coded the surveys with numbers so that no identifiers were passed on to the researcher for the statistical analysis. Once the data from the previous course sections is pulled, it was placed into the Statistical Package for the Social Sciences (SPSS) for analysis.

The results for the Zoomerang End of the Course Evaluation Survey are completely anonymous and are available for instructors to review at the end of the course.

Data Analysis

Several steps were included in the analysis of the course data (Creswell, 2003). Data was analyzed using SPSS Statistics. Specific sections of Pre and Post ProfilerPRO and Zoomerang Evaluation instruments were made into variables (see Appendix A). Cronbach’s Alpha reliability was conducted on specific items in ProfilerPRO and Zoomerang surveys to determine the reliability/validity of the specific questions in the survey. This statistical analysis is used to determine if multiple items correlate with each
other to produce a single variable (Salkind, 2004). If the alpha is .700 or higher (meaning there is a strong correlation between items), a new variable can be created. If the alpha is lower than .700 (meaning there is a low correlation between items) then one or more items need to be removed in order to make the correlation stronger. Next, a factor analysis was performed to see what items being used from the surveys can be condensed into specific variables. From these two analyses, two new variables (Competence Total and Confidence Total) were created.

Descriptive statistics were conducted to provide a summary of the mean, median, and standard deviation. The next step was to conduct independent t-tests on the Pre ProfilerPRO for the online and face-to-face formats to see if there is a significant difference between the data in such formats. T-tests were performed on the Likert-scale data with a p-value of .05. T-tests revealed that there were differences so data from Pre ProfilerPRO and Post ProfilerPRO was used to conduct analysis of covariance (ANCOVA) for both the face-to-face group and the online group to answer question 1a, “are there are differences between pre-service teacher education students within an online technology course compared to those within a face-to-face computer lab course, in reference to their self-reported technology competence.” And then, independent t-tests were conducted on the data from question 6 on the Zoomerang instrument, which answers question 1b, “are there are differences between pre-service teacher education students within an online technology course compared to those within a face-to-face computer lab course, in reference to their self-reported technology confidence.”
The next step, answering question 2, was to establish within each course format to what extent are there differences in the degree students use problem solving strategies, before and within the course, and for specific technology skills, in reference to: (a) seeking instructor assistance and waiting for a response, (b) finding out the answer from a peer, (c) discovering the answer via their own reading, and (d) discovering the answer via their own investigation using trial and error. Four independent t-tests were conducted on the data from question 7 on the Zoomerang instrument, which asks what problem solving skills participants used before taking EDT 3470. The t-test determined some significant differences between data from course formats; therefore, analysis of covariance was conducted to explore the differences between groups while statistically controlling a variable that may be influencing scores (Pallant, 2005). According to Pallant, the removal of the influence can increase the power of the tests. Four independent t-tests were conducted on data from question 8 to analyze the frequencies, means, and percentages in an overall view of the self-reported use of the problem-solving skills along with comparing the online data to the face-to-face data. Crosstabs analysis were completed on data from question 9 to determine the percentages of each problem solving skill used for specific individual assignments and comparing the online usage to the face-to-face usage. Then, T-tests were conducted to find the differences of problem solving skills used between course formats.

Analysis of covariance was conducted to explore the differences between groups while statistically controlling a variable that may be influencing scores (Pallant, 2005). According to Pallant, the removal of the influence can increase the power of the tests.
Finally, Pearson correlation coefficients and regressions were performed to in order to determine what relationships exist between students' self-reported technology competencies, self-reported technology usage confidence, and their use of any given problem solving strategies for the online course and the face-to-face computer lab course; and what differences within these relationships exist between the two course formats.

Chapter III Summary

This chapter has presented the design overview and research questions, along with the participants, instruments, data collection methods, data analysis, data reduction, delimitations and limitations, and measures for research questions. Now, let us turn to Chapter 4 which presents the results of the measures for each research question.
CHAPTER IV
RESULTS

This chapter presents the problem solving strategies used by university students in learning specific technology skills, and whether those strategies used are influenced by the format of their course (i.e., face-to-face computer lab vs. online). In addition, it also presents to what extent the type of problem solving strategies and/or course format are related to students’ expressed level of confidence and competence to integrate technology into their future teaching classroom settings. Data from two pre-existing surveys completed by college students who took an educational technology teacher methods course was used for this study. The chapter begins by discussing the demographics of those who participated in completing both surveys. Secondly, this chapter addresses the research questions posed in the previous chapter. Each of the three research questions are sequentially addressed in this chapter. Results presented include frequency data, percentages, means, T-tests, crosstabs, analysis of covariance, correlations coefficients and regressions.

Participant Description

Fifteen hundred and twelve students over 19 semesters responded to all questions on a ProfilerPRO survey (both Pre and Post), which measured technology competence. Of those students, 870 (57.5%) took EDT 3470 in the face-to-face computer lab, while 642 (42.5%) took the course online (Table 1). Thirteen hundred sixty students over 19 semesters responded to all questions on a Zoomerang survey, which measured problem solving approaches, and technology use confidence. Of those students, 858 (62.2%) took
EDT 3470 in the face-to-face computer lab while 522 (37.8%) took the course online.

Table 1

*Research Participants*

<table>
<thead>
<tr>
<th>Survey</th>
<th>F2F n (%)</th>
<th>Online n (%)</th>
<th>Total (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProfilerPro</td>
<td>870 (57.5)</td>
<td>642 (42.5)</td>
<td>1512</td>
</tr>
<tr>
<td>(tech competence)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zoomerang</td>
<td>858 (62.2)</td>
<td>522 (37.8)</td>
<td>1380</td>
</tr>
<tr>
<td>(problem solving &amp; tech confidence)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pre-course Computer Competency Data and Analysis**

The ProfilerPRO survey used in the EDT 3470 course is given to students *prior* to course instruction and measures what a student leaving a teacher education program should know and be able to perform. Fourteen out of the 17 forced choice, likert-scale items from this survey are used for this research to measure self-reported technology competence. The forced choice selections for participants are as follows: (1) no opportunity or exposure (No Opp), (2) I am aware, but I do not use this in my practice (Aware), (3) I am literate and integrate some of the indicators (Literate), (4) I integrate this into my teaching (Integrate), and (5) I am able to teach others (Teach). Students in the face-to-face course (N=870) and the online course (N=642) identified their levels of pre-course technology competence in each of 14 areas.

Although this study does not include random assignment to groups, it does involve the comparison of data from two groups of students: those who took the EDT 3470 via a face-to-face method and those who took it via an online format. Therefore, it
is important to determine if there were any initial major differences between these two 
groups (since random selection and assignment were not possible for this study). 
Therefore, the data from the “pre” ProfilerPRO was used to ascertain any significant 
differences.

Independent samples *t*-test were used to determine if there are differences 
between the pre-course reported competence for those in the face-to-face and online 
classes, and revealed significant differences for each of the 14 items. The negative *t*
values show that the first group (F2F) means are smaller than the second group (online)
means for each item. These included: students’ understanding the nature/operation of 
technology systems (*t*_{1466}=-4.13, *p*=.000), use of input/output devices (*t*_{1417}=-4.20, 
*p*=.000), use of technology to improve products and learning (*t*_{1468}=-5.84, *p*=.000), use of 
content-specific tools to support learning/research (*t*_{1510}=-5.20, *p*=.000), use of 
technology to gain higher thinking skills (*t*_{1510}=-2.89, *p*=.004), use of technology to 
develop strategies (*t*_{1510}=-4.04, *p*=.000), use of technology to locate information (*t*_{1419}=-
6.04, *p*=.000), use of technology to process data/report results (*t*_{1510}=-4.50, *p*=.000), use of 
proper tool for specific tasks (*t*_{1453}=-2.76, *p*=.006), use of technology to create group 
projects (*t*_{1415}=-3.43, *p*=.001), observe/experience technology use in field of study (*t*_{1443}=-
5.04, *p*=.000), use technology to manage and communicate (*t*_{1510}=-6.58, *p*=.000), use of a 
variety of media and format (*t*_{1510}=-3.27, *p*=.001), and positive attitude for use of 
technology (*t*_{1510}=-6.52, *p*=.000).

Table 2 displays these *t* test results, showing the means for face-to-face, the 
means for online, the *t* value and the *p* value.
### Table 2

*T-tests for Pre Course Technology Competency*

<table>
<thead>
<tr>
<th>Item</th>
<th>F2F M</th>
<th>Online M</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understand nature/operation of technology systems</td>
<td>2.91</td>
<td>3.14</td>
<td>-4.13</td>
<td>.000*</td>
</tr>
<tr>
<td>Use input/output devices</td>
<td>2.58</td>
<td>2.81</td>
<td>-4.20</td>
<td>.000*</td>
</tr>
<tr>
<td>Use to improve products, learning</td>
<td>3.12</td>
<td>3.44</td>
<td>-5.84</td>
<td>.000*</td>
</tr>
<tr>
<td>Use content-specific tools to support learning/research</td>
<td>3.19</td>
<td>3.45</td>
<td>-5.20</td>
<td>.000*</td>
</tr>
<tr>
<td>Use to gain higher thinking skills</td>
<td>3.08</td>
<td>3.24</td>
<td>-2.89</td>
<td>.004*</td>
</tr>
<tr>
<td>Use to develop strategies</td>
<td>3.16</td>
<td>3.38</td>
<td>-4.04</td>
<td>.000*</td>
</tr>
<tr>
<td>Use to locate information</td>
<td>3.54</td>
<td>3.85</td>
<td>-6.04</td>
<td>.000*</td>
</tr>
<tr>
<td>Use to process data/report results</td>
<td>3.24</td>
<td>3.48</td>
<td>-4.50</td>
<td>.000*</td>
</tr>
<tr>
<td>Use proper tool for specific tasks</td>
<td>2.88</td>
<td>3.02</td>
<td>-2.76</td>
<td>.006*</td>
</tr>
<tr>
<td>Use to create group projects</td>
<td>2.67</td>
<td>2.87</td>
<td>-3.43</td>
<td>.001*</td>
</tr>
<tr>
<td>Observe/experience use in field of study</td>
<td>2.90</td>
<td>3.17</td>
<td>-5.04</td>
<td>.000*</td>
</tr>
</tbody>
</table>
Because the $t$ tests on self-reported technology competence prior to taking EDT 3470 determined there are significant differences between these two groups, and random selection and assignment were not possible for this study, a one-way analysis of covariance (ANCOVA) was therefore necessary to compare self-reported computer competency of the face-to-face and online groups after taking EDT 3470. An ANCOVA minimizes the effects of pre-existing individual differences among variables (i.e., groups), thereby reducing the differences that may affect the outcome of an analysis (Pallant, 2005). This analysis of perceived computer competence is summarized in the next section.

**Perceived Computer Competence**

The same fourteen survey questions from the pre ProfilerPRO were used at the end of the course in the post ProfilerPRO to measure perceived computer competence. Data from these questions were used to answer research question 1a, which examines to what extent there are differences between pre-service teacher education students within
an online technology course compared to those within a face-to-face computer lab course, in reference to their self-reported technology competence. Responses for all questions from the survey were also recorded on a 5-point Likert scale (i.e., 1=No opportunity for exposure, 2=I am aware but do not plan to use this in my practice, 3=I am literate and will integrate some of indicators, 4=I will integrate this into my teaching, 5=I am able to teach others).

Table 3 contains the frequencies and percentages as ranked from highest to lowest means for the fourteen questions related to computer competence after taking EDT 3470 in the face-to-face format. Table 4 contains the frequencies and percentages as ranked from highest to lowest for the fourteen questions related to computer competence after taking EDT 3470 in the online format.

Table 3

*Face-to-face Post Course Computer Competency*

<table>
<thead>
<tr>
<th>Technology Skill</th>
<th>No Opp n(%)</th>
<th>Aware n(%)</th>
<th>Literate n(%)</th>
<th>Integrate n(%)</th>
<th>Teach n(%)</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use to locate information</td>
<td>0 (0.0)</td>
<td>7 (0.8)</td>
<td>105 (12.1)</td>
<td>358 (41.1)</td>
<td>400 (46.0)</td>
<td>4.32</td>
</tr>
<tr>
<td>Use to process data/report results</td>
<td>1 (0.1)</td>
<td>13 (1.5)</td>
<td>124 (14.3)</td>
<td>380 (43.7)</td>
<td>352 (40.5)</td>
<td>4.23</td>
</tr>
<tr>
<td>Use to improve products, learning</td>
<td>1 (0.1)</td>
<td>11 (1.3)</td>
<td>112 (12.9)</td>
<td>433 (49.8)</td>
<td>313 (36.0)</td>
<td>4.20</td>
</tr>
<tr>
<td>Exhibit positive attitude for use</td>
<td>1 (0.1)</td>
<td>11 (1.3)</td>
<td>119 (13.7)</td>
<td>25 (48.9)</td>
<td>314 (36.1)</td>
<td>4.20</td>
</tr>
<tr>
<td>Use content - specific tools to support learning/research</td>
<td>0 (0.0)</td>
<td>16 (1.8)</td>
<td>164 (18.9)</td>
<td>427 (49.1)</td>
<td>263 (30.2)</td>
<td>4.08</td>
</tr>
<tr>
<td>Technology Skill</td>
<td>No Opp n(%)</td>
<td>Aware n(%)</td>
<td>Literate n(%)</td>
<td>Integrate n(%)</td>
<td>Teach n(%)</td>
<td>M</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>-------------</td>
<td>------------</td>
<td>---------------</td>
<td>----------------</td>
<td>------------</td>
<td>-----</td>
</tr>
<tr>
<td>Use to develop strategies</td>
<td>0 (0.0)</td>
<td>17 (2.0)</td>
<td>158 (17.2)</td>
<td>464 (53.3)</td>
<td>239 (27.5)</td>
<td>4.06</td>
</tr>
<tr>
<td>Use to manage/communicate</td>
<td>1 (0.1)</td>
<td>26 (3.0)</td>
<td>190 (21.8)</td>
<td>390 (44.8)</td>
<td>263 (30.2)</td>
<td>4.02</td>
</tr>
<tr>
<td>Understand nature/operation of technology systems</td>
<td>3 (0.3)</td>
<td>20 (2.3)</td>
<td>184 (21.1)</td>
<td>425 (48.9)</td>
<td>238 (27.4)</td>
<td>4.01</td>
</tr>
<tr>
<td>Use to gain higher thinking skills</td>
<td>1 (0.1)</td>
<td>14 (1.6)</td>
<td>170 (19.5)</td>
<td>479 (55.1)</td>
<td>206 (23.7)</td>
<td>4.01</td>
</tr>
<tr>
<td>Use variety of media/format</td>
<td>2 (0.2)</td>
<td>29 (3.3)</td>
<td>182 (20.9)</td>
<td>405 (46.6)</td>
<td>252 (29.0)</td>
<td>4.01</td>
</tr>
<tr>
<td>Use to create group projects</td>
<td>2 (0.2)</td>
<td>30 (3.4)</td>
<td>204 (23.4)</td>
<td>383 (44.0)</td>
<td>251 (28.9)</td>
<td>3.98</td>
</tr>
<tr>
<td>Evaluate/select proper tool for specific tasks</td>
<td>3 (0.3)</td>
<td>18 (2.1)</td>
<td>215 (24.7)</td>
<td>440 (50.6)</td>
<td>194 (22.3)</td>
<td>3.92</td>
</tr>
<tr>
<td>Observe/experience use in field of study</td>
<td>1 (0.1)</td>
<td>29 (3.3)</td>
<td>213 (24.5)</td>
<td>436 (50.1)</td>
<td>191 (22.0)</td>
<td>3.90</td>
</tr>
<tr>
<td>Use input/output devices</td>
<td>7 (0.8)</td>
<td>40 (4.6)</td>
<td>270 (31.0)</td>
<td>376 (43.2)</td>
<td>177 (20.3)</td>
<td>3.78</td>
</tr>
</tbody>
</table>

Likert scale: 1=No opportunity or exposure, 2=I am aware, but do not use this in my practice, 3=I am literate and integrate some of the indicators, 4=I integrate this into my teaching, 5=I am able to teach others
* p≤.05

When presented with the statement “Demonstrate a sound understanding of the nature and operation of technology systems (Understand nature/operation of technology systems),” 425 (48.9%) of the F2F student and 277 (43.1%) of the online students felt
they would integrate this skill into their teaching, while 238 (27.4%) F2F and 263 (41.0%) online students felt they were able to teach it to others. For statement 2, “Demonstrate proficiency in the use of common input and output devices; solve routine hardware and software problems; make informed choices about technology systems, resources, and services” (Use input/output devices), 376 (43.2%) F2F and 282 (43.9%) online students felt they would integrate this skill into their teaching, with 270 (31.0%) F2F students and 200 (31.2%) online students indicating they were able to teach it to others.

Table 4

<table>
<thead>
<tr>
<th>Technology Skill</th>
<th>No Opp n(%)</th>
<th>Aware n(%)</th>
<th>Literate n(%)</th>
<th>Integrate n(%)</th>
<th>Teach n(%)</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use to locate information</td>
<td>0 (0.0)</td>
<td>3 (0.5)</td>
<td>43 (6.7)</td>
<td>195 (30.4)</td>
<td>401 (62.5)</td>
<td>4.55</td>
</tr>
<tr>
<td>Use to improve products, learning</td>
<td>0 (0.0)</td>
<td>4 (0.6)</td>
<td>42 (6.5)</td>
<td>255 (39.7)</td>
<td>341 (53.1)</td>
<td>4.45</td>
</tr>
<tr>
<td>Exhibit positive attitude for use</td>
<td>0 (0.0)</td>
<td>3 (0.5)</td>
<td>49 (7.6)</td>
<td>249 (38.8)</td>
<td>341 (53.1)</td>
<td>4.45</td>
</tr>
<tr>
<td>Use to process data/report results</td>
<td>1 (0.2)</td>
<td>2 (0.3)</td>
<td>76 (11.8)</td>
<td>222 (34.6)</td>
<td>341 (53.1)</td>
<td>4.40</td>
</tr>
<tr>
<td>Use content-specific tools to support learning/research</td>
<td>0 (0.0)</td>
<td>5 (0.8)</td>
<td>68 (10.6)</td>
<td>295 (46.0)</td>
<td>274 (42.7)</td>
<td>4.31</td>
</tr>
<tr>
<td>Use to manage/communicate</td>
<td>1 (0.2)</td>
<td>8 (1.2)</td>
<td>92 (14.3)</td>
<td>247 (38.5)</td>
<td>294 (45.8)</td>
<td>4.29</td>
</tr>
</tbody>
</table>
Table 4—continued

<table>
<thead>
<tr>
<th>Technology Skill</th>
<th>No Opp n(%)</th>
<th>Aware n(%)</th>
<th>Literate n(%)</th>
<th>Integrate n(%)</th>
<th>Teach n(%)</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use variety of media/format</td>
<td>0 (0.0)</td>
<td>9 (1.4)</td>
<td>84 (13.1)</td>
<td>243 (37.9)</td>
<td>300 (46.7)</td>
<td>4.29</td>
</tr>
<tr>
<td>Use to develop strategies</td>
<td>0 (0.0)</td>
<td>5 (0.8)</td>
<td>86 (13.4)</td>
<td>287 (44.7)</td>
<td>264 (41.1)</td>
<td>4.26</td>
</tr>
<tr>
<td>Understand nature/operation of technology systems</td>
<td>2 (0.3)</td>
<td>5 (0.8)</td>
<td>95 (14.8)</td>
<td>277 (43.1)</td>
<td>263 (41.0)</td>
<td>4.24</td>
</tr>
<tr>
<td>Use to gain higher thinking skills</td>
<td>0 (0.0)</td>
<td>3 (0.5)</td>
<td>83 (12.9)</td>
<td>319 (49.7)</td>
<td>237 (36.9)</td>
<td>4.23</td>
</tr>
<tr>
<td>Evaluate/select proper tool for specific tasks</td>
<td>0 (0.0)</td>
<td>6 (0.9)</td>
<td>101 (15.7)</td>
<td>316 (49.2)</td>
<td>219 (34.1)</td>
<td>4.17</td>
</tr>
<tr>
<td>Use to create group projects</td>
<td>1 (0.2)</td>
<td>11 (1.7)</td>
<td>116 (18.1)</td>
<td>271 (42.2)</td>
<td>243 (37.9)</td>
<td>4.16</td>
</tr>
<tr>
<td>Observe/experience use in field of study</td>
<td>1 (0.2)</td>
<td>9 (1.4)</td>
<td>111 (17.3)</td>
<td>301 (46.9)</td>
<td>220 (34.3)</td>
<td>4.14</td>
</tr>
<tr>
<td>Use input/output devices</td>
<td>1 (0.2)</td>
<td>21 (3.3)</td>
<td>138 (21.5)</td>
<td>282 (43.9)</td>
<td>200 (31.2)</td>
<td>4.03</td>
</tr>
</tbody>
</table>

Likert scale: 1=No opportunity or exposure, 2=I am aware, but do not use this in my practice, 3=I am literate and integrate some of the indicators, 4=I integrate this into my teaching, 5=I am able to teach others
* p≤.05

On another statement, “Use technology tools and information resources to increase productivity, promote creativity, and facilitate academic learning” (Use to improve products, learning), 433 (49.8%) F2F students felt they would integrate this skill
into their teaching with 313 (36.0%) feeling they were able to teach it to others.

However, 341 (53.1%) online students felt they were able to teach it to others, with 255 (39.7%) feeling they would integrate it into their teaching. For statement 4, "Use content-specific tools (e.g. software, simulation, environmental probes, graphing calculators, exploratory environments, Web tools) to support learning and research" (Use content-specific tools to support learning/research), 427 (49.1%) F2F and 295 (46.0%) online students felt they would integrate this skill into their teaching, whereas, 263 (30.2%) F2F and 274 (42.7%) online students felt they were able to teach it to others.

When presented with “Use technology resources to facilitate higher order and complex thinking skills, including problem solving, critical thinking, informed decision making, knowledge construction, and creativity” (Use to gain higher thinking skills), 479 (55.1%) F2F and 319 (49.7%) online students felt they would integrate this skill into their teaching. Meanwhile, 206 (23.7%) F2F and 237 (36.9%) online students felt they were able to teach it to others. Looking at the statement, “Use technology in the development of strategies for solving problems in the real world” (Use to develop strategies), 464 (53.3%) F2F and 287 (44.7%) online students felt they would integrate this skill into their teaching, and 239 (27.5%) F2F and 264 (41.1%) online students felt they were able to teach it to others.

The statement, “Use technology to locate, evaluate and collect information from a variety of sources” (Use to locate information), 400 (46.0%) F2F and 401 (62.5%) online students felt they were able to teach this skill to others, and 358 (41.1%) F2F and 195 (30.4%) online students felt they would integrate into their teaching. For another
statement, “Use technology tools to process data and report results” (Use to process data/report results), 380 (43.7%) F2F students felt they would integrate this skill into their teaching, with 352 (40.5%) feeling they were able to teach to others. Meanwhile, 341 (53.1%) of the online students felt they were able to teach it to others, while 222 (34.6%) felt they would integrate it into their teaching.

Given the statement, “Evaluate and select new information resources and technological innovations based on their appropriateness to specific tasks” (Evaluate/select proper tool for specific tasks), 440 (50.6%) F2F and 316 (49.2%) online students felt they would integrate this skill into their teaching. However, 215 (24.7%) F2F students felt they were literate and might be able to integrate it into their teaching, with 219 (34.1%) online students feeling they were able to teach this to others. For another statement, “Collaborate in constructing technology-enhanced models, preparing publications, and producing other creative works using productivity tools (Use to create group projects), 383 (44.0%) F2F and 271 (42.2%) online students felt they would integrate this skill into their teaching, while 251 (28.9%) F2F and 243 (37.9%) online students felt they were able to teach it to others.

When presented with the statement, “Observe and experience the use of technology in their major field of study” (Observe/experience use in field of study), 436 (50.1%) F2F and 301 (46.9%) online students felt they would integrate this skill into their teaching. Meanwhile, 213 (24.5%) F2F students felt they were literate with this skill and might be able to integrate it into their teaching, with 220 (34.3%) online students feeling they were able to teach it to others. For another statement, “Use technology tools and
resources for managing and communicating information (e.g., finances, schedules, addresses, purchases, correspondence)” (Use to manage/communicate), 390 (44.8%) F2F students felt they would integrate this skill into their teaching, with 263 (30.2%) feeling they were able to teach it to others. However, for the online students, 294 (45.8%) felt they were able to teach it to others, while 247 (38.5%) felt they would integrate it into their teaching.

Given the statement, “Use a variety of media and formats, including telecommunications to collaborate, publish, and interact with peers, experts, and other audiences” (Use variety of media/format), 405 (46.6%) F2F students felt they would integrate this skill into their teaching, with 252 (29.0%) feeling they were able to teach to it to others. Yet, for the online students, 300 (46.7%) felt they were able to teach it to others, while 243 (37.9%) felt they would integrate it into their teaching.

And for the last statement, “Exhibit positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity” (Exhibit positive attitude for use), 425 (48.9%) F2F students felt they would integrate this skill into their teaching, with 314 (36.1%) feeling they were able to teach to it to others. However, 341 (53.1%) online students felt they were able to teach others with 249 (38.8%) feeling they would integrate into teaching.

As stated before, because the independent samples t test detected statistically significant differences between the aggregate face-to-face group and online group means regarding computer competence prior to taking EDT 3470, a one-way analysis of covariance was conducted for each of the fourteen questions to compare the perceived
computer competency of the face-to-face and online groups after taking EDT 3470. An ANCOVA minimizes the effects of pre-existing individual differences among groups (Pallant, 2005).

Preliminary checks were conducted to ensure that there was no violation of assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes, and reliable measurement of the covariate. For each of the analyses, the independent variable was the course format (i.e., face-to-face, online). Table 5 displays the results of the analysis of covariance, showing the degree of freedom between subjects, the observed $F$ values, the significance levels, and the eta squared values. Statistically significant differences were found between the F2F and online groups for all 14 computer competency items.

Table 5

*Analysis of Covariance for Post Course Perceived Computer Competence*

<table>
<thead>
<tr>
<th>Source</th>
<th>F2F M</th>
<th>Online M</th>
<th>df</th>
<th>F</th>
<th>$\eta$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understand the nature and operation of technology systems</td>
<td>4.01</td>
<td>4.24</td>
<td>1</td>
<td>24.41</td>
<td>.02</td>
<td>.00*</td>
</tr>
<tr>
<td>Use of input/output devices</td>
<td>3.78</td>
<td>4.03</td>
<td>1</td>
<td>22.44</td>
<td>.02</td>
<td>.00*</td>
</tr>
<tr>
<td>Use to improve products, learning</td>
<td>4.20</td>
<td>4.45</td>
<td>1</td>
<td>37.50</td>
<td>.02</td>
<td>.00*</td>
</tr>
<tr>
<td>Use content-specific tools to support learning/research</td>
<td>4.08</td>
<td>4.31</td>
<td>1</td>
<td>24.06</td>
<td>.02</td>
<td>.00*</td>
</tr>
<tr>
<td>Use to gain higher thinking skills</td>
<td>4.01</td>
<td>4.23</td>
<td>1</td>
<td>31.59</td>
<td>.02</td>
<td>.00*</td>
</tr>
</tbody>
</table>
Table 5—continued

<table>
<thead>
<tr>
<th>Source</th>
<th>F2F M</th>
<th>Online M</th>
<th>df</th>
<th>F</th>
<th>η</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use to develop strategies</td>
<td>4.06</td>
<td>4.26</td>
<td>1</td>
<td>19.64</td>
<td>.02</td>
<td>.00*</td>
</tr>
<tr>
<td>Use to locate information</td>
<td>4.32</td>
<td>4.55</td>
<td>1</td>
<td>25.57</td>
<td>.02</td>
<td>.00*</td>
</tr>
<tr>
<td>Use to process data/report results</td>
<td>4.23</td>
<td>4.40</td>
<td>1</td>
<td>13.41</td>
<td>.01</td>
<td>.00*</td>
</tr>
<tr>
<td>Evaluate/select proper tool for specific tasks</td>
<td>3.92</td>
<td>4.17</td>
<td>1</td>
<td>33.70</td>
<td>.02</td>
<td>.00*</td>
</tr>
<tr>
<td>Use to create group projects</td>
<td>3.98</td>
<td>4.16</td>
<td>1</td>
<td>13.70</td>
<td>.01</td>
<td>.00*</td>
</tr>
<tr>
<td>Observe/experience use in field of study</td>
<td>3.90</td>
<td>4.14</td>
<td>1</td>
<td>23.77</td>
<td>.02</td>
<td>.00*</td>
</tr>
<tr>
<td>Use to manage/communicate</td>
<td>4.02</td>
<td>4.29</td>
<td>1</td>
<td>23.79</td>
<td>.02</td>
<td>.00*</td>
</tr>
<tr>
<td>Use variety of media/format</td>
<td>4.01</td>
<td>4.29</td>
<td>1</td>
<td>39.00</td>
<td>.03</td>
<td>.00*</td>
</tr>
<tr>
<td>Exhibit positive attitude for use</td>
<td>4.20</td>
<td>4.45</td>
<td>1</td>
<td>29.25</td>
<td>.02</td>
<td>.00*</td>
</tr>
</tbody>
</table>

Likert scale: 1=No opportunity or exposure, 2=I am aware, but do not use this in my practice, 3=I am literate and integrate some of the indicators, 4=I integrate this into my teaching, 5=I am able to teach others
* p<0.05

For the first analysis, the dependent variable consisted of data for understanding the nature and operation of technology from Post ProfilerPRO, with the same skill in Pre ProfilerPRO used as the covariate. The analysis revealed there was a significant difference between the two groups \(F(1,1509)=24.42, p=.00, η=.02\). The mean for the perceived understanding the nature and operation of technology systems is higher for participants in the online course than the mean for participants in the face-to-face course (F2F \(M=4.01\), Online \(M=4.24\), with the difference between the means being .23.
For the second analysis, the dependent variable consisted of data for using input and output devices from Post ProfilerPRO, with the same skill in Pre ProfilerPRO used as the covariate. The analysis revealed there was a significant difference between the two groups \([F(1,1509)=22.43, p=.00, \eta^2=.02]\). The mean for the perceived using input and output devices is higher for participants in the online course than the mean for participants in the face-to-face course (F2F \(M=3.78\), Online \(M=4.03\)), with the difference between the means being .25.

On the third analysis, the dependent variable consisted of data for using technology to improve products and learning from Post ProfilerPRO, with the same skill in Pre ProfilerPRO used as the covariate. The analysis revealed there was a significant difference between the two groups \([F(1,1509)=37.50, p=.00, \eta^2=.02]\). The mean for the perceived using technology to improve products and learning is higher for participants in the online course than the mean for participants in the face-to-face course (F2F \(M=4.20\), Online \(M=4.45\)), with the difference between the means being .25.

When completing the fourth analysis, the dependent variable consisted of data for using content-specific tools from Post ProfilerPRO, with the same skill in Pre ProfilerPRO used as the covariate. The analysis revealed there was a significant difference between the two \([F(1,1509)=24.06, p=.00, \eta^2=.02]\). The mean for the perceived using content-specific tools is higher for participants in the online course than the mean for participants in the face-to-face course (F2F \(M=4.08\), Online \(M=4.31\)), with the difference between the means being .23.
For the fifth analysis, the dependent variable consisted of data for using technology to gain higher thinking skills from Post ProfilerPRO, with the same skill in Pre ProfilerPRO used as the covariate. The analysis revealed there was a significant difference between the two groups \( F(1,1509) = 31.59, p = .00, \eta^2 = .02 \). The mean for the perceived using technology to gain higher thinking skills is higher for participants in the online course than the mean for participants in the face-to-face course (F2F \( M = 4.01 \), Online \( M = 4.23 \)), with the difference between the means being .22.

On the sixth analysis, the dependent variable consisted of data for using technology to develop strategies from Post ProfilerPRO, with the same skill in Pre ProfilerPRO used as the covariate. The analysis revealed there was a significant difference between the two groups \( F(1,1509) = 19.64, p = .00, \eta^2 = .02 \). The mean for the perceived using technology to develop strategies is higher for participants in the online course than the mean for participants in the face-to-face course (F2F \( M = 4.06 \), Online \( M = 4.26 \)), with the difference between the means being .20.

While conducting the seventh analysis, the dependent variable consisted of data for using technology to locate information from Post ProfilerPRO, with the same skill in Pre ProfilerPRO used as the covariate. The analysis revealed there was a significant difference between the two groups \( F(1,1509) = 25.57, p = .00, \eta^2 = .02 \). The mean for the perceived using technology to locate information from is higher for participants in the online course than the mean for participants in the face-to-face course (F2F \( M = 4.32 \), Online \( M = 4.55 \)), with the difference between the means being .23.
For the eighth analysis, the dependent variable consisted of data for using technology to process data and report results from Post ProfilerPRO, with the same skill in Pre ProfilerPRO used as the covariate. The analysis revealed there was a significant difference between the two groups \( F(1,1509)=13.41, p=.00, \eta^2=.01 \). The mean for the perceived using technology to process data and report results is higher for participants in the online course than the mean for participants in the face-to-face course (F2F \( M=4.23 \), Online \( M=4.40 \)), with the difference between the means being .17.

When conducting the ninth analysis, the dependent variable consisted of data for using proper tool for specific tasks from Post ProfilerPRO, with the same skill in Pre ProfilerPRO used as the covariate. The analysis revealed there was a significant difference between the two groups \( F(1,1509)=33.70, p=.00, \eta^2=.02 \). The mean for the perceived using proper tool for specific tasks is higher for participants in the online course than the mean for participants in the face-to-face course (F2F \( M=3.92 \), Online \( M=4.17 \)), with the difference between the means being .25.

For the tenth analysis, the dependent variable consisted of data for using technology to create group projects from Post ProfilerPRO, with the same skill in Pre ProfilerPRO used as the covariate. The analysis revealed there was a significant difference between the two groups \( F(1,1509)=13.70, p=.00, \eta^2=.01 \). The mean for the perceived using technology to create group projects is higher for participants in the online course than the mean for participants in the face-to-face course (F2F \( M=3.98 \), Online \( M=4.16 \)), with the difference between the means is .18.
When completing the eleventh analysis, the dependent variable consisted of data for observe/experience technology use in field of study from Post ProfilerPRO, with the same skill in Pre ProfilerPRO used as the covariate. The analysis revealed there was a significant difference between the two groups \([F(1,1509)=23.77, p=.00, \eta^2=.02]\). The mean for the perceived experience technology in field of study is higher for participants in the online course than the mean for participants in the face-to-face course (F2F \(M=3.90\), Online \(M=4.14\)), with the difference between the means being .24.

When conducting the twelfth analysis, the dependent variable consisted of data for using technology to manage and communicate from Post ProfilerPRO, with the same skill in Pre ProfilerPRO used as the covariate. The analysis revealed there was a significant difference between the two groups \([F(1,1509)=23.79, p=.00, \eta^2=.02]\). The mean for the perceived using technology to manage and communicate is higher for participants in the online course than the mean for participants in the face-to-face course (F2F \(M=4.02\), Online \(M=4.29\)), with the difference between the means is .27.

On conducting the thirteenth analysis, the dependent variable consisted of data for using a variety of media and format from Post ProfilerPRO, with the same skill in Pre ProfilerPRO used as the covariate. The analysis revealed there was a significant difference between the two groups \([F(1,1509)=39.00, p=.00, \eta^2=.03]\). The mean for the perceived using a variety of media and format is higher for participants in the online course than the mean for participants in the face-to-face course (F2F \(M=4.01\), Online \(M=4.29\)), with the difference between the means being .28.
Finally, the dependent variable for the fourteenth analysis consisted of data for exhibiting a positive attitude for using technology from Post ProfilerPRO, with the same skill in Pre ProfilerPRO used as the covariate. The analysis revealed there was a significant difference between the two groups \(F(1,1509)=29.25, p=.00, \eta^2=.02\). The mean for the perceived exhibiting a positive attitude for using technology is higher for participants in the online course than the mean for participants in the face-to-face course (F2F \(M=4.20\), Online \(M=4.45\)), with the difference between the means being .25.

Perceived Computer Confidence

The second data set used in this study is from the end-of-course evaluation instrument developed for the EDT 3470 course. This instrument has 14 items likert-scale forced choice items, and measures a number of items related specifically to the EDT 3470 course. However, only one question with 3 subsections examines computer confidence, and data from that question was used to address research question 1b, which examines the extent of differences between pre-service teacher education students within an online technology course compared to those within a face-to-face computer lab course, in reference to their self-reported technology confidence. A 5-point, Likert scale was used to answer these subsections of the question with the following choices: (1) Strongly Disagree; (2) Disagree; (3) No Opinion; (4) Agree; and (5) Strongly Agree. Students in the face-to-face course (N=858) and the online course (N=522) identified their levels of technology confidence for each of the three subsections of the question.

When presented with the statement, “I am now confident that I understand how technology can successfully be used to support student learning” (Supports student
learning), 444 (51.7%) F2F students and 246 (47.1%) online students agreed, and 302 (35.2%) F2F and 211 (40.4%) online students strongly agreed. For the statement, “I am now confident that I will personally use technology as a tool to enhance my students' learning” (Enhances student learning), 427 (49.8%) F2F students and 217 (41.6%) online students agreed, and 285 (33.2%) F2F and 215 (41.2%) online students strongly agreed. For the last statement, “This course provided me with the skills needed to continue updating my electronic portfolio after this class has ended” (Update portfolio), 411 (47.9%) F2F students and 205 (39.3%) online students agreed, and 259 (30.2%) F2F and 170 (32.6%) online students strongly agreed.

Table 6 contains the frequencies and percentages as ranked from highest to lowest means for the three subsection questions related to computer confidence after taking EDT 3470.

Table 6

Computer Confidence

<table>
<thead>
<tr>
<th>Format/Technology Use</th>
<th>Strongly Disagree (1) n(%)</th>
<th>Disagree (2) n(%)</th>
<th>No Opinion (3) n(%)</th>
<th>Agree (4) n(%)</th>
<th>Strongly Agree (5) n(%)</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>F2F</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understands how technology supports student learning</td>
<td>6 (0.7)</td>
<td>21 (2.4)</td>
<td>85 (9.9)</td>
<td>444 (51.7)</td>
<td>302 (35.2)</td>
<td>4.18</td>
</tr>
</tbody>
</table>
Table 6—continued

<table>
<thead>
<tr>
<th>Format/Technology Use</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>No Opinion</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Will use technology to enhance student learning</td>
<td>17 (2.0)</td>
<td>35 (4.1)</td>
<td>94 (11.0)</td>
<td>427 (49.8)</td>
<td>285 (33.2)</td>
<td>4.08</td>
</tr>
<tr>
<td>Can update portfolio</td>
<td>16 (1.9)</td>
<td>40 (4.7)</td>
<td>132 (15.4)</td>
<td>411 (47.9)</td>
<td>259 (30.2)</td>
<td>4.00</td>
</tr>
</tbody>
</table>

**Online**

| Understands how technology supports student learning | 5 (1.0) | 13 (2.5) | 47 (9.0) | 246 (47.1) | 211 (40.4) | 4.24 |
| Will use technology to enhance student learning | 14 (2.7) | 31 (5.9) | 45 (8.6) | 217 (41.6) | 215 (41.2) | 4.13 |
| Can update portfolio | 17 (3.3) | 54 (10.3) | 76 (14.6) | 205 (39.3) | 170 (32.6) | 3.88 |

Independent samples t test was used to determine if there are differences between the aggregate means for the face-to-face and online student groups, and detected no significant differences for students’ computer confidence regarding their understanding of how technology supports student learning ($t_{1378}=-1.23, p=.220$), and the use of technology to enhance student learning ($t_{1010}=-0.86, p=.393$). However, the test did detect a statistically significant difference between face-to-face and online computer confidence.
regarding the ability to use technology to update their portfolios, once the course has ended ($t_{552}=2.19$, $p=.029$).

Table 7

_T-test for Technology Confidence_

<table>
<thead>
<tr>
<th>Item</th>
<th>F2F M</th>
<th>Online M</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understands how technology supports student learning</td>
<td>4.18</td>
<td>4.24</td>
<td>-1.23</td>
<td>.220</td>
</tr>
<tr>
<td>Will use technology to enhance student learning</td>
<td>4.08</td>
<td>4.13</td>
<td>-0.86</td>
<td>.393</td>
</tr>
<tr>
<td>Can update portfolio</td>
<td>4.00</td>
<td>3.88</td>
<td>2.19</td>
<td>.029*</td>
</tr>
</tbody>
</table>

Likert scale: 1=Strongly disagree, 2=Disagree, 3=No opinion, 4=Agree, 5=Strongly agree
* $p \leq .05$

Pre-course Problem Solving Data and Analysis

A question on the second data set used in this study from the end-of-course evaluation instrument asked students what problem solving skills they used _prior_ to taking EDT 3470. This question has four subsections (a=Waiting for instructor’s assistance, b=Finding out the answer from a peer/other person, c=Discovering the answer through trial and error on your own, d=Discover the answer through further reading). Responses were recorded on a 5-point Likert-scale (1=Never, 2=Not very often, 3=Often, 4=Most of the time, 5=Always).
And, again, although this study does not include random assignment to groups, it does involve the comparison of data from two groups of students: those who took the EDT 3470 via a face-to-face method and those who took it via an online format. Therefore, it is important to determine if there were any initial major differences between these two groups (since random selection and assignment were not possible for this study). Instead, the data from this question was used to ascertain any significant differences.

Table 8

_Problem Solving Skills Used Prior to Taking EDT 3470_

<table>
<thead>
<tr>
<th>Item</th>
<th>F2F M</th>
<th>Online M</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructor</td>
<td>3.30</td>
<td>3.14</td>
<td>2.93</td>
<td>.003*</td>
</tr>
<tr>
<td>Peer</td>
<td>3.44</td>
<td>3.36</td>
<td>1.60</td>
<td>.109</td>
</tr>
<tr>
<td>Trial and error</td>
<td>3.19</td>
<td>3.56</td>
<td>-6.65</td>
<td>.000*</td>
</tr>
<tr>
<td>Read</td>
<td>2.78</td>
<td>2.97</td>
<td>-3.35</td>
<td>.001*</td>
</tr>
</tbody>
</table>

Likert scale: 1=Never, 2=Not very often, 3=Often, 4=Most of the time, 5=Always
* p<.05

Independent samples _t-tests_ were used to determine if there are differences between the problem solving skills students used in the face-to-face and online groups _prior to taking EDT 3470_. These _t_ tests detected statistically significant differences between face-to-face and online computer competence _prior to taking EDT 3470_ for three of the four problem solving strategies: waiting for instructor's assistance (instructor) (_t_{1378}=2.93, p=.003_), discovering the answer through trial and error on your
own (trial and error) \((t_{1229}=-6.65, p=.000)\), and discovering the answer through further reading (read) \((t_{1378}=-5.35, p=.001)\). However, there was no significant difference for finding out the answer from a peer/other person (peer) \((t_{1378}=1.60, p=.109)\).

Table 8 displays the results of the \(t\) test, showing the means for face-to-face, the means for online, the \(t\) value and the \(p\) value.

Because the results of the \(t\) tests on problem solving skills used prior to taking EDT 3470 determined there are no significant differences between these two groups for finding out the answer from peers, a \(t\) test will be conducted to determine the differences between the groups on this specific subsection while taking EDT 3470. For each of the other three problem solving strategies (i.e., waiting for instructor, trial and error on your own, and discovering answer through further reading), a significant difference between the groups was determined. Therefore, a one-way analysis of variance (ANCOVA) will be used to compare these three problem solving skills used by the face-to-face and online groups while taking EDT 3470. An ANCOVA minimizes the effects of pre-existing individual differences among variables (i.e., groups), thereby reducing the concerns that may affect the outcome of an analysis (Pallant, 2005).

Problem Solving Skills Used During EDT 3470

At the end of the course, students were also asked what problem solving skills they had used while taking EDT 3470. This question has the same four subsections (a=Waiting for instructor’s assistance, b=Finding out the answer from a peer/other person, c=Discovering the answer through trial and error on your own, d=Discover the
answer through further reading), and the same 5-point Likert-scale (1=Never, 2=Not very often, 3=Often, 4=Most of the time, 5=Always).

Table 9

**Problem Solving Skills Used While Taking EDT 3470**

<table>
<thead>
<tr>
<th>Question/Format</th>
<th>Never (1)</th>
<th>Not Very Often (2)</th>
<th>Often (3)</th>
<th>Most of The Time (4)</th>
<th>Always (5)</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waiting for instructor's assistance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F2F</td>
<td>22 (2.6)</td>
<td>167 (19.5)</td>
<td>269 (31.4)</td>
<td>299 (34.8)</td>
<td>101 (11.8)</td>
<td>3.34</td>
</tr>
<tr>
<td>Online</td>
<td>26 (5.0)</td>
<td>144 (27.6)</td>
<td>152 (29.1)</td>
<td>142 (27.2)</td>
<td>58 (11.1)</td>
<td>3.12</td>
</tr>
<tr>
<td>Total</td>
<td>48 (3.5)</td>
<td>311 (22.5)</td>
<td>421 (30.5)</td>
<td>441 (32.0)</td>
<td>159 (11.5)</td>
<td>3.26</td>
</tr>
</tbody>
</table>

| Finding out the answer from a peer/other person |           |                    |           |                      |            |    |
| F2F             | 40 (4.7)  | 127 (14.8)         | 287 (33.4)| 314 (36.6)           | 90 (10.5)  | 3.33|
| Online          | 33 (6.3)  | 110 (21.1)         | 142 (27.2)| 183 (35.1)           | 54 (10.3)  | 3.22|
| Total           | 73 (5.3)  | 237 (17.2)         | 429 (31.1)| 497 (36.0)           | 144 (10.4) | 3.29|

| Discovering the answer through trial and error on your own |           |                    |           |                      |            |    |
| F2F             | 93 (10.8) | 187 (21.8)         | 280 (32.6)| 213 (24.8)           | 85 (9.9)   | 3.01|
| Online          | 19 (3.6)  | 84 (16.1)          | 111 (21.3)| 228 (43.7)           | 80 (15.3)  | 3.51|
| Total           | 112 (8.1) | 271 (19.6)         | 391 (28.1)| 441 (32.0)           | 165 (12.0) | 3.20|

| Discovering the answer by further reading |           |                    |           |                      |            |    |
| F2F             | 133 (15.5)| 252 (29.4)         | 272 (31.7)| 154 (17.9)           | 47 (5.5)   | 2.69|
| Online          | 30 (5.7)  | 120 (23.0)         | 240 (46.0)| 100 (19.2)           | 32 (6.1)   | 2.97|
| Total           | 163 (11.8)| 372 (27.0)         | 512 (37.1)| 254 (18.4)           | 79 (5.7)   | 2.79|

The question started with “how often did you use each of the following strategies to help solve problems?” and then displayed each subsection. When presented with “waiting for instructor’s assistance,” 299 (34.8%) of the F2F students did so most of the time, and 269 (31.4%) did often. However, 152 (24.1%) of the online students would ask instructor for assistance often and 144 (27.6%) would not ask very often. For “finding out the answer from a peer/other person,” 314 (36.6%) F2F students and 183 (35.1%)
online students reported they would do this most of the time, and 287 (33.4%) F2F and 142 (27.2%) online report they would do this often.

On "discovering the answer through trial and error on your own," 280 (32.6%) F2F students felt they would do so often, while 213 (24.8%) would do so most of the time. For the online students, 228 (43.7%) reported they would discover the answer through trial and error most of time, and 111 (21.3%) felt they did so often. When presented with "discover the answer through further reading," 272 (31.7%) F2F students and 240 (46.0%) online students felt they did so often. Whereas, 252 (29.4%) F2F and 120 (23.0%) online students felt they did not very often discover the answer through further reading.

Table 9 contains the frequencies, percentages, and means for both the F2F and online groups of the problem solving skills used while taking EDT 3470.

Table 10

* T-test for Peer Problem Solving Skills Used While Taking EDT 3470

<table>
<thead>
<tr>
<th>Item</th>
<th>F2F M</th>
<th>Online M</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peer</td>
<td>3.33</td>
<td>3.22</td>
<td>1.99</td>
<td>.047*</td>
</tr>
</tbody>
</table>

1=Never, 2=Not very often, 3=Often, 4=Most of the time, 5=Always
* p≤.05

Because there was no significant difference between face-to-face and online groups for "finding out the answer from a peer/other person" prior to taking EDT 3470, an independent samples t test was used to determine if there are differences between face-to-face and online groups for "finding out the answer from a peer/other person" while
taking the course. The independent samples $t$ test detected a significant difference between face-to-face and online in finding the answer from a peer/other person ($t_{1378}=1.99, p=.047$). Table 10 displays the results.

For the other three problem solving skills, the results of the $t$ tests revealed significant differences between the face-to-face and online groups before taking EDT 3470. Therefore, a one-way analysis of covariance was conducted on subsection “waiting for instructor’s assistance,” labeled as Instructor, comparing use of this skill during the semester by the face-to-face and online groups. The independent variable was the course format, and the dependent variable consisted of data of same during the semester. Data from participants’ scores on for “waiting for instructor’s assistance” were used as the covariate in this analysis. Preliminary checks were conducted to ensure that there was no violation of assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes, and reliable measurement of the covariate. After adjusting for “waiting for instructor” scores, there was a significant difference between the two groups [$F(1,1377)=7.23, p=.007, \eta^2=.005$]. The mean is higher for participants in the face-to-face course than the mean for participants in the online course (F2F $M=3.31$, Online $M=3.17$), with the difference between the means being .14.

A one-way analysis of covariance was also conducted on “discovering the answer through trial and error on your own,” labeled as Trial and error, comparing use of this skill during the semester of the face-to-face and online groups. The independent variable was the course format, and the dependent variable consisted of data for “discovering the answer through trial and error on your own” during the semester. Data from participants’
scores on "discovering the answer through trial and error on your own" prior to taking EDT 3470 were used as the covariate in this analysis. Preliminary checks were conducted to ensure that there was no violation of assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes, and reliable measurement of the covariate. After adjusting for scores, there was a significant difference between the two groups on the "discovering the answer through trial and error on your own" [F(1,1377)=31.00, p=.000, η=.022]. The Trial and error mean is higher for participants in the online course than for participants in the face-to-face course (F2F M=3.09, Online M=3.39), with the difference between the means being .30.

And finally, a one-way analysis of covariance was conducted on "discover the answer through further reading," labeled as Read, comparing use of this skill during the semester of the face-to-face and online groups. The independent variable was the course format, and the dependent variable consisted of data of "discover the answer through further reading" during the semester. Data from participants' scores on "discover the answer through further reading" prior to taking EDT 3470 were used as the covariate in this analysis. Preliminary checks were conducted to ensure that there was no violation of assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes, and reliable measurement of the covariate. After adjusting for scores, there was a significant difference between the two groups on the "discover the answer through further reading" [F(1,1377)=15.71, p=.000, partial η=.011]. The Read mean is higher for participants in the online course than for participants in the face-to-face course (F2F
$M=2.71$, Online $M=2.93$), with the difference between the means being .22. Table 11 displays the results of the analysis of covariance.

Table 11

*Analysis of Covariance for Use of Problem Solving Skills (Instructor, Trial and Error, and Read) during EDT 3470*

<table>
<thead>
<tr>
<th>Source</th>
<th>F2F M</th>
<th>Online M</th>
<th>$F$</th>
<th>$\eta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructor</td>
<td>3.31</td>
<td>3.17</td>
<td>7.23</td>
<td>.005</td>
<td>.007*</td>
</tr>
<tr>
<td>Trial and error</td>
<td>3.09</td>
<td>3.39</td>
<td>31.00</td>
<td>.022</td>
<td>.000*</td>
</tr>
<tr>
<td>Read</td>
<td>2.71</td>
<td>2.93</td>
<td>15.71</td>
<td>.011</td>
<td>.000*</td>
</tr>
</tbody>
</table>

1=Never, 2=Not very often, 3=Often, 4=Most of the time, 5=Always
* $p \leq 0.05$

**Individual Problem Solving Skills**

Questions on the Zoomerang survey also asked participants which of the four problem solving skills they used for specific problems during the semester. Due to the fact that several changes were made to the course and the survey collection tool starting in Fall 2008, only four survey questions (i.e., getting interactive PowerPoint to work, inserting images into movie, exporting slide show into movie, managing site) were the same for all time periods. Therefore, the first analysis of these data used all participants (from Summer I 2005 to Fall 2009). Then data for all other survey questions were separated into two groups: Group 1 (Summer I 2005 to Summer II 2008) and Group 2 (Fall 2008 to Fall 2009). Data from eight questions were used for Group 1 (i.e., getting images to show up on web site, getting attachments to show up on web site, sending files to server for web site, getting files from server for web site, linking to external sites
properly, linking to internal pages properly, creating “hot links” in Word documents, adjusting the content areas in Publisher to meet requirements). Data from three questions on the survey were used for Group 2 (setting up blog, communicating with group members, combining individual podcasts to create Collaborative Podcasts). Responses for all used a 4-point Likert scale (1= Waiting for instructor’s assistance, 2= Finding out the answer from a peer/other person, 3= Discovering the answer through trial and error on your own, 4= Discover the answer through further reading). Crosstabulations were conducted to discover which of the problem solving skills was used more often for specific tasks within the EDT 3470 course.

Table 12 displays the results of all the analysis completed for the specific problem solving skills. It shows frequencies, percentages, and means.

Table 12

*Problem Solving Skills Used for Computer Competencies*

<table>
<thead>
<tr>
<th>Question/Format</th>
<th>Instructor (1) n(%)</th>
<th>Peer (2) n(%)</th>
<th>Trial &amp; error (3) n(%)</th>
<th>Read (4) n(%)</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All participants (n=1380; Summer 2005 to Fall 2009)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Getting Interactive PowerPoint to work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F2F</td>
<td>155 (18.1)</td>
<td>178 (20.7)</td>
<td>492 (57.3)</td>
<td>33 (3.8)</td>
<td>2.47</td>
</tr>
<tr>
<td>Online</td>
<td>44 (8.4)</td>
<td>70 (13.4)</td>
<td>353 (67.6)</td>
<td>55 (10.5)</td>
<td>2.80</td>
</tr>
<tr>
<td>Total</td>
<td>199 (14.4)</td>
<td>248 (18.0)</td>
<td>845 (61.2)</td>
<td>88 (6.4)</td>
<td>2.66</td>
</tr>
<tr>
<td>Inserting Images into Movie</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F2F</td>
<td>258 (30.1)</td>
<td>189 (22.0)</td>
<td>384 (44.8)</td>
<td>27 (3.1)</td>
<td>2.21</td>
</tr>
<tr>
<td>Online</td>
<td>59 (11.3)</td>
<td>109 (20.9)</td>
<td>295 (56.5)</td>
<td>59 (11.3)</td>
<td>2.68</td>
</tr>
<tr>
<td>Total</td>
<td>317 (23.0)</td>
<td>298 (21.6)</td>
<td>679 (49.2)</td>
<td>86 (6.2)</td>
<td>2.45</td>
</tr>
</tbody>
</table>
Table 12—continued

<table>
<thead>
<tr>
<th>Question/Format</th>
<th>Instructor (1)</th>
<th>Peer (2)</th>
<th>Trial &amp; error (3)</th>
<th>Read (4)</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n(%)</td>
<td>n(%)</td>
<td>n(%)</td>
<td>n(%)</td>
<td></td>
</tr>
<tr>
<td>Exporting slide show into movie</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F2F</td>
<td>328 (38.2)</td>
<td>173 (20.2)</td>
<td>320 (37.3)</td>
<td>37 (4.3)</td>
<td>2.08</td>
</tr>
<tr>
<td>Online</td>
<td>63 (12.1)</td>
<td>118 (22.6)</td>
<td>274 (52.5)</td>
<td>67 (12.8)</td>
<td>2.66</td>
</tr>
<tr>
<td>Total</td>
<td>391 (28.3)</td>
<td>291 (21.1)</td>
<td>594 (43.0)</td>
<td>104 (7.5)</td>
<td>2.37</td>
</tr>
<tr>
<td>Managing Site</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F2F</td>
<td>281 (32.8)</td>
<td>209 (24.4)</td>
<td>333 (38.8)</td>
<td>35 (4.1)</td>
<td>2.14</td>
</tr>
<tr>
<td>Online</td>
<td>63 (12.1)</td>
<td>173 (33.1)</td>
<td>225 (43.1)</td>
<td>61 (11.7)</td>
<td>2.54</td>
</tr>
<tr>
<td>Total</td>
<td>344 (24.9)</td>
<td>382 (27.7)</td>
<td>558 (40.4)</td>
<td>96 (7.0)</td>
<td>2.34</td>
</tr>
</tbody>
</table>

Group 1 (n=1221; Summer I 2005 to Summer II 2008)

Getting images to show up on web site
- F2F: 162 (20.0) 154 (19.1) 463 (57.3) 29 (3.6) 2.46
- Online: 63 (15.3) 138 (33.4) 179 (43.3) 33 (8.0) 2.46
- Total: 225 (18.4) 292 (23.9) 642 (52.6) 62 (5.1) 2.46

Getting attachments to show up on web site
- F2F: 232 (28.7) 162 (20.0) 387 (47.9) 27 (3.3) 2.26
- Online: 52 (12.6) 123 (29.8) 201 (48.7) 37 (9.0) 2.55
- Total: 284 (23.3) 285 (23.3) 588 (48.2) 64 (5.2) 2.40

Sending files to server for web site
- F2F: 304 (37.6) 166 (20.5) 303 (37.5) 35 (4.3) 2.08
- Online: 56 (13.6) 121 (29.3) 190 (46.0) 46 (11.0) 2.56
- Total: 360 (29.5) 287 (23.5) 493 (40.4) 81 (6.6) 2.32

Getting files from the server for web site
- F2F: 273 (33.8) 179 (22.2) 320 (39.6) 36 (4.5) 2.15
- Online: 47 (11.4) 112 (27.1) 210 (50.8) 44 (10.7) 2.61
- Total: 320 (26.2) 291 (23.8) 530 (43.4) 90 (6.6) 2.38

Linking to external sites properly
- F2F: 262 (32.4) 156 (19.3) 350 (43.3) 40 (5.0) 2.23
- Online: 48 (11.6) 86 (20.8) 227 (55.0) 52 (12.6) 2.72
- Total: 310 (25.4) 242 (19.8) 577 (47.3) 92 (7.5) 2.48
<table>
<thead>
<tr>
<th>Question/Format</th>
<th>Instructor (1)</th>
<th>Peer (2)</th>
<th>Trial &amp; error (3)</th>
<th>Read (4)</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n(%)</td>
<td>n(%)</td>
<td>n(%)</td>
<td>n(%)</td>
<td></td>
</tr>
<tr>
<td>Linking to internal pages properly</td>
<td>F2F 250 (30.9)</td>
<td>153 (18.9)</td>
<td>371 (45.9)</td>
<td>34 (4.2)</td>
<td>2.24</td>
</tr>
<tr>
<td></td>
<td>Online 35 (2.9)</td>
<td>80 (19.4)</td>
<td>256 (40.8)</td>
<td>42 (10.2)</td>
<td>2.79</td>
</tr>
<tr>
<td></td>
<td>Total 285 (23.3)</td>
<td>233 (19.1)</td>
<td>627 (51.4)</td>
<td>76 (6.2)</td>
<td>2.52</td>
</tr>
<tr>
<td>Creating &quot;hot links&quot; in Word documents</td>
<td>F2F 202 (25.0)</td>
<td>139 (17.2)</td>
<td>419 (51.9)</td>
<td>48 (5.9)</td>
<td>2.39</td>
</tr>
<tr>
<td></td>
<td>Online 33 (8.0)</td>
<td>90 (21.8)</td>
<td>236 (57.1)</td>
<td>54 (13.1)</td>
<td>2.76</td>
</tr>
<tr>
<td></td>
<td>Total 235 (19.2)</td>
<td>229 (18.8)</td>
<td>655 (53.6)</td>
<td>102 (8.4)</td>
<td>2.56</td>
</tr>
<tr>
<td>Adjusting the content areas in Publisher to meet requirements</td>
<td>F2F 177 (21.9)</td>
<td>133 (16.5)</td>
<td>438 (54.2)</td>
<td>60 (7.4)</td>
<td>2.48</td>
</tr>
<tr>
<td></td>
<td>Online 43 (10.4)</td>
<td>117 (28.3)</td>
<td>214 (51.8)</td>
<td>39 (9.4)</td>
<td>2.56</td>
</tr>
<tr>
<td></td>
<td>Total 220 (18.0)</td>
<td>250 (20.5)</td>
<td>652 (53.4)</td>
<td>99 (8.1)</td>
<td>2.52</td>
</tr>
</tbody>
</table>

Group 2 (n=159; Fall 2008 to Fall 2009)

<table>
<thead>
<tr>
<th>Setting up a blog</th>
<th>F2F</th>
<th>Online</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7 (14.0)</td>
<td>2 (1.8)</td>
<td>9 (5.7)</td>
</tr>
<tr>
<td>Communicating with group members</td>
<td>F2F</td>
<td>0 (0.0)</td>
<td>31 (62.0)</td>
</tr>
<tr>
<td></td>
<td>5 (4.6)</td>
<td>5 (3.1)</td>
<td>66 (41.5)</td>
</tr>
<tr>
<td>Combining individual podcasts to create Collaborative Podcast</td>
<td>F2F</td>
<td>7 (14.0)</td>
<td>27 (54.0)</td>
</tr>
<tr>
<td></td>
<td>19 (17.4)</td>
<td>43 (39.4)</td>
<td>39 (35.8)</td>
</tr>
<tr>
<td></td>
<td>26 (16.4)</td>
<td>70 (44.0)</td>
<td>53 (33.3)</td>
</tr>
</tbody>
</table>
Common Tasks for All Participants

Data from the first four subsections for all 1380 students who completed the second survey for all 19 semesters (Summer I 2005 to Fall 2009) will be reviewed first. In order to get their interactive PowerPoint to work properly, 845 (61.2%) students used the trial and error method, with 492 (57.3%) students from face-to-face computer lab course and 353 (67.6%) students from the online course. The mean for the problem solving skill used to get the interactive PowerPoint to work properly is higher for participants in the online course than the mean for participants in the face-to-face course (F2F $M=2.47$, Online $M=2.80$), with the difference between the means being .33.

When students had problems with inserting images into their movies, 679 (49.2%) of them used the trial and error, with 384 (44.8%) students from face-to-face course and 295 (56.5%) students from online. The mean for the problem solving skill used to insert the images into their movies is higher for participants in the online course than the mean for participants in the face-to-face course (F2F $M=2.21$, Online $M=2.68$), with the difference between the means being .47.

If students were having problems exporting their slide shows into movies, 594 (43.0%) of them used the trial and error method, with 320 (37.3%) students from the face-to-face course and 274 (52.5%) from the online course. However, almost the same number of face-to-face students, 328 (38.2%) waited for their instructor to assist them with this task. The mean for the problem solving skill used to export their slide shows into movies is higher for participants in the online course than the mean for participants
in the face-to-face course (F2F $M=2.08$, Online $M=2.66$), with the difference between the means being .58.

And, finally, when students needed help with managing their web sites, 558 (40.4%) students used the trial and error method, with 333 (38.8%) of them from the face-to-face course and 225 (43.1%) from the online course. For face-to-face students, 281 (32.8%) waited for the instructor, and for online students, 173 (33.1%) went to their peers for assistance. The mean for the problem solving skill used to managing their web sites is higher for participants in the online course than the mean for participants in the face-to-face course (F2F $M=2.14$, Online $M=2.54$), with the difference between the means being .40.

*Additional Tasks for Group 1*

Now we will look at the data for 1221 students who completed the second survey for 14 semesters (Summer I 2005 to Summer II 2008). Eight hundred and eight students were in the face-to-face computer lab course and 413 were in the online course. When students had difficulty getting images to show up on their web sites, 642 (52.6%) used the trial and error method, with 463 (57.3%) in the face-to-face course and 179 (43.3%) in the online. One hundred thirty-eight (33.4%) online students went to their peers for help. The mean for the problem solving skill used to images to show up on their web sites is the same for participants in the online course and the face-to-face course (F2F $M=2.46$, Online $M=2.46$).

Five hundred eighty-eight (48.2%) students who have problems with getting attachments to show up on their web site use the trial and error method, with 387 (47.9%)
students from the face-to-face course and 201 (48.7%) students from the online course. The mean for the problem solving skill used to get attachments to show up on their web site is higher for participants in the online course than the mean for participants in the face-to-face course (F2F $M=2.26$, Online $M=2.55$), with the difference between the means being .29.

When running into problems sending files for their web site to the server, 493 (40.4%) students used the trial and error method, with 303 (37.5%) students from the face-to-face course and 190 (46.0%) students from the online course. The mean for the problem solving skill used to send files for their web site to the server is higher for participants in the online course than the mean for participants in the face-to-face course (F2F $M=2.08$, Online $M=2.56$), with the difference between the means being .48.

If students need assistance in retrieving files from the server for their web site, 530 (43.4%) students used the trial and error method, with 320 (39.6%) students from the face-to-face course and 210 (50.8%) from the online course. The mean for the problem solving skill used to retrieve files from the server for their web site is higher for participants in the online course than the mean for participants in the face-to-face course (F2F $M=2.15$, Online $M=2.61$), with the difference between the means being .46.

When students have problem linking external links to their web sites, 577 (47.3%) used the trial and error method, with 350 (43.3%) from the face-to-face course and 227 (55.0%) from the online course. However, 262 (32.4%) students from the face-to-face course waited for instructor assistance. The mean for the problem solving skill used to link external links to their web site is higher for participants in the online course than the
mean for participants in the face-to-face course (F2F $M=2.23$, Online $M=2.72$), with the
difference between the means being .49.

When students had problem linking to internal pages properly, 627 (51.4%) used
the trial and error method, with 371 (45.9%) being face-to-face student and 256 (40.8%)
being online students. The mean for the problem solving skill used to link internal pages
properly is higher for participants in the online course than the mean for participants in
the face-to-face course (F2F $M=2.24$, Online $M=2.79$), with the difference between the
means being .55.

If students had problems creating “hot links” in a Word document, 655 (53.6%) used
the trial and error method, with 419 (51.9%) being face-to-face students and 214
(57.1%) being online students. The mean for the problem solving skill used to create “hot
links” in a Word document is higher for participants in the online course than the mean
for participants in the face-to-face course (F2F $M=2.39$, Online $M=2.76$), with the
difference between the means being .37.

Six hundred fifty-two (53.4%) students who has problems adjusting the content
area in Publisher used trial and error method, with 438 (54.2%) from the face-to-face
course, and 214 (51.8%) from the online course. The mean for the problem solving skill
used to adjust the content area in Publisher is slightly higher for participants in the online
course than the mean for participants in the face-to-face course (F2F $M=2.48$, Online
$M=2.56$), with the difference between the means being .08.
Additional Tasks for Group 2

Finally, we will discuss the data for 159 students who completed the second survey for five semesters (from Fall 2008 to Fall 2009). Fifty students were in the face-to-face course and 109 in the online. When students needed assistance in setting up their blog, 84 (52.8%) used the trial and error method, with 22 (44.0%) being face-to-face students and 62 (56.9%) being online students. The mean for the problem solving skill used to set up their blog is higher for participants in the online course than the mean for participants in the face-to-face course ($F2F \bar{M}=2.34$, Online $\bar{M}=2.77$), with the difference between the means being .43.

If students had problems communicating with their group members, 74 (46.5%) used the trial and error method, with 17 (34.0%) of them in the face-to-face course and 57 (52.3%) in the online course. However, 31 (62.0%) of the students in the face-to-face course went to their peers for help. The mean for the problem solving skill used to communicate with their group members is higher for participants in the online course than the mean for participants in the face-to-face course ($F2F \bar{M}=2.42$, Online $\bar{M}=2.70$), with the difference between the means being .28.

Seventy (44.0%) students who had problems combining individual podcasts to create a collaborative podcast went to peers to get assistance, with 27 (54.0%) from the face-to-face course and 43 (39.4%) from the online course. However, 39 (35.8%) online students used the trial and error method for this problem. The mean for the problem solving skill used to combine individual podcasts to create a collaborative podcast is higher for participants in the online course than the mean for participants in the face-to-
face course (F2F $M=2.22$, Online $M=2.33$), with the difference between the means being .11.

Independent samples $t$-test were used to determine if there are differences between the problem solving skills used for specific computer competencies for those in the face-to-face and online classes, and revealed significant differences for all but two of the 15 items. The negative $t$ values show that the first group (F2F) means are smaller than the second group (online) means for each item. The thirteen items with significant differences included: getting interactive PowerPoint to work ($t_{1204}=-7.76, p=.000$), inserting images into movie ($t_{1190}=-9.86, p=.000$), exporting slideshow into movie ($t_{1203}=-11.77, p=.000$), managing site ($t_{1173}=-8.22, p=.000$), getting attachments to show up on the web site ($t_{927}=-5.30, p=.000$), sending files to server for web site ($t_{920}=-8.13, p=.000$), getting files from the server for web site ($t_{940}=-8.19, p=.000$), linking to external sites properly ($t_{948}=-8.61, p=.000$), linking to internal pages properly ($t_{1035}=-10.45, p=.000$), creating “hot links” in Word documents ($t_{958}=-6.67, p=.000$), adjusting the content areas in Publisher to meet requirements ($t_{926}=-1.43, p=.000$), setting up a blog ($t_{159}=-3.66, p=.000$), and communicating with group members ($t_{159}=-2.38, p=.019$). The two items that revealed no significant differences between course formats included: getting images to show up on web site ($t_{1221}=-0.06, p=.950$) and combining individual podcasts into collaborative podcasts ($t_{159}=-0.79, p=.430$).

Table 13 displays these $t$ test results, showing the means for face-to-face, the means for online, the $t$ value and the $p$ value.
Table 13

* * *

T-tests for Problem Solving Skills Used for Computer Competencies

All participants (n=1380; Summer I to 2005 to Fall 2009)

<table>
<thead>
<tr>
<th>Skill</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Getting Interactive PowerPoint to work</td>
<td>2.47</td>
<td>2.46</td>
</tr>
<tr>
<td>Inserting images into movie</td>
<td>2.21</td>
<td>2.46</td>
</tr>
<tr>
<td>Exporting slides into movie</td>
<td>2.08</td>
<td>2.46</td>
</tr>
<tr>
<td>Managing site</td>
<td>2.14</td>
<td>2.46</td>
</tr>
</tbody>
</table>

* * *

Group 1 (n=1221; Summer I 2005 to Summer II 2008)

<table>
<thead>
<tr>
<th>Skill</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Getting images to show up on web site</td>
<td>2.46</td>
<td>2.39</td>
</tr>
<tr>
<td>Getting attachments to show up on web site</td>
<td>2.26</td>
<td>2.24</td>
</tr>
<tr>
<td>Sending files to server for web site</td>
<td>2.08</td>
<td>2.39</td>
</tr>
<tr>
<td>Getting files from server for web site</td>
<td>2.15</td>
<td>2.48</td>
</tr>
<tr>
<td>Linking to external sites properly</td>
<td>2.23</td>
<td>2.23</td>
</tr>
<tr>
<td>Linking to internal pages properly</td>
<td>2.24</td>
<td>2.48</td>
</tr>
<tr>
<td>Creating “hot links” in Word documents</td>
<td>2.39</td>
<td>2.48</td>
</tr>
<tr>
<td>Adjusting content areas in Publisher</td>
<td>2.48</td>
<td>2.56</td>
</tr>
</tbody>
</table>

* * *

Group 2 (n=159; Fall 2008 to Fall 2009)

<table>
<thead>
<tr>
<th>Skill</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting up a blog</td>
<td>2.34</td>
<td>2.34</td>
</tr>
<tr>
<td>Communicating with group members</td>
<td>2.42</td>
<td>2.42</td>
</tr>
</tbody>
</table>
Table 13—continued

<table>
<thead>
<tr>
<th>Item</th>
<th>F2F M</th>
<th>Online M</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combining individual podcasts to create Collaborative Podcast</td>
<td>2.22</td>
<td>2.33</td>
<td>-0.79</td>
<td>.430</td>
</tr>
</tbody>
</table>

Likert scale: 1=Waiting for instructor assistance, 2=Finding out the answer from a peer/other person, 3=Discovering the answer through trial and error on your own, 4=Discover the answer through further reading

*p<.05

New Variable Creation and Relationships Between Competencies, Confidence, Problem Solving Skills, and Course Format

The third research question focused on examining any relationships between students’ self-reported technology competencies, self-reported technology usage confidence, and their use of any given problem solving strategies; and any differences within these relationships between the two course formats. Before this could be addressed variable reduction needed to take place, and Cronbach’s Alpha reliability was used to determine the correlation of items and gauge the reliability in order to be able to produce a single variable (Santos, 1999). Nunnaly (1978) has indicated that a coefficient of .700 or higher is an acceptable reliability for a group of items, allowing them to collapse into a single variable. If the coefficient is below .700, certain items are to be removed to create stronger correlations.

The results of my analysis show that the 14 questions, focused on self-reported computer competence, have a strong internal consistency with a Cronbach’s Alpha coefficient of .944. Therefore, a new variable, Competence Total was created to continue the analysis for research question 3. Cronbach’s Alpha reliability was also conducted on the three items measuring self-reported computer confidence, and the results reveal a
good internal consistency, with a Cronbach’s Alpha coefficient of .704. Therefore, a new factor, Confidence Total, was created to continue the analysis.

Table 14 displays the statistical analysis of survey variables and Cronbach’s Alpha levels.

Table 14

Survey Variables and Cronbach’s Alpha

<table>
<thead>
<tr>
<th>Variables/Items</th>
<th>Cronbach’s Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competence Total</td>
<td></td>
</tr>
<tr>
<td>Understand the nature and operation of technology</td>
<td></td>
</tr>
<tr>
<td>Use of input/output devices</td>
<td></td>
</tr>
<tr>
<td>Use to improve products, learning</td>
<td></td>
</tr>
<tr>
<td>Use content-specific tools for learning/research</td>
<td></td>
</tr>
<tr>
<td>Use to gain higher thinking skills</td>
<td></td>
</tr>
<tr>
<td>Use to develop strategies</td>
<td></td>
</tr>
<tr>
<td>Use to locate information</td>
<td></td>
</tr>
<tr>
<td>Use to process data/report results</td>
<td></td>
</tr>
<tr>
<td>Evaluate/select proper tool for specific tasks</td>
<td></td>
</tr>
<tr>
<td>Use to create group projects</td>
<td></td>
</tr>
<tr>
<td>Experience in field of study</td>
<td></td>
</tr>
<tr>
<td>Use to manage/communicate</td>
<td></td>
</tr>
<tr>
<td>Use variety of media/format</td>
<td></td>
</tr>
<tr>
<td>Exhibit positive attitude for use</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.944</td>
</tr>
</tbody>
</table>

Confidence Total                                                                  | .704             |
| Understands how technology supports student learning                            |                  |
| Will use technology to enhance student learning                                 |                  |
| Can update portfolio                                                           |                  |
|                                                                              |                  |

Once the new variables were created, it was time to run the analysis for questions 3. A correlation analysis was used to determine if any relationship exists between the variables of competence total, confidence total, and the four problem solving skills (i.e., instructor, peer, trial and error, and read). A correlation of .300 or higher represents a
moderate correlation with a correlation of .100 to .299 representing a small correlation (Pallant, 2005).

Table 15

**Overall Correlations Between Competence, Confidence, and Problem Solving Strategies**

<table>
<thead>
<tr>
<th></th>
<th>Format</th>
<th>Comp Total</th>
<th>Conf Total</th>
<th>Instructor</th>
<th>Peer</th>
<th>Trial &amp; error</th>
<th>Read</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Format</strong></td>
<td>1.000</td>
<td>.114*</td>
<td>.028</td>
<td>-.102*</td>
<td>-.053*</td>
<td>.214*</td>
<td>.131*</td>
</tr>
<tr>
<td><strong>Comprehension Total</strong></td>
<td>1.000</td>
<td>.017</td>
<td>.060*</td>
<td>-.013</td>
<td>-.005</td>
<td>.016</td>
<td></td>
</tr>
<tr>
<td><strong>Confidence Total</strong></td>
<td>1.000</td>
<td>.001</td>
<td>.027</td>
<td>.128*</td>
<td>.059*</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Instructor</strong></td>
<td>1.000</td>
<td>.226*</td>
<td>-.061*</td>
<td>.103*</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Peer</strong></td>
<td>1.000</td>
<td>.167*</td>
<td>.138*</td>
<td>.000</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Trial and error</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.250*</td>
<td></td>
</tr>
<tr>
<td><strong>Read</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.000</td>
</tr>
</tbody>
</table>

*Significant with r≥.100

The Pearson correlation found **Trial and error and Peer** have a small correlation (r(1380)=.250, p=.000), and **Instructor and Peer** have a small correlation (r(1380)=.226, p=.000. Additionally, **Course Format and Trial and error** are correlated (r(1380)=.214, p=.000). Other relationships with small correlations consist of: **Peer and Trial and error** (r(1380)=.167, p=.000); **Peer and Read** (r(1380)=.138, p=.000; **Course Format and Read** (r(1380)=.131, p=.000); **Confidence and Trial and error** (r(1380)=.128, p=.000); **Course Format and Competence** (r(1380)=.114, p=.000); **Instructor and Read** (r(1380)=.103,
p = .000); and Course Format and Instructor (r(1380) = -1.02, p = .000. Table 15 displays the findings of the correlations of all the data.

Table 16

Face-to-face Group Correlations

<table>
<thead>
<tr>
<th></th>
<th>Comprehension Total</th>
<th>Confidence Total</th>
<th>Instructor</th>
<th>Peer</th>
<th>Trial and error</th>
<th>Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comprehension Total</td>
<td>1.000</td>
<td>.024</td>
<td>.036</td>
<td>-.025</td>
<td>-.009</td>
<td>-.006</td>
</tr>
<tr>
<td>Confidence Total</td>
<td>1.000</td>
<td>.082</td>
<td>.061</td>
<td>.156*</td>
<td>.078</td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td>1.000</td>
<td>.308*</td>
<td>.055</td>
<td>.182*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peer</td>
<td>1.000</td>
<td>.269*</td>
<td>.185*</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial and error</td>
<td>1.000</td>
<td>.290*</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Read</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant with r > .100

To answer the first section of question three, two separate Pearson correlations were conducted to find the relationship between competence, confidence, and problem solving skills – one on data for the face-to-face computer lab course and the other on the data for the online course. The Pearson correlation for the face-to-face computer lab course data found Instructor and Peer have a small correlation (r(858) = .308, p = .000), and Trial and error and Read have a small correlation (r(858) = .290, p = .000).

Additionally, Peer and Trial and error are correlated (r(858) = .269, p = .000). Two other relationships with small correlations consist of: Peer and Read (r(858) = .185, p = .000);
and Confidence and Trial and error ($r(858) = .156, p = .000$). Table 16 displays the findings of the correlations for the face-to-face course data.

The Pearson correlation for the online course data found Instructor and Trial and error have a small correlation ($r(522) = -.197, p = .000$), and Competence and Instructor have a small correlation ($r(522) = .126, p = .002$). Additionally, Confidence and Trial and error are correlated ($r(522) = .116, p = .004$). Two other relationships with small correlations consist of: Trial and error and Read ($r(522) = .103, p = .009$; and Instructor and Peer ($r(522) = .100, p = .011$). Table 17 displays the findings of the correlations for the online course data.

Table 17

*Online Group Correlations*

<table>
<thead>
<tr>
<th></th>
<th>Comprehension Total</th>
<th>Confidence Total</th>
<th>Instructor</th>
<th>Peer</th>
<th>Trial and error</th>
<th>Read</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comprehension Total</td>
<td>1.000</td>
<td>.008</td>
<td>.126*</td>
<td>.021</td>
<td>-.068</td>
<td>.015</td>
</tr>
<tr>
<td></td>
<td>.432</td>
<td>.002</td>
<td>.315</td>
<td>.062</td>
<td>.364</td>
<td></td>
</tr>
<tr>
<td>Confidence Total</td>
<td>1.000</td>
<td>-.053</td>
<td>.008</td>
<td>.116*</td>
<td>.015</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.113</td>
<td>.429</td>
<td>.004</td>
<td>.147</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td>1.000</td>
<td>.100*</td>
<td>-.197*</td>
<td>.007</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.011</td>
<td>.000</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peer</td>
<td>1.000</td>
<td>.043</td>
<td>.081</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.165</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial and error</td>
<td>1.000</td>
<td>.103*</td>
<td>.009</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Read</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant with $r \geq .100$
A regression analysis was run with the four Problem solving skills variables within each course format in relationship to Competence. A regression analysis is used to explain how well a set of variables is able to predict an outcome (Pallant, 2005). The regression analysis was used to determine if problem solving skills for both face-to-face and online groups are predictive to computer competency. The results for the regression analysis of problem solving skills relationship to computer competency within both course formats is shown in Table 18.

Table 18

*Regression for Competence and Problem Solving Skills*

<table>
<thead>
<tr>
<th>Competence</th>
<th>PS Skills</th>
<th>B</th>
<th>Std Error</th>
<th>Beta</th>
<th>T</th>
<th>Sig</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face</td>
<td>Instructor</td>
<td>.032</td>
<td>.151</td>
<td>.050</td>
<td>1.380</td>
<td>.169</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peer</td>
<td>-.025</td>
<td>.023</td>
<td>-.040</td>
<td>-1.064</td>
<td>.289</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trial &amp; error</td>
<td>.001</td>
<td>.020</td>
<td>.001</td>
<td>.040</td>
<td>.968</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Read</td>
<td>-.005</td>
<td>.021</td>
<td>-.008</td>
<td>-.233</td>
<td>.816</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All 4 skills</td>
<td>.068</td>
<td>.026</td>
<td>.116</td>
<td>2.588</td>
<td>.100*</td>
<td>.003</td>
</tr>
<tr>
<td>Online</td>
<td>Instructor</td>
<td>.006</td>
<td>.026</td>
<td>.010</td>
<td>.230</td>
<td>.818</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peer</td>
<td>-.029</td>
<td>.027</td>
<td>-.047</td>
<td>-1.052</td>
<td>.293</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trial &amp; error</td>
<td>.012</td>
<td>.030</td>
<td>.018</td>
<td>.418</td>
<td>.676</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Read</td>
<td>.049*</td>
<td>.018</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Statistically significance at p<0.05

The regression revealed that for all items in the dependent variable Competence when all variables were considered there is a statistically significant influence for each item for the online format. The regression analysis found the composite of all variables for problem solving skills (i.e., Instructor, Peer, Trial and error, and Read) within the online course (p=.049) account for 1.80% of the variance for Competence in the online course. The regression analysis also revealed the composite of all variables for problem
solving skills within the face-to-face course account for .30% of the variance for

*Competence*.

Individually, the variable Instructor (B=.068, p=.010) in the online course influences this item. Individually for the face-to-face course, none of the items showed any influence on computer competence.

A regression analysis was also run with the four Problem solving skills variables within each course format in relationship to *Confidence*. The regression analysis was used to determine if problem solving skills for both face-to-face and online groups are predictive to computer confidence. The results for the regression analysis of problem solving skills relationship to computer confidence within both course formats are shown in Table 19.

The regression revealed that for all items in the dependent variable *Confidence* when all four of the problems solving skills variables were considered there is a statistically significant influence for each item for the face-to-face format. The regression analysis found the composite of all variables for problem solving skills (i.e., Instructor, Peer, Trial and error, and Read) within the face-to-face course (p=.000) account for 3% of the variance for *Confidence* in the face-to-face course. The regression analysis also found the composite of all variables for problem solving skills (i.e., Instructor, Peer, Trial and error, and Read) within the online course account revealed 1.60% of the variance for *Confidence*. 
Individually, the variable Instructor ($B=.051$, $p=.048$) in the face-to-face course influences this item. Individually for the online course, the variable Trial and error ($B=.150$, $p=.018$) influences Confidence.

Table 19

Regression for Confidence and Problem Solving Skills

<table>
<thead>
<tr>
<th>Confidence</th>
<th>PS Skills</th>
<th>B</th>
<th>Std Error</th>
<th>Beta</th>
<th>T</th>
<th>Sig</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face</td>
<td>Instructor</td>
<td>.051</td>
<td>.026</td>
<td>.071</td>
<td>1.977</td>
<td>.048*</td>
<td>.030</td>
</tr>
<tr>
<td></td>
<td>Peer</td>
<td>-.003</td>
<td>.026</td>
<td>-.005</td>
<td>-.125</td>
<td>.900</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trial &amp; error</td>
<td>.092</td>
<td>.023</td>
<td>.146</td>
<td>4.037</td>
<td>.000*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Read</td>
<td>.015</td>
<td>.023</td>
<td>.023</td>
<td>.649</td>
<td>.516</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All 4 skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Online</td>
<td>Instructor</td>
<td>-.045</td>
<td>.061</td>
<td>-.033</td>
<td>-.732</td>
<td>.464</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peer</td>
<td>.005</td>
<td>.060</td>
<td>.004</td>
<td>.085</td>
<td>.932</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trial &amp; error</td>
<td>.150</td>
<td>.063</td>
<td>.106</td>
<td>2.369</td>
<td>.018*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Read</td>
<td>.055</td>
<td>.069</td>
<td>.035</td>
<td>.798</td>
<td>.425</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All 4 skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.084</td>
<td>.016</td>
</tr>
</tbody>
</table>

*Statistically significance at $p<.05$

Chapter IV Summary

Chapter four has presented descriptive and statistical analysis of data from two pre-existing surveys completed by university students who took an educational technology teacher methods course. The respondents of the first survey, which measures self-reported competency, consisted of 1512 students, with 57.5% from face-to-face sections and 42.5% from online sections of EDT 3470. For the second survey, there were 1380 participants, with 62.2% of the students from the face-to-face computer lab sections and 37.8% from the course online.

The first survey used for this research was taken at the beginning and at the end of the semester. An analysis was conducted on the pre-course survey and found that the
groups (i.e., face-to-face and online) were significantly different and set the stage for the type of analysis to use for the post-course survey. The results of the post-course survey, which measured self-reported computer competence, revealed that a majority of the students in both the face-to-face and online sections of EDT 3470 believe that after taking the course they will integrate into their teaching or are able to teach others each of the 14 technology competencies. However, there were significant differences between the groups on each of the 14 items with the online students' average being higher than the face-to-face students.

When analyzing self-reported computer confidence, it was revealed that there was no significant difference between the face-to-face and online groups when asked about technology supporting and enhancing student learning. However, a significant difference was found between the two groups regarding updating their portfolios with the face-to-face group having a higher average than the online group.

Participants also reported the problem solving skills they used prior to and while taking EDT 3470. An analysis was conducted on the pre-course question, stating the problem solving skills used before taking the course, and set the stage for the type of analysis to use for the during-course question, stating the problem solving skills used while taking the course. Analysis revealed that there was no significant difference between the two groups when going to a peer for assistance before taking the course. However, for the other three problem solving skills (waiting for instructor, discovering answer through trial and error, and discovering answer through further reading), a significant difference was found and again set the stage for the type of analysis to be
conducted. This analysis revealed that students in the face-to-face course more often waited for an instructor or asked a peer while online students used the trial and error method to solve a problem or discovered the answer through reading more often. In looking at specific technology tasks and the problem solving skill used on each, the majority of the students in both online and face-to-face courses used the trial and error method.

The analysis of the relationships between course format, competence, confidence, and problem solving skills revealed that a small relationship exists between the Instructor and competence, and trial and error and confidence in the online course. In the face-to-face course, small relationships exist between Instructor and confidence, and trial and error and confidence.

This chapter contains information on all of the data, the types of analysis used for, and results for this study. Now, let us turn to Chapter 5 for a discussion on these finding and recommendations.
CHAPTER V
DISCUSSION

The purpose of this study is to explore the problem solving strategies used by students within a university course designed to teach pre-service teachers educational technology, and whether those strategies used are influenced by the format of the course they took (i.e., face-to-face computer lab vs. online). In addition, it examines to what extent the type of problem solving strategies and/or course format are correlated with students’ expressed level of confidence and competence to integrate technology into their future classroom settings. Data was extracted from two survey instruments of over 1,500 students who had taken the educational technology methods course during nineteen (19) different online and face-to-face semesters at Western Michigan University. Because random selection and assignment were not possible for this study, it was important to determine if there were any initial major differences between these two groups prior to taking the course. This was accomplished by analyzing data from the “pre” ProfilerPRO and “pre-course” questions on Zoomerang. Included in this chapter, respectively, are the keys findings from that data, a comparison of those findings with previous research, implications for teacher preparation programs, and recommendations for further research.

Key Findings

Self-reported Computer Competence Differences Between Formats

My study found that more than 85% of the students in both the face-to-face and online sections felt, after completing the university course which involved using several computer applications to create a variety of projects, they were able to either integrate
technology into their teaching or teach such technology to others (i.e., technology competence). This finding is in alignment with the results of several research studies that found that, in order to gain computer competence, students need intense computer use and experience (Cretchley, 2007; Jih, 2004; Karabenick & Newman, 2006; van Braak & Goeman, 2003). Apparently this university course offered such an intensive experience for these students.

Even though a majority of the students considered themselves competent enough to either integrate technology into their teaching or teach it to others, some significant differences were revealed between the course formats. Looking at each of the 14 technology skills assessed, a pattern was found with the students in the online course feeling more competent to teach each skill, while the students in the face-to-face course felt they had more of an ability to integrate it into their teaching. For example, a higher percentage of students (63%) from the online course agree or strongly agree that they were able to teach the use of technology to locate, evaluate and collect information from a variety of sources (i.e., Use to locate information) when compared with the students (46%) in the face-to-face course (a difference of 17%); while a higher number of students (41%) in the face-to-face course felt they had the ability to integrate this competency in their teaching compared to 30% of the online students (a difference of 11%). The only exception to the pattern of the online students feeling more competent to teach, while those in the face-to-face felt more competent to integrate into teaching was that online students (44%) believed they could integrate the use of input/output devices more than the face-to-face students (43%) (a slight difference of 1%).
A comparison of the percentage differences for each individual technology skill is displayed in Table 20, whereby the table shows how much higher one format was than the other for each competence skill and which were significantly different (for actual percentages, see Table 2, page 57 and Table 3, page 63).

Table 20

Comparison of Competence for Integration and Teaching of Technology Skill

<table>
<thead>
<tr>
<th>Technology Skill</th>
<th>F2F Teach</th>
<th>Online Teach</th>
<th>F2F Integrate</th>
<th>Online Integrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use to locate information</td>
<td>+17%*</td>
<td>+11%*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use to improve products, learning</td>
<td>+17%*</td>
<td>+10%*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhibit positive attitude for use</td>
<td>+17%*</td>
<td>+10%*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use to manage/communicate</td>
<td>+16%*</td>
<td>+9%*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use a variety of media/format</td>
<td>+16%*</td>
<td>+9%*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understand nature/operation of technology systems</td>
<td>+14%*</td>
<td>+6%*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use to develop strategies</td>
<td>+13%*</td>
<td>+8%*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use to gain higher thinking skills</td>
<td>+13%*</td>
<td>+5%*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use content-specific tools to support learning/research</td>
<td>+13%*</td>
<td>+3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use to process data/report results</td>
<td>+12%*</td>
<td>+9%*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observe/experience use in field of study</td>
<td>+12%*</td>
<td>+3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use proper tool for specific tasks</td>
<td>+12%*</td>
<td>+2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use to create group projects</td>
<td>+12%*</td>
<td>+2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use input/output devices</td>
<td>+11%*</td>
<td>+1%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: + # = % higher than the % in the other format; *=significant difference

An overall look at the results of the analysis for competence found significant differences between course formats, with a definite pattern being found. More of the students in the online course felt they were able to teach others each of the technology skills, while more face-to-face course felt they would integrate those skills into their teaching. So, which is better – integrating into teaching or being able to teach to others? Honestly, it is a matter of opinion. When you integrate technology into your teaching, it could be using technology to teach, or having your students use technology to complete a
task. And, when students use a technology to complete a task, sometimes they need to be taught how to use that technology. However, sometimes teachers are not teaching the technology skill but have technology coordinators or someone with technology expertise teach the skill. Whichever way it is looked at, this study revealed an interesting pattern of having more face-to-face students feel comfortable with integrating technology into their future teaching (when compared to those taking the same class online), while most online students feel comfortable enough to teach technology (when compared to those taking the same class face-to-face). Further study on this issue is warranted.

Self-reported Computer Confidence Differences Between Formats

My study also found that most (85%) of the students in both the face-to-face and online sections felt, after taking EDT 3470, they have the confidence to use technology in their future teaching. This is in alignment with the results of research studies that found students who rated themselves as more knowledgeable in using technology were also more confident about using computers and believe them to be useful tools for their future classrooms (Albion, 2007; Lambert, Gong, & Cuper, 2008).

No significant difference was found between course formats in looking at two of the three confidence questions. Students (88% with 47% who agree and 41% who strongly agree) in the online course and students (87% with 52% who agree and 35% who strongly agree) in the face-to-face course agreed or strongly agreed that they understood how technology supports student learning (a difference of only 1%). The same percentage of online students (83% with 42% who agree and 41% who strongly agree) and face-to-face students (83% with 50% who agree and 33% who strongly agree)
agreed or strongly agreed that they would use technology to enhance student learning. However, a small significant difference was revealed when students were asked about updating the portfolio that was created while taking EDT 3470. More students (78% with 48% who agree and 30% who strongly agree) in the face-to-face course than students (72% with 39% who agree and 33% who strongly agree) in the online course agreed or strongly agreed they could so (a difference of 6%).

An overall look at the results of the study reveals that course format does make a small difference when it comes to computer confidence, with more of the face-to-face students slightly more confident than the online students. A comparison of the percentage differences for each computer usage confidence is displayed in Table 21, whereby the table shows how much higher one format was than the other for computer use confidence and which was significantly different (for actual percentages, see Table 6, page 77).

Table 21

<table>
<thead>
<tr>
<th></th>
<th>F2F Agree/Strongly Agree</th>
<th>Online Agree/Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understands technology supports student learning</td>
<td>+1%</td>
<td></td>
</tr>
<tr>
<td>Will use technology to enhance student learning</td>
<td>(no difference)</td>
<td>(no difference)</td>
</tr>
<tr>
<td>Can update portfolio after course</td>
<td>+6%*</td>
<td></td>
</tr>
</tbody>
</table>

Note: + # = % higher than the % in the other format; *=significant difference

Differences Between F2F and Online Overall Problem Solving Skills During Course

My study revealed that the overall use of the four problem solving skills discussed in this research differ between course formats. As an instructor for EDT 3470 both online and face-to-face, I noticed that when students in the face-to-face course needed
Ill-assistance, they would either come to me or ask someone in the class sitting next to them. I also noticed that when students in the online class emailed me with a question, before I could email the answer to that question, either their assignment would be completed, or I would receive an email letting me know they already found the answer. So not surprisingly, survey data confirmed that students in the face-to-face course either waited for assistance from their instructor or went to a peer for assistance. Online students chose to discover an answer through the trial and error method or through further reading.

Examination of the data revealed that 78% (31% often, 35% most of the time, and 12 always) of the face-to-face students compared to 67% (29% often, 27% most of the time, and 11% always) of the online students waited for their instructor for assistance (a difference of 11%). And, 81% (33% often, 37% most of the time, and 11% always) of the face-to-face students compared to 72% (27% often, 35% most of the time, and 10% always) of the online students went to their peers for assistance (a difference of 9%). The data also revealed that 83% (21% often, 47% most of the time, and 15% always) of the online students compared to 67% (32% often, 25% most of the time, and 10% always) of the face-to-face students discovered the answer to a problem through the trial and error method (a difference of 12%). And, 71% (46% often, 19% most of the time, and 6% always) of the online students compared to 55% (31% often, 18% most of the time, and 6% always) of the face-to-face students discovered the answer to a problem through further reading (a difference of 16%).

A summary of the percentage differences for overall problem solving skills used during EDT 3470 is displayed in Table 22, whereby the table shows how much higher
one format was than the other for use of problem solving skills and which were significantly different (for actual percentages, see Table 9, page 78).

Table 22

*Comparison of Problem Solving Skills Used Most Overall*

<table>
<thead>
<tr>
<th></th>
<th>F2F</th>
<th>Online</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructor</td>
<td>+11%*</td>
<td>+13%*</td>
</tr>
<tr>
<td>Peer</td>
<td>+9%*</td>
<td>+16%*</td>
</tr>
<tr>
<td>Trial and error</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Further reading</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: + # = % higher than the % in the other format; *=significant difference

In addition to asking in general which problem solving techniques they tend to use, students were given specific technology “problems” and asked which of the problem solving skills they used for each. For example, students were asked to create a web site. In doing so, they had to create internal links (linking to other pages they created). When students had problems creating these links, the students (46%) in face-to-face course waited for their instructor to assist them, while only 3% of the online students waited for their instructor help (a difference of 28%).

As another example, students in EDT 3470 were also asked to create a movie. A software program was used that has the user create slides and then export those slides into a movie. If the exportation of the slides into the movie is not done properly, the movie will not work. Thirty-eight percent of the students in the face-to-face course and 12% of the online students waited for the instructor to assist them (a difference of 26%). However, 53% of the students in the online course and 37% of the students in the face-to-face course used the trial and error method for this problem (a difference of 16%).
As I reviewed the other problems and ways to get solutions, a pattern was revealed with a few exceptions. For most of the tasks in EDT 3470, the majority of the students in both courses used the trial and error method, with some students in the face-to-face course waiting for the instructor’s assistance and some in the online course asking a peer for assistance. The exceptions are face-to-face students equally used instructor assistance (38%) and trial and error (38%) to help get their web files to the server; face-to-face students (62%) went to peers for assistance in communicating with their group; and face-to-face students (54%) also went to peers regarding the podcast.

As stated before, the majority of the students in both courses used the trial and error method for solving specific tasks with a few exceptions. To this end, a summary was created to show which problem solving skill was used the most for those specific individual tasks within each format while taking EDT 3470 and is displayed in Table 23.

Table 23

<table>
<thead>
<tr>
<th>Most Used Problem Solving Skills for Specific Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instructor</strong></td>
</tr>
<tr>
<td>Internal links</td>
</tr>
<tr>
<td>Export movie</td>
</tr>
<tr>
<td>Files to server</td>
</tr>
<tr>
<td>From server</td>
</tr>
<tr>
<td>External links</td>
</tr>
<tr>
<td>Insert images</td>
</tr>
<tr>
<td>Hot links</td>
</tr>
<tr>
<td>Attachments</td>
</tr>
<tr>
<td>Publisher</td>
</tr>
<tr>
<td>Setting up blog</td>
</tr>
<tr>
<td>Managing Site</td>
</tr>
<tr>
<td>PowerPoint</td>
</tr>
<tr>
<td>Images on web</td>
</tr>
<tr>
<td>Group commun.</td>
</tr>
<tr>
<td>Podcast</td>
</tr>
</tbody>
</table>

▲ = F2F most used; ■ = online most used.
A summary of the percentage differences for problem solving skills used for each specific task during EDT 3470 is displayed in Table 24, whereby the table shows how much higher one format was than the other for use of problem solving skills for those individual tasks and which were significantly different.

Table 24

Comparison of Problem Solving Skills for Specific Tasks

<table>
<thead>
<tr>
<th>Instructor</th>
<th>F2F</th>
<th>Online</th>
<th>F2F</th>
<th>Online</th>
<th>F2F</th>
<th>Online</th>
<th>F2F</th>
<th>Online</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal links</td>
<td>+28%*</td>
<td>+3%*</td>
<td>+16%*</td>
<td>+9%*</td>
<td>+24%*</td>
<td>+5%</td>
<td>+8%*</td>
<td>+6%*</td>
</tr>
<tr>
<td>Export movie</td>
<td>+26%*</td>
<td>+17%*</td>
<td>+16%*</td>
<td>+9%*</td>
<td>+17%*</td>
<td>+5%*</td>
<td>+6%*</td>
<td>+7%*</td>
</tr>
<tr>
<td>Files to server</td>
<td>+24%*</td>
<td>+16%*</td>
<td>+13%*</td>
<td>+9%*</td>
<td>+11%*</td>
<td>+9%*</td>
<td>+4%*</td>
<td>+8%*</td>
</tr>
<tr>
<td>From server</td>
<td>+23%*</td>
<td>+16%*</td>
<td>+13%*</td>
<td>+9%*</td>
<td>+11%*</td>
<td>+9%*</td>
<td>+4%*</td>
<td>+8%*</td>
</tr>
<tr>
<td>External links</td>
<td>+20%*</td>
<td>+16%*</td>
<td>+13%*</td>
<td>+9%*</td>
<td>+11%*</td>
<td>+9%*</td>
<td>+4%*</td>
<td>+8%*</td>
</tr>
<tr>
<td>Insert images</td>
<td>+19%*</td>
<td>+16%*</td>
<td>+13%*</td>
<td>+9%*</td>
<td>+11%*</td>
<td>+9%*</td>
<td>+4%*</td>
<td>+8%*</td>
</tr>
<tr>
<td>Hot links</td>
<td>+17%*</td>
<td>+16%*</td>
<td>+13%*</td>
<td>+9%*</td>
<td>+11%*</td>
<td>+9%*</td>
<td>+4%*</td>
<td>+8%*</td>
</tr>
<tr>
<td>Attachments</td>
<td>+16%*</td>
<td>+16%*</td>
<td>+13%*</td>
<td>+9%*</td>
<td>+11%*</td>
<td>+9%*</td>
<td>+4%*</td>
<td>+8%*</td>
</tr>
<tr>
<td>Publisher</td>
<td>+12%*</td>
<td>+10%*</td>
<td>+13%*</td>
<td>+9%*</td>
<td>+11%*</td>
<td>+10%*</td>
<td>+2%</td>
<td>+6%*</td>
</tr>
<tr>
<td>Setting up blog</td>
<td>+12%*</td>
<td>+10%*</td>
<td>+13%*</td>
<td>+9%*</td>
<td>+11%*</td>
<td>+10%*</td>
<td>+2%</td>
<td>+6%*</td>
</tr>
<tr>
<td>Managing Site</td>
<td>+11%*</td>
<td>+9%*</td>
<td>+4%*</td>
<td>+8%*</td>
<td>+10%*</td>
<td>+8%*</td>
<td>+5%*</td>
<td>+2%</td>
</tr>
<tr>
<td>PowerPoint</td>
<td>+10%*</td>
<td>+8%*</td>
<td>+11%*</td>
<td>+7%*</td>
<td>+5%*</td>
<td>+14%</td>
<td>+14%</td>
<td>+4%</td>
</tr>
<tr>
<td>Images on web</td>
<td>+5%</td>
<td>+14%</td>
<td>+18%*</td>
<td>+7%*</td>
<td>+5%</td>
<td>+14%</td>
<td>+14%</td>
<td>+4%</td>
</tr>
<tr>
<td>Group commun.</td>
<td>+5%*</td>
<td>+30%*</td>
<td>+18%*</td>
<td>+7%*</td>
<td>+5%*</td>
<td>+14%</td>
<td>+14%</td>
<td>+4%</td>
</tr>
<tr>
<td>Podcast</td>
<td>+3%</td>
<td>+14%</td>
<td>+8%</td>
<td>+3%</td>
<td>+14%</td>
<td>+8%</td>
<td>+3%</td>
<td>+14%</td>
</tr>
</tbody>
</table>

Note: +# = % higher than the % in the other format; *=significant difference

Relationships Between Computer Competence, Computer Use Confidence, Problem Solving Skills, and Course Format

My study revealed that there are some small relationships between computer competence, computer use confidence, problem solving skills, and course format. It also disclosed the differences of the relationships between the course formats.

By using a multiple regression, I was able to determine that the variables of waiting for instructor assistance, asking a peer for assistance, discovering an answer through trial and error, and discovering through further reading explain for 1.8% of
variance in *competence* for the online students and .3% for the face-to-face students. This predicts students are more competent if they engage in some form of problem solving. My results align with previous studies which reveal that when students seek help, they feel more confident (McGee, 2005; Ryan & Pintrick, 1997). My results can also be used to predict that students in an online course feel a bit more competent when they engage in problem solving, than the students in the face-to-face course. This is a new finding in the field as no previous research regarding differences in course format and problem solving related to competency could be found.

Another multiple regression was used which revealed that the variables of waiting for instructor assistance, asking a peer for assistance, discovering an answer through trial and error, and discovering through further reading explain 1.6% of variance in *confidence* for the online students and 3.0% for the face-to-face students. This supports McGee’s (2005) assertion where problem solving is seen as an investment that increases confidence. My results allow prediction that students in the face-to-face course feel more confident when they partake in problem solving than the students in the online course. This is a new finding in the field as no previous research regarding differences in course format and problem solving related to confidence could be found.

**Key Outcomes Compared to Previous Research**

The previous section covered my key outcomes and mentioned connections to other research findings. This section recaps my core findings, discussing which findings are new and which align with previous research, and presenting implications for such. A summary table is offered at the end.
Overall, students felt, after leaving a course that had them use several computer applications to create a number of projects that they were able to either integrate technology into their teaching or teach such technology to others. This aligned with the results of several research studies that found that, in order to gain computer competence, students need intense computer use and experience (Cretchley, 1007; Jih, 2004; Karabenick & Newman, 2006; van Braak & Goeman, 2003). An explanation for this finding could be that the course used for this research, EDT 3470, has students use technology every week to create some type of project. Students in the face-to-face course not only spend scheduled computer lab time working on those projects, but need extra outside-of-class time to accomplish each one. The online students are using technology for every portion of the course.

Differences in the level of competence were found between course formats. More students in the face-to-face course felt they would integrate each of the technology skills into their teaching, while more online students felt they were able to teach others. This is a new finding as no previous research comparing technology competence between course formats could be found. Deciding whether of integrating technology or teaching technology is of greater quality depends on how a person looks at integration. Some might think that integrating technology into teaching includes having instructors and students using it, with the need for it to be taught to the students. They may believe that integrating is far more accomplished than just teaching it. However, others may look at teaching to be far more superior. Either way, more face-to-face students feel comfortable
with integrating technology into their future teaching and more online students feel they are able to teach it.

Most of the students in both formats felt they do have the knowledge to use technology in their teaching. This aligned with findings by Albion (2007), and Lambert, Gong and Cuper (2008) that students who rated themselves as more knowledgeable in using technology were also more confident about using computers and believed them to be useful tools for their future classroom. An overall look at the results of my study reveals that course format does makes a small difference when it comes to computer confidence, with more of the face-to-face students slightly more confident the students online.

When looking at specific tasks completed in EDT 3470, and when students ran into problems, most of the students in both formats primarily used the trial and error method to solve them. This is another new finding as no previous research was found comparing the problem-solving skills of face-to-face students with those used by online students.

Some small relationships were discovered between computer competence, computer use confidence, problem solving skills, and course format, with differences found between the course formats. The variables of waiting for instructor assistance, asking a peer for assistance, discovering an answer through trial and error, and discovering through further reading predict students are more competent if they engage in problem solving. These results also allow for the prediction that students in the face-to-face course feel more confident when they partake in problem solving than the students in
the online course. The results confirmed that when students seek help, they feel more competent and confident (Ryan & Pintrick, 1997), and problem solving is seen as an investment that increases competence and confidence (McGee, 2005). Yet, previous research had not looked at course format differences, so my finding which reveals the differences between course formats in regard to relationships between the type of problem solving skills used, self-reported computer competence, and computer use is a new finding for the field.

Table 25

*Significant Findings from the Study Compared to Previous Research Findings*

<table>
<thead>
<tr>
<th>Findings (Peterson, 2010)</th>
<th>Previous Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>After taking EDT 3470, nearly all students do feel <em>competent</em> in either integrating into teaching or teaching specific technology tasks</td>
<td>Aligns with findings by Cretchley (2007), Karabenick and Newman (2006), van Braak and Goeman (2003), and Jih (2004) that found students need computer experience and intense computer use</td>
</tr>
<tr>
<td>Students in face-to-face sections feel more <em>competent</em> to integrate technology into their teaching, while students in the online sections feel more <em>competent</em> to teach specific technology tasks than students in the face-to-face sections</td>
<td>No previous research found</td>
</tr>
<tr>
<td>After taking EDT 3470, nearly all students do feel <em>confident</em> using technology</td>
<td>Aligns with findings by Albion (2007), and Lambert, Gong and Cuper (2008) that students who rated themselves as more knowledgeable in using technology were more confident about using computers</td>
</tr>
<tr>
<td>Students in the face-to-face sections feel a little more <em>confident</em> using technology than students in the online sections</td>
<td>No previous research found</td>
</tr>
<tr>
<td>Overall, more face-to-face participants in this study either ask their peers for assistance or wait for the instructor for assistance, and more online students in this study either discover the answer through trial and error method or further reading</td>
<td>No previous research found</td>
</tr>
</tbody>
</table>
Table 25—continued

<table>
<thead>
<tr>
<th>Findings (Peterson, 2010)</th>
<th>Previous Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>For specific individual tasks, the problem solving skill used most in both sections is trial and error</td>
<td>No previous research found</td>
</tr>
<tr>
<td>Small relationships exist between problem solving and competence</td>
<td>Supports McGee (2005) findings that problem solving is seen as an investment that increases competence</td>
</tr>
<tr>
<td>Small relationships exist between problem solving and confidence</td>
<td>Supports McGee (2005) and Ryan and Pintrich (1997) findings that reveals when students seek help, they feel more competent and confident</td>
</tr>
<tr>
<td>The relationships between problem solving, competence, and confidence differ between formats</td>
<td>No previous research found</td>
</tr>
</tbody>
</table>

Implications for Higher Education Leaders

With the growing influence of technology in today’s society, it is imperative that students acquire technology skills. Consequently, technology has become an essential component in today’s educational environment. Educators need to ensure students attain technology proficiencies to compete in the 21st century. However, before educators are able to integrate and teach technology, they need to gain computer competence and confidence. Crucial to their success as tech-savvy instructors is teacher preparation programs that incorporate technology. To that end, higher educational institutions are responsible for creating programs that build computer competence and confidence so when these instructors begin their teaching careers they will successfully integrate and teach technology. Based on my findings, the students completing EDT 3470 within one university’s teacher preparation program consider themselves to be able to successfully integrate technology into their future curriculum and teach technology to their future students. Therefore, curriculum for teacher education programs should offer a similar
course involving critical use of technology, which broadens knowledge of such, and gives students an experience base in the use of technology in the classroom.

Problem solving is an important predictor of student learning, and an activity that contributes to successful students (Kempler & Linnenbrink, 2006; McGee, 2005). My research found that most students will solve a technology problem on their own, using various problem solving strategies, and in doing so feel more technology competent and confident. Consequently, educators in teacher preparation programs need to offer opportunities for students to solve problem, giving them the time to find solutions on their own, while assuring them that the instructor is available for assistance, and then as needed, encourage students to ask their peers.

Recommendations for Future Study

In order to support the existing research and where this study enters into the professional discussion, I would like to suggest the several things to continue the conversation about technology use in teacher education programs.

First, a qualitative study that would delve deep into what pre-service and in-service teachers believe would assist them to be more competent with integrating technology into their curriculum and teaching technology. Research has been conducted and solutions have been suggested that the repeated use of, and attitudes toward, technology help build competence and confidence, but still there are many teachers who are not integrating and teaching (NCES, 2005). If the learners speak to us through interviews, educators of pre-service teachers and in-service teachers may find variables other than problem solving that will contribute to technology competence and confidence.
Second, a follow-up, quantitative study on participants of this study to see who is actually integrating technology into their teaching, who is teaching technology to their students, and who are doing both. This would assist in seeing if this university’s course, EDT 3470, really made a difference once these pre-service teachers actually begin teaching in a classroom.

Third, this study could be broadened by going outside of the single university and surveying students from several teacher preparation programs to see if there are any similar significant relationships between competence, confidence, problem solving skills, and course format.

Fourth, a longitudinal study, using data from this research, that takes a look at differences between technology competence gains from students in the first year up to students in the fifth year. This would enable us to see if there is a change in the type students over the years. This study could also demonstrate if there is a trend of higher competence gains over the years.

Overall Conclusion

Because students need to be prepared for the 21st century workforce, technology has become an essential element of today’s education. Educators face the challenges of not only integrating technology into their curriculum, but also teaching technology. One of the biggest obstructions for in-service teachers is the lack of technology competence and confidence, which leads to not using, integrating, or teaching technology (Cretchley, 2007; Jih, 2004; Karabenick & Newman, 2006; van Braak & Goeman, 2003). Higher education teacher preparation programs play an integral role in creating technology competent and
confident educators. As pre-service teachers are learning technologies, problems may arise. Problem solving is an essential part of the learning process, and is a critical strategy for learning (Karabenick & Newman, 2006; Ryan & Pintrich, 1997). Based on this information, knowledge of the relationships between course format, problem solving, computer competence, and computer use confidence is helpful to educators.

In reference to technology confidence and competence, my study revealed that the vast majority of students in both the face-to-face and online sections felt, after completing a technology course as part of their teacher preparation program, they could integrate technology into their teaching, teach such technology to others, and use technology in their future teaching. More of the online students felt they could teach technology to others, with more of the face-to-face students believing they will integrate technology into their future teaching.

The results of my study show that, overall, when students were asked what problem solving skill they used when they encounter a problem in technology, the largest part of the face-to-face students either waited for their instructor to assist them or asked a peer for help to solve it, with more of the online students using the trial and error method or further reading. An explanation for this may be face-to-face students have immediate access to instructors and peers while online student do not. Online students use the problem-solving methods which are quickest for them – trial and error or further reading. This could also explain the results of more online students feeling they could teach technology and more face-to-face students feel they can integrate technology into their future classrooms. As a result of online students doing their own problem solving, they
internalize the learning and feel confident enough to teach others. With the face to face students, they learn by watching the teacher model how she/he has integrated technology into the lesson, giving them more confidence to do the same. However, when looking at specific tasks within a pre-service teaching technology methods course, a majority of the students in the online and face-to-face sections actually used the trial and error method more often to solve a problem.

Further investigation revealed that the use problem solving skills, especially using the trial and error method, can predict whether a student will feel competent or confident to integrate technology into their curriculum or teach it. Moreover, course format, online or face-to-face can predict whether more students will feel competent or confident after completing the course.

My research has provided a beginning for a conversation on ways to build computer competence and computer use confidence by looking at the problem solving skills students use. With technology being a fundamental element of education, and only a little over half of public school teachers feeling comfortable with technology (NCES, 2009), efforts need to continue to assist educators in understanding how to use technology with competence and confidence.
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Appendix A

Table of Research Questions, Data Elements, and Statistics Used
<table>
<thead>
<tr>
<th>RESEARCH QUESTION</th>
<th>SURVEY QUESTIONS/DATA</th>
<th>STATS USED</th>
</tr>
</thead>
<tbody>
<tr>
<td>la. self-reported technology competence for online vs. face-to-face</td>
<td>PROFILERPRO - 1. Demonstrate a sound understanding of the nature and operation of technology systems. PROFILERPRO - 2. Demonstrate proficiency in the use of common input and output devices; solve routine hardware and software problems; make informed choices about technology systems, resources and services. PROFILERPRO - 3. Use technology tools and information resources to increase productivity, promote creativity, and facilitate academic learning. PROFILERPRO - 4. Use content-specific tools (e.g. software, simulation, environmental probes, graphing calculators, exploratory environments, Web tools) to support learning and research. PROFILERPRO - 5. Use technology resources to facilitate higher order and complex thinking skills, including problem solving, critical thinking, informed decision making, knowledge construction, and creativity. PROFILERPRO - 6. Use technology in the development of strategies for solving problems in the real world. PROFILERPRO - 7. Use technology to locate, evaluate and collect information from a variety of sources. PROFILERPRO - 8. Use technology tools to process data and report results. PROFILERPRO - 9. Evaluate and select new information resources and technological innovations based on their appropriateness to specific tasks. PROFILERPRO - 10. Collaborate in constructing technology-enhanced models, preparing publications, and producing other creative works using productivity tools. PROFILERPRO - 11. Observe and experience the use of technology in their major field of study. PROFILERPRO - 12. Use technology tools and resources for managing and communicating information (e.g., finances, schedules, addresses, purchases, correspondence) PROFILERPRO - 13. Use a variety of media formats, including telecommunications to collaborate, publish, and interact with peers, experts, and other audiences. PROFILERPRO - 14. Exhibit positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.</td>
<td>Cronbach’s alpha to find single or fewer variable(s) t-test on Pre ProfilerPRO for SD between groups If SD, analysis of covariance</td>
</tr>
<tr>
<td>RESEARCH QUESTION</td>
<td>SURVEY QUESTIONS/DATA</td>
<td>STATS USED</td>
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</table>
| 1b. technology usage confidence for online and face-to-face | ZOOMERANG - 6d. I am now confident that I understand how technology can successfully be used to support student learning.  
ZOOMERANG - 6e. I am now confident that I will personally use technology as a tool to enhance my students’ learning.  
ZOOMERANG - 6f. This course provided me with the skills needed to continue updating my electronic portfolio after this class has ended. | Cronbach’s alpha to find single or fewer variable(s)  
t-tests |
| 2. problem solving strategies For online and face-to-face | ZOOMERANG - 7a. & 8a. Waiting for instructor’s assistance.  
ZOOMERANG - 7b & 8b. Finding out the answer from a peer/other person.  
ZOOMERANG - 7c & 8c. Discovering the answer through trial and error on your own.  
ZOOMERANG - 7d & 8d. Discovering the answer by further reading. | t-tests on 7 to see if SD between course formats  
If SD, analysis of covariance |
| 2. problem solving strategies (a) Seeking instructor assistance and waiting for response (b) Finding out answer from a peer (c) Discovering answer via their own reading (d) Discovering the answer via their own investigation using trial and error | ZOOMERANG - 9a. Getting interactive PowerPoint to work properly.  
ZOOMERANG - 9b. inserting images into Kid Pix.  
ZOOMERANG - 9c. Exporting Kid Pix slide show into QuickTime Movie.  
ZOOMERANG - 9d. Managing (defining) site in Dreamweaver.  
ZOOMERANG - 9e. getting images to show up on web site.  
ZOOMERANG - 9f. getting attachments to show up on web site.  
ZOOMERANG - 9g. sending files to server for web site.  
ZOOMERANG - 9h. retrieving files from server for web site.  
ZOOMERANG - 9i. linking to external sites properly.  
ZOOMERANG - 9j. linking to internal pages properly.  
ZOOMERANG - 9k. creating “hot links” in Word documents.  
ZOOMERANG - 9l. adjusting the content areas in Publisher to meet requirements. | Crosstabs  
t-tests |
<table>
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<th>RESEARCH QUESTION</th>
<th>SURVEY QUESTIONS/DATA</th>
<th>STATS USED</th>
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</thead>
<tbody>
<tr>
<td>3a. in online format, relationship between technology competence, technology usage confidence and problem solving strategies</td>
<td></td>
<td>Correlation Coefficient Regressions</td>
</tr>
<tr>
<td>3a. in face-to-face format, relationship between technology competence, technology usage confidence and problem solving strategies</td>
<td></td>
<td>Correlation Coefficient Regressions</td>
</tr>
<tr>
<td>3b. differences of relationship of technology competence, technology usage confidence and problem solving strategies between course formats</td>
<td></td>
<td>Correlation Coefficient Regressions</td>
</tr>
</tbody>
</table>
Appendix B

Post ProfilerPRO
To live, learn, and work successfully in an increasingly complex and information rich society, students and teachers must use technology effectively. Prospective teachers must experience and observe effective uses of technology in general education coursework. This survey captures what a student exiting a general preparation teacher education program should know and be able to do related to the National Education standards and performance indicators. Please complete the survey below by selecting one of the choices about each of the technology related indicators. A 5 means that you are very knowledgeable and willing to teach others a particular skill, whereas a 2 means that you have an awareness of this skill or topic, but are not comfortable with using this in your practice. A 1 indicates that you have had no exposure to this topic. (Based on ISTE)

I agree that the information from this survey may be used for research purposes.

- Yes
- No

**Technology Operations and Concepts**

1. Demonstrate a sound understanding of the nature and operation of technology systems. (NETS I)

   - No opportunity
   - I am aware but do not plan to use
   - I am literate and will integrate some of this into my practice of the indicators
   - I will integrate this into my practice of the indicators
   - I am able to teach others

2. Demonstrate proficiency in the use of common input and output devices; solve routine hardware and software problems; make informed choices about technology systems, resources, and services. (NETS I)

   - No opportunity
   - I am aware but do not plan to use
   - I am literate and will integrate some of this into my practice of the indicators
   - I will integrate this into my practice of the indicators
   - I am able to teach others

3. Use technology tools and information resources to increase productivity, promote creativity, and facilitate academic learning. (NETS I, III, IV, V)
No opportunity I am aware but do I am literate and I will integrate I am able for exposure not plan to use will integrate some this into my to teach this in my practice of the indicators teaching others

Teaching, Learning and the Curriculum

4. Use content-specific tools (e.g. software, simulation, environmental probes, graphing calculators, exploratory environments, Web tools) to support learning and research (NETS I, III, V)

No opportunity I am aware but do I am literate and I will integrate I am able for exposure not plan to use will integrate some this into my to teach this in my practice of the indicators teaching others

5. Use technology resources to facilitate higher order and complex thinking skills, including problem solving, critical thinking, informed decision making, knowledge construction, and creativity. (NETS I, III, V)

No opportunity I am aware but do I am literate and I will integrate I am able for exposure not plan to use will integrate some this into my to teach this in my practice of the indicators teaching others

6. Use technology in the development of strategies for solving problems in the real world. (NETS I, III, V)

No opportunity I am aware but do I am literate and I will integrate I am able for exposure not plan to use will integrate some this into my to teach this in my practice of the indicators teaching others

Assessment and Evaluation

7. Use technology to locate, evaluate and collect information from a variety of sources. (NETS I, IV, V)
8. Use technology tools to process data and report results. (NETS I, III, IV, V)

No opportunity I am aware but do I am literate and I will integrate I am able for exposure not plan to use will integrate some this in my practice of the indicators teaching others

9. Evaluate and select new information resources and technological innovations based on their appropriateness to specific tasks. (NETS I, III, IV, V)

No opportunity I am aware but do I am literate and I will integrate I am able for exposure not plan to use will integrate some this in my practice of the indicators teaching others

Productivity and Professional Practice

10. Collaborate in constructing technology-enhanced models, preparing publications, and producing other creative works using productivity tools. (NETS I, V)

No opportunity I am aware but do I am literate and I will integrate I am able for exposure not plan to use will integrate some this in my practice of the indicators teaching others

11. Observe and experience the use of technology in their major field of study. (NETS III, V)

No opportunity I am aware but do I am literate and I will integrate I am able for exposure not plan to use will integrate some this in my practice of the indicators teaching others

12. Use technology tools and resources for managing and communicating information (e.g., finances, schedules, addresses, purchases, correspondence) (NETS I, V)
13. Use a variety of media and formats, including telecommunications to collaborate, publish, and interact with peers, experts, and other audiences. (NETS I, V)

No opportunity I am aware but do I am literate and I will integrate I am able for exposure not plan to use will integrate some this into my practice teaching others

14. Exhibit positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity. (NETS V, VI)

No opportunity I am aware but do I am literate and I will integrate I am able for exposure not plan to use will integrate some this into my practice teaching others

Social, Ethical, Legal and Human Issues

15. Demonstrate an understanding of the legal, ethical, cultural and societal issues related to technology. (NETS VI)

No opportunity I am aware but do I am literate and I will integrate I am able for exposure not plan to use will integrate some this into my practice teaching others

16. Discuss diversity issues related to electronic media. (NETS I, VI)

No opportunity I am aware but do I am literate and I will integrate I am able for exposure not plan to use will integrate some this into my practice teaching others

17. Discuss the health and safety issues related to technology use. (NETS VI)
| No opportunity | I am aware but do not plan to use | I am literate and will integrate some of this into my practice of the indicators | I am able to teach others |
Appendix C

EDT 3470 Online Zoomerang End-of-course Evaluation
1

I agree that the information from this survey may be used for research purposes.

[ ] YES [ ] NO

2

Which lab instructor were you assigned to:

[ ] Sharon Peterson
[ ] Bob Leneway
[ ] Shawn Knaack
[ ] Kelsey Woodard
[ ] Mark Raffler
What is your current class standing

- Junior
- Senior
- Other, Please Specify
a) The Teaching and Learning with Technology by Lever-Duffy, McDonald, and Mizell textbook was of value to my learning experience.

b) Use of online instructional support materials ie. ProfilerPRO, TaskStream, etc were helpful to the learning experience.

c) Access to an online class web site was helpful.

d) The availability of the Intel Teach to the Future workbook and CD were helpful to my understanding of course work.

e) The availability of an instructor for Friday afternoon labs was helpful.
The following individual assignments were valuable learning experiences and should be continued as part of this course:

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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>Strongly Disagree</td>
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<tr>
<td>Disagree</td>
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<tr>
<td>No Opinion/Neutral</td>
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<tr>
<td>Agree</td>
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<tr>
<td>Strongly Agree</td>
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</table>

ProfilerPRO

Use of WebCT

Use of KidPix

Use of TaskStream for Lesson Planning

Online Quiz Assignments
The Kids Domain Web Assignment

PowerPoint

Excel

Publisher

Inspiration

Dreamweaver

Creating a Electronic Portfolio
<table>
<thead>
<tr>
<th>Question</th>
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<tr>
<td>Midterm Exam</td>
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<td>MS Publisher</td>
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<td>I-Webfolio</td>
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<tr>
<td>Final Collaborative Project</td>
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</table>

**BENEFIT DERIVED FROM COURSE:**


a) The course increased my interest in the subject

| 1 | 2 | 3 | 4 | 5 |
b) The lab experience added to my learning in this course.

1 2 3 4 5

c) The lecture experience added to my learning in this course.

1 2 3 4 5

d) I am now confident that I understand how technology can successfully be used to support student learning.

1 2 3 4 5

e) I am now confident that I will personally use technology as a tool to enhance my students' learning.

1 2 3 4 5

f) This course provided me with the skills needed to continue updating my electronic portfolio after this class has ended.

1 2 3 4 5

g) Overall, the course and instructors met my expectations

1 2 3 4 5
Prior to taking this course, when you had problems using technology, how often did you use each of the following strategies to help solve such problems?

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<th>2</th>
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<tr>
<td>Never</td>
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<td>Not very often</td>
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<tr>
<td>Often</td>
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<tr>
<td>Most of the time</td>
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<tr>
<td>Always</td>
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</table>

a) Waiting for instructor’s assistance

[ ] [ ] [ ] [ ] [ ]

b) Finding out the answer from a peer/other person

[ ] [ ] [ ] [ ] [ ]

c) Discovering the answer through trial and error on your own

[ ] [ ] [ ] [ ] [ ]

d) Discovering the answer by further reading

[ ] [ ] [ ] [ ] [ ]
While taking this course, when you had problems using technology, how often did you use each of the following strategies to help solve such problems?

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<tr>
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<td>Never</td>
<td>Not very often</td>
<td>Often</td>
<td>Most of the time</td>
<td>Always</td>
</tr>
</tbody>
</table>

a) Waiting for instructor's assistance

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</table>

b) Finding out the answer from a peer/other person

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</table>

c) Discovering the answer through trial and error on your own

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d) Discovering the answer by further reading

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</table>

To complete the following technology tasks, what primary problem-solving strategy did you use for each? (select only one per each task)
<table>
<thead>
<tr>
<th></th>
<th>Waiting for instructor assistance</th>
<th>Finding answer from peer/other person</th>
<th>Trial and error on your own</th>
<th>Further reading</th>
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<tbody>
<tr>
<td>a)</td>
<td>Getting interactive PowerPoint to work properly.</td>
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<td></td>
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<td></td>
<td>1</td>
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<td>b)</td>
<td>Inserting images into movie.</td>
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<td>c)</td>
<td>Exporting slide show into Movie.</td>
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<td>d)</td>
<td>Managing (defining) site.</td>
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<td>e)</td>
<td>Getting images to show up on web site.</td>
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<td>f)</td>
<td>Getting attachments to show up on web site.</td>
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</table>
g) Sending files to server for web site.

h) Retrieving files from server for web site.

i) Linking to external sites properly.

j) Linking to internal pages properly.

k) Creating “hot links” in Word documents.

l) Adjusting the content areas in Publisher to meet requirements.
I plan to continue to update my electronic portfolio after this class.

<table>
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<th>Definitely Not</th>
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<th>Definitely Yes</th>
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11

Comments about the lecture portion of the course?

12

What was the most valuable part of the course.
13

What would you like to see improved in the course.

14

Please estimate how much total time outside of class you spend working on course assignments.

- Less than 10 hours outside of regular lab time
- 10 to 30 hours
- 31 to 50 hours
- 51 to 80 hours
- 81 to 100 hours
- More than 100 hours outside of regular lab time
Other, Please Specify
Appendix D

HSIRB Letters of Approval
Date: February 11, 2010

To: Louann Bierlein-Palmer, Principal Investigator
    Sharon Peterson, Student Investigator for dissertation

From: Amy Naugle, Ph.D., Chair

Re: HSIRB Project Number: 10-02-17

This letter will serve as confirmation that your research project titled "Facilitating Pre-service Teachers' Competence in Integrating Technology into Teaching: A Study of Two Course Approaches" has been approved under the exempt category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note that you may only conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: February 11, 2011
Date: May 12, 2010

To: Louann Bierlein-Palmer, Principal Investigator
   Sharon Peterson, Student Investigator for dissertation

From: Amy Naugle, Ph.D., Chair

Re: HSIRB Project Number: 10-02-17

This letter will serve as confirmation that the changes to your research project now titled "Assessing Problem Solving Strategy Differences within Online and Face-to-Face Courses and their Relationship to Pre-service Teachers' Competence and Confidence for Integrating Technology into Teaching" requested in your memo dated 2/12/2010 (change title as above, add data from Spring 2008 through Fall 2009; increase total subjects to 1500) have been approved by the Human Subjects Institutional Review Board.

The conditions and the duration of this approval are specified in the Policies of Western Michigan University.

Please note that you may only conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: February 11, 2011