Preservice teachers' preconceptions about the role of the computer in learning and teaching

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Preservice teachers' preconceptions about the role
of the computer in learning and teaching

by

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Signatures have been redacted for privacy
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ABSTRACT

The purpose of this research study was to examine preservice teachers' preconceptions of the role of the computer in learning and teaching and the factors effecting those preconceptions. During the 1997 fall semester, 279 preservice teachers in an introductory instructional technology course were given the three survey instruments. The instruments were designed to gather data about the subjects' background, experience with computers, attitudes toward computers, attitudes toward computers in education, computer proficiency, beliefs about effective computer use, and epistemological beliefs.

The results of this research study revealed several factors that significantly effected preservice teachers' ability to conceptualize advanced ways of using the computer in the classroom such as: computer attitudes, computer proficiency, and beliefs about knowledge acquisition. The results have interesting implications for all aspects of teacher education, particularly the development of preservice teachers' beliefs about teaching, learning, and computer use in education.

Knowledge of preservice teachers' existing attitudes and beliefs about teaching, learning, and computers, affords teacher educators the opportunity to design and implement instruction that will help preservice teachers to develop more comprehensive conceptions of the role of the computer in the classroom.
CHAPTER I. INTRODUCTION

Computers have become commonplace in our personal as well as our professional lives (Naisbitt, 1984). We come across computers in the grocery store, the bank, our vehicles, our homes and our schools. Computers have made many of our everyday tasks easier and faster and made our society, as a whole, more productive (Roberts & Ferris, 1997).

..., education will be every citizen's most prized possession. Our schools will have the highest standards in the world, igniting the spark of possibility in the eyes of every girl and boy. And the doors of education will be open to all. The knowledge and power of the Information Age will be within reach of not just a few, but of every classroom, every library, every child (Clinton, 1997).

National initiatives to place the "power of the information age" in every classroom appear to focus on the hardware and overlook a very important set of variables: the classroom teacher and the teacher's attitudes about and preconceptions of effective uses of computers in the classroom (Becker, 1986; Byrum & Cashman, 1993). In this research study, preservice teachers' preconceptions about the role of the computer in learning and teaching were investigated.

The purpose of this chapter is to provide an overview of this research study. It consists of seven sections: background, statement of the problem,
purpose of the study, research questions, assumptions, limitations of the study, and definition of terms.

Background

“We are at the point in the history of education when radical change is possible, and the possibility for that change is directly related to computers” (Papert, 1980). This pronouncement by Papert was one of the many made by educators who recognized the potential of computers to change learning and teaching. In so doing, they drew attention to the computer and ignored other factors that would impact the computer’s potential in education. The key factor in influencing the use of the computer in the classroom is the teacher (Papert, 1993; Byrum & Cashman, 1993); more specifically, the teacher’s beliefs about knowledge acquisition (Dupagne & Krendl, 1992; Hannafin & Freeman, 1995; Moar & Taylor, 1995), attitudes toward computers (Byrum & Cashman, 1993; Koohang, 1987) and experiences with computers determine how the teacher will use the computer with his/her students (Byrum & Cashman, 1993; Chiou, 1995; Clement, 1981; Davidson & Ritchie, 1994; Koohang, 1987).

Pedagogical Theories

Computers in education are part of the larger instructional context in which they exist. Thus, it is important to consider the instructional theories that are dominant in today’s classrooms because they influence how
Computers are incorporated into the larger instructional context. Pedagogy refers to the art or science of teaching (Ferguson, 1995). Growing disagreements among learning theorists have centered around which teaching strategies are most effective in today's technological classroom. This controversy has inspired the growth of two very different views about teaching and learning (Jonassen & Duffy, 1992). One view, behaviorism, is grounded in systematic, teacher-directed, instruction (Evans & Nation, 1996; Wallace, 1996; Gagne, 1985). The other, constructivism, is based on student-centered knowledge construction (Perkins, 1992; Bransford, Franks, Vye & Sherwood, 1989; Bruner, 1973).

When teaching within a behaviorist framework, instruction is teacher-directed, student objectives are clearly stated and tested, and traditional teaching and assessment methods are emphasized (i.e. lectures, worksheets, tests). Behaviorists believe that students learn through stimulus and response actions. The teacher creates an environment where the students are shown how to complete a task, then students are asked to complete the task using the manner in which they were shown (Burden & Byrd, 1994; Jonassen & Duffy, 1992).

In the constructivist classroom, learning occurs when the student creates his/her own knowledge. The teacher attempts to create an environment in which students develop their own understanding and meaning of concepts through experimentation and active engagement.
Constructivists believe that students are self-motivated and learn through real-life experiences; these experiences help them to construct their own knowledge (Burden & Byrd, 1994; Jonassen & Duffy, 1992). Research shows that teachers’ use of pedagogical theories (i.e., behaviorism, constructivism) are based upon their beliefs and attitudes about knowledge acquisition (Dupagne & Krendl, 1992; Pope & Gilbert, 1983; Tobin, 1990).

Teacher Attitudes and Beliefs About Knowledge Acquisition

Teachers’ beliefs about knowledge acquisition influence their instructional practices and their conceptions of the role of the computer in learning and teaching (Hannafin and Freeman, 1995). Dupagne and Krendl (1992) noted that many educators tend to teach in an objectivist or behaviorist manner in which knowledge is acquired as a result of information being given to the learner. Moreover, teachers who believe knowledge is acquired in a behavioristic perspective tend to use the computer for reinforcement or reward (Hannafin and Freeman, 1995). In contrast, for teachers who believe that knowledge is the product of each students’ experiences and construction, the interactive nature of the computer further enables them to design environments for students to create knowledge. A teacher’s tendency to see students as passive beneficiaries (or active builders) of knowledge may undermine (or enable) their willingness to use the computer for anything other than reinforcement or information recall (Hannafin & Freeman, 1995).
Unger, Draper and Pendergrass (1986) investigated students' beliefs about knowledge acquisition from a world view and categorized their results into two positions: students who held beliefs in the social constructionist position (SC) and students who held beliefs in the logical positivist position (LP). Unger et al. (1986) found that many epistemological beliefs are rooted in life experience, and that many students, due to their epistemological beliefs, would not enroll in courses that were inconsistent with their beliefs (Unger, 1989). The results of Unger et al. suggest that, an adherence to one epistemological belief over another may effect a preservice teachers' preconceptions about and cognitive development in the area of computer use for learning and teaching.

Computers in the Classroom

The rapid diffusion of computers into K-12 schools prompted many educators and researchers to develop models describing how to use computers in the classroom. Educational futurist, Chris Dede (1987) predicted that educational programs would be based upon cognition enhancers that would enable students to extend their cognitive powers. Dede (1987) suggested that three types of cognition enhancers would emerge in educational computer applications: empowering environments, hypermedia and microworlds.
Empowering environments are computer tool applications designed to simplify general tasks enabling users to focus on building higher level thinking skills. Tool software such as word processors and spreadsheets are examples of empowering environments. Dede defined hypermedia as applications that use a non-linear representation of information. Dede suggested that information portrayed in this manner were realistic extensions of the human mind. Applications such as these often contain audio, video and text-based media under the direct control of the user. Finally, computer microworlds help students expand their experiences and cognition through the use of artificial realities (Dede, 1987). Using microworlds, students experience and explore worlds formerly not available in classrooms. A flight simulator, that simulates flying a plane through the use of a computer is an example of a microworld.

Taylor (1980) proposed a categorization system for computers in education where the computer’s role is that of a tutor, a tool, or a tutee. When using the computer as a tutor, the computer is programmed by an expert and the student is then taught or tutored by the computer. A keyboarding program is an example of tutoring software in which the learner is asked to retype words that appear on the screen. The computer keeps a tally of the answers and prompts the student to repeat the task until a predetermined number of correct answers is reached. When the computer functions as a tool, it is programmed to assist with menial tasks. For example,
a word processor allows a student to write without being concerned with correct spelling or grammar through the use of a spelling or grammar checker. Finally, when the computer is used as a tutee, the student teaches the computer. For the student to teach the computer, the student must learn a language that the computer understands. In effect, the student uses a programming language to teach the computer. Taylor proposed that learners gain new insights into their own thinking through learning to program (1980). “Extended use of the computer as a tutee can shift the focus of education in the classroom from end product to process, from acquiring facts to manipulating them” (Taylor, 1980, p.4). Further articulating the educational benefits of students teaching computers, Papert (1980) argued that by showing the computer how to think, the students begin to inquire about how they themselves think; in a way, the students create their own knowledge. Papert (1980) described the role of the teacher and the computer as tools in facilitating the production of intellectual structures.

The early focus of the educational computing community on the features of software applications caused Thomas and Boysen (1984) to theorize about a classification system in which they contended that the categorization of software was insufficient. Thomas and Boysen (1984) argued that “since student learning is the ultimate purpose in utilizing computers for instruction, a taxonomy should focus on the needs of the learner. It should provide guidance for the development of lessons and their instructional use”
Thomas and Boysen proposed a taxonomy for computer use in the classroom where the classifying variable was the state of the student with respect to the knowledge being acquired. That is, the role of the computer in instruction was contingent on the students' level of knowledge of the topic being taught. The Thomas and Boysen Taxonomy consisted of five categories: experiencing, informing, reinforcing, integrating and utilizing.

When a new topic is introduced, the student generally has little knowledge of the concepts. The role of the computer at this level is experiencing. The computer helps set the stage for the concepts to be taught and serves as a catalyst for future learning. When using the computer in an informing manner, the student is prepared to receive formal instruction about the topic of study. As such, the computer helps to supplement or replace the textbook and support the initial introduction to a topic. The computer also can be used by the learner to acquire information. When using the computer for reinforcing, the computer helps the learner to strengthen knowledge that has already been acquired. This level is similar to Taylor's (1980) tutor example in that, the student works with the computer to practice and build on concepts that have already been taught to the student by the instructor. At the integrating level, the learner is linking previously unrelated ideas to form new knowledge. In so doing, the computer is used to help make the connections. Also, at the integrating level, students may connect classroom knowledge with real world situations to solve problems.
For example the student can work with a program in which the user is asked to sell pizza. Through the use of this program, the student needs to consider sale prices (i.e. percentages) and slices or portions of pizza (i.e., fractions). At the utilizing level the computer functions as a tool to build, organize, and make students' previously learned knowledge concrete. That is, tool software such as databases and word processors can be used to eliminate menial tasks and allow the student to concentrate on the context and the quality of the finished product (e.g., the arguments presented in the term paper), not the process in which they arrived there (e.g., spelling, punctuation, etc.) (Thomas & Boysen, 1984).

The existence of paradigms that help teachers decide how to incorporate computers into the teaching and learning process will not cause teachers to use computers in the classroom. Furthermore, such paradigms will not change a teachers' attitudes and beliefs about how to use computers effectively to bring about learning. Teachers' attitudes and beliefs toward computer use in the classroom significantly influence how computers are used (Chiou, 1995).

Inservice and Preservice Teachers' Beliefs and Attitudes Toward Computers in the Classroom

Several researchers have investigated teachers' beliefs about computer use in the classroom (Chin & Horton, 1995; Cumming, 1988-89; Davidson &
Ritchie, 1994; Dupagne & Krendl, 1992; Kerr, 1991; Koohang, 1987; Stevens, 1980). Teachers’ beliefs tend to effect how they use the computer in the classroom (Chiou, 1995, Hannafin & Freeman, 1995). Although many teachers advocate the use of computers in education, this endorsement is given only after they have had experience with or formal instruction about computers and computer use in education (Dupagne & Krendl, 1992). Computer experience often fosters positive attitudes toward computers; moreover, lack of training accounts for teachers’ low confidence level when they initiate computer activities (Dupagne & Krendl, 1992; Koohang, 1987). This lack of computer training often results in high anxiety about computer use in the classroom. The high levels of anxiety can lead to negative attitudes about computers and eventually negatively influence the use of computers in the learning process (Koohang, 1987).

Dupagne and Krendl (1992) reported that many teachers were skeptical about the value of computers in education. This skepticism related to hostility, fear and uncertainty about how to use computers (Chin & Horton, 1995). Davidson and Ritchie (1994) found that teachers were concerned about the impact computers would have on their role in the classroom; moreover, many teachers were concerned that they might have to compete with computers in the classroom. In addition, Davidson and Ritchie (1994) reported that educators believed teaching would be more complex with computers.
While some teachers viewed the computer as a valuable tool for enhancing student learning, Bosch (1993) found that many teachers viewed the computer as a subject to be taught in a separate class; and if the computer was taught in a computer class, many teachers believed it did not need to be used in their class. In addition, teachers thought that there was not enough time for students to carry out computer activities in the content classrooms (Bosch, 1993; Dupagne & Krendl, 1992). Kerr (1991) stated that educators tended to see themselves as teachers first and as users of educational technology a distant second. Kerr (1991) also noted that teachers have many noncurricular activities to be concerned with before they can integrate technology into the classroom. Many teachers stated they had to learn how to use the computer before they could try to integrate it (Kerr, 1991).

Background Summary

The key factor in influencing the use of the computer in the classroom is the teacher (Thompson, 1989). Specifically, the teachers’ beliefs about knowledge acquisition (Moar & Taylor, 1995), computer use in education, and their experiences with computers (Dupagne & Krendl, 1992; Koohang, 1987) determine how the teacher will use the computer with his/her students.

Currently, two instructional theories are prevalent in classrooms: behaviorism and constructivism (Jonassen & Duffy, 1992). Behaviorism is grounded in systematic, teacher-directed, instruction (Evans & Nation, 1996;

Dupagne and Krendl (1992) found that teachers' use of pedagogical theories was based upon their beliefs about knowledge acquisition. An adherence to one epistemological perspective over another tends to effect a teacher's choice of how to use the computer in the classroom (Moar & Taylor, 1995). In the field of instructional technology, there are several models describing how to use computers in the classroom; yet the use of computers by teachers is contingent, in part, upon their beliefs about knowledge acquisition (Dupagne & Krendl, 1992), attitudes towards computers, and their experience with computers (Chiou, 1995; Clement, 1981; Davidson & Ritchie, 1994).

Statement of the Problem

Current interest in the area of educational computing in the classroom centers around why some teachers do not and some teachers do use computers (Hannafin & Freeman, 1995). It is evident that computers are here to stay, whether used by educators or not. Because preservice teachers play a major role in the future of education, it is important to understand preservice teachers' preconceptions about how computer technologies impact student learning (Darling-Hammond, 1996). Little research exists that explores
preservice teachers' preconceptions about the role of computers in the classroom. Moreover, understanding preservice teachers' preconceptions about the role of the computer in the classroom may enable teacher educators to design and implement instruction that will assist preservice teachers to develop more complete and comprehensive conceptions about computers in the classroom.

Purpose of the Study

The purpose of this study was to investigate preservice teachers' preconceptions about the role of the computer in learning and teaching and to identify and examine factors that effect preservice teachers' preconceptions of computer use in the classroom.

Research Questions

1. What category of the Thomas and Boysen Taxonomy will be most representative of the preservice teachers' preconceptions about computer use in education?

2. Will preservice teachers with high computer proficiency scores conceptualize more advanced ways of using the computer in the classroom?
3. Will preservice teachers with high epistemology scores (social constructionist or constructivist perspectives) conceptualize more advanced ways of using the computer in the classroom?

4. Will preservice teachers with low computer attitude scores be able to conceptualize more advanced ways of using the computer in the classroom?

Assumptions

Several assumptions were made by the researcher for this study. The first assumption was that the data collection instruments would accurately elicit the subjects’ preconceptions. Second, it was assumed that the subjects had the capacity to clearly and consistently express their preconceptions.

Limitations of the Study

The subjects for this study were Iowa State University undergraduate students. Because the majority of Iowa State University students are midwestern natives, their K-12 educational experience is based on midwestern values; this may cause the results to be less generalizable to the national preservice teacher population. Undergraduate students’ experience and knowledge of educational disciplines and the field of education in general may be a limitation as well.
Finally, the taxonomy upon which part of the data collection instrument was based was also a limitation. The Thomas and Boysen Taxonomy contains five categories. The items in the data collection instrument were configured around these categories, thus limiting the range of responses from which the subjects had to choose. The researcher believed that the Thomas and Boysen Taxonomy implies two general levels of computer use in the classroom: simplistic and advanced. The researcher interpreted reinforcing and informing as simplistic levels and experiencing, integrating, and utilizing as advanced levels of computer use in the classroom.

**Definition of Terms**

*Advanced ways of using the computer in education* - Experiencing, integrating and utilizing levels of the Thomas and Boysen Taxonomy.

*Computer-Related Technology* - Constantly evolving forms of computers, peripherals and supporting software used to enhance learning (Schmidt, 1991).

*Preconception* - An idea or opinion formed in advance of or prior to formal instruction.

*Simplistic ways of using the computer in education* - Reinforcing and informing levels of the Thomas and Boysen Taxonomy.
Thomas and Boysen Taxonomy- A classification of computer use in the classroom, consisting of five categories: experiencing, informing, reinforcing, integrating, and utilizing.
CHAPTER II LITERATURE REVIEW

Teachers’ use of the computer in the classroom is driven by many underlying attitudes and beliefs. The purpose of this chapter is to provide a review of the research literature in which factors that influence computer use in the classroom were discussed. This chapter consists of five sections: pedagogical theories; teacher attitudes and beliefs about knowledge acquisition; computer use in the classroom; inservice and preservice teacher attitudes and beliefs about computers in the classroom; conceptions and preconceptions; and summary.

"We are at the onset of a major revolution in education, a revolution unparalleled since the invention of the printing press. The computer will be the instrument of this revolution.... By the year 2000 the major way of learning at all levels, and in almost all subject areas will be through the interactive use of computers" (Bork, 1979). As predicted by Naisbitt (1984) and others, computers are commonplace in all facets of today’s society, including schools. The Office of Technology Assessment (1995) reported that a 1:9 ratio of computers to students existed in U. S. schools. Ongoing advances with computer technology have resulted in an increased number of powerful computers in schools; however, the revolution Bork (1979) and others predicted has yet to be realized. Clearly, the mere presence of powerful computer-related technologies in K-12 schools has not resulted in a dramatic
transformation in learning and teaching. This lack of transformation in K-12 classrooms is due, in part, to the lack of attention paid to classroom teachers (Thompson, 1989). The key factor influencing the use of the computer in the classroom is the teacher (Byrum & Cashman, 1995; Cuban, 1984; Thompson, 1989). Specifically, the teacher’s beliefs about knowledge acquisition (Moar & Taylor, 1995), computer use in education, and experiences with computers (Dupagne & Krendl, 1992; Koohang, 1987) determine how the teacher will use the computer with his/her students.

Pedagogical Theories

Pedagogy refers to the art or science of teaching (Ferguson, 1995). Pedagogy incorporates many instructional theories based on decades of psychological research on human cognition including: behavior, memory storage and recall processes, and stages of mental development and growth (Burden & Byrd, 1994). Today in the field of education, there are two dominant instructional theories to which teachers subscribe (Jonassen & Duffy, 1992). One view, behaviorism, is grounded in systematic, teacher-directed instruction (Evans & Nation, 1996; Wallace, 1996; Gagne, 1985). The other, constructivism, is based on student-centered knowledge construction (Burden & Byrd, 1994; Bransford, Franks, Vye & Sherwood, 1989; Bruner, 1973; Perkins, 1992).
Behaviorism is based on the principle that instruction should be designed to produce measurable, observable and quantifiable behaviors in the learner (Burden & Byrd, 1994). Skinner (1968) generated much of the data that serves as the basis of behaviorism. Skinner and other behavior learning theorists believed that the student's mind is a blank slate and that learning could be accomplished through cause and effect relationships. According to behaviorists, the teacher is viewed as an expert whose task is to modify the student's mind. This is achieved by creating environments where the students are shown how to complete a task and then asked to exhibit the completion of the task in the same manner they were taught (Burden & Byrd, 1994).

In the behaviorist model, students are given information, the information is then reinforced or practiced through the use of worksheets or other instructional practices. The student is then tested on the information previously given resulting in a measurable outcome (Burden & Byrd, 1994; Jonassen & Duffy, 1992). After this process, the students are prepared to receive new information usually building on the previously learned skill (Gagne, 1985). In this manner, teachers can link low-level skills to higher-level skills helping students to form schema which, again, is ready to link new higher-level knowledge. According to behaviorism, the teacher can determine all the skills needed to meet a specific learning objective and
ensure that all students have learned each skill in a step-by-step manner (Skinner, 1968; Gagne, 1985).

Constructivism differs from behaviorism in that, constructivists believe that meaning and understanding are created by the individual, rather than existing independent of the individual (Jonassen, 1992). Moreover, experiences help the individual to construct their knowledge based on the principle that students are self-motivated and learn through real-life situations (Bruner, 1973; Dewey, 1938). Constructivist teaching strategies are grounded in several branches of cognitive science. According to Piaget (1972), there are four stages of cognitive development: sensorimotor, preoperational, concrete operational and formal operational. Piaget believed that children progress through each stage based on experiences they have in life in which they organize patterns of behavior grounded in what they have learned. Piaget added to this theory by noting that sometimes children adapt new experiences to their existing schemes or patterns of behavior through processes he called assimilation and accommodation. Assimilation is the understanding of a new concept by comparing and changing it so it is easily incorporated with previously learned concepts (Piaget, 1972). Accommodation is an act, in which old concepts are radically changed and replaced with new ones (Piaget, 1972).

When teaching in a constructivist framework, the teacher's responsibility is to provide an environment from which experiences are born,
deciphered, and grow in the student’s mind (Bruner, 1973). In this manner, students construct knowledge themselves instead of receiving it from teachers. In a constructivist classroom, students may work in cooperative learning groups and work on projects that require solutions to problems (Cognition and Technology Group at Vanderbilt, 1990). Moreover, in constructivist environments, the teacher acts as a facilitator and guides the self-motivated students to set their own goals and in effect, teach themselves (Papert, 1980).

The differences between constructivist and behaviorist instructional theories stem from underlying epistemologies. That is, instructors tend to teach using one model over the other dependent upon how they believe knowledge is acquired (Dupagne & Krendl, 1992). Behaviorists tend to believe that learning occurs when information is transmitted or given to the learner. Constructivists tend to believe that learning occurs when a learner constructs knowledge based on his or her background, experiences, and previously learned concepts (Willis, 1995).

Teacher Attitudes And Beliefs About Knowledge Acquisition

Children’s beliefs about knowledge are first influenced by their parents (Schommer, 1993). Once the child enters school, that influence is shared by the teacher. If the teacher feeds information to the child like food then the child might grow to believe that knowledge is acquired from an expert who
transfers the knowledge (Anderson, 1984; Schommer, 1993). As the child progresses through elementary and secondary school and on to college, his or her personal epistemological beliefs may lead them to enroll in and complete courses that are consistent with their view of knowledge. Thus, the teacher and the courses in which the student enrolls tend to reinforce and somewhat strengthen his/her epistemological beliefs (Unger, Draper & Pendergrass, 1986).

Buss (1975; 1978) argued that psychology, as a discipline, has shifted back and forth between two basic world views: (1) reality constructs the person and (2) the person constructs reality. These two views are based upon the relationship between individuals and the forces that shape them (i.e., society). Buss (1975) defined world view as a set of implicit causal relationships shared across apparently disparate conceptual domains. Based on Buss’s research, Unger, Draper and Pendergrass (1986) investigated college students’ beliefs about knowledge acquisition from a world view. This was accomplished through the use of the Attitudes About Reality scale (AAR).

The AAR scale was designed to assess students’ epistemological beliefs using a continuum that ranged from those who held beliefs in the social constructionist position (SC) to those who held beliefs in the logical positivist position (LP). The lowest possible score on the scale would represent an extreme positivist or behaviorist perspective in which the subject “… would believe in some form of universal truth, in the importance and validity of
external authority, in the existence and value of objectivity, and in the possibility of determining material causal relationships” (Unger, 1996 p. 168).

In addition, Unger (1996) suggested that positivist individuals tended to support the social status quo and believed that science works well and can solve all society’s problems. In contrast, the highest possible score on the scale represented an extreme constructionist or constructivist perspective in which the subject “… would believe in the relative nature of truths, concern for subjectivity, focus on the individual as a source of authenticity and authority, and acknowledgment of the role played by chance in the determination of events” (Unger, 1996 p. 169). Unger (1996) also suggested that constructionists preferred environmental explanations over biological ones and were sympathetic towards efforts to create social change.

The 40 items in the AAR scale, were developed through an examination of research about knowledge acquisition and discussions with social activist scholars who appeared to support the social constructionist viewpoint (Unger, 1984). Unger, et al. (1986) argued that subjects with extremely low scores on the scale would support the logical positivist (i.e., behaviorist) perspective and would:

1. show a predominant tendency to concur with statements that indicate reality is stable, irreversible, and deterministic;

2. concur with statements indicating biological or intraphysical (rather than environmental) causality;
3. believe in individualistic rather than social determination of power and status;
4. demonstrate a general acceptance of the status quo; and
5. believe that science as an aspect of society works well and that success is a result of merit (p.71).

Subjects whose scores were at the extreme high end of the scale would support the social constructionist (i.e., constructivist) position and would:

1. show a predominant tendency to concur with statements that indicate reality is changeable and largely a matter of cultural and historical definition;
2. believe in environmental causality of many social problems;
3. see control by factors outside oneself as an important dynamic in the way society works;
4. be less content with the status quo and less likely to view negatively individual efforts toward social change; and,
5. not be convinced that meritocracy works in science as well as in other aspects of society (Unger et al., 1986, p. 71).

Similar to Hannafin and Freeman (1995), in this research, the terms constructionism and constructivism were used interchangeably. Papert (1993) discussed constructionism from an instructional perspective inherently incorporating epistemological characteristics. In that, the goal when teaching in a constructionist manner is to "teach in such a way as to produce the most
learning for the least teaching” (Papert, 1993 p. 139). This style of instruction, similar to constructivism, results in the student constructing his or her own understanding and knowledge through discovery. This codifies the traditional, behaviorist, style of teaching. In that the student is not fed the knowledge, but assisted in learning how to build knowledge.

Many teachers tend to believe that students learn best through knowledge transmission. That is, knowledge and information are transmitted from the instructor to the student; thus, resulting in many instructors teaching in a behaviorist manner (Dupagne & Krendl, 1992). Moreover, an examination of pedagogical theories and beliefs about knowledge acquisition indicate that learning and teaching are reciprocal. A child who grows up in a behaviorist world with teachers who reinforce logical positivist beliefs becomes a teacher who delivers information to students in a behavioristic manner and strengthens his or her behavioral beliefs about knowledge acquisition (Unger, 1996; 1983). In contrast, if more instructors were to teach in a constructivist manner, learning would be in the hands of the student and would grow and expand differently with each child.

Computer Use In The Classroom

With the emergence of computers in the schools, several models have been developed that describe or prescribe how the computer should be used in the classroom. Many of these models described how instructional theories,
epistemologies and the computer can be used to enhance student learning. In this section, several models that describe how the computer should be used in instruction are discussed. The models discussed are: Empowering Environments (Dede, 1987), Tutor, Tool, Tutee (Taylor, 1980), Perkins five facets of a learning environment (1992), and the Thomas and Boysen Taxonomy of Educational Uses of the Computer (Thomas & Boysen, 1984).

In an article projecting the future of educational computing, Dede (1987) predicted that educational programs would be based on cognition enhancers that enable students to extend their cognitive powers. Dede’s categories of cognition enhancers focused on defining and categorizing different types of software and their potential in education. “The concept of cognition enhancers is that the complementary cognitive strengths of a person and an information technology can be used in partnership” (Dede, 1987, p. 21). That is, a person’s use of real world experiences and metacognitive skills coupled with the computer’s algorithmic and memory capabilities could enhance the user’s thinking and problem solving skills. Dede predicted the emergence of three types of cognition enhancers: empowering environments, hypermedia and microworlds.

Empowering environments are computer tool applications designed to simplify general tasks so students can focus on building higher level thinking skills (Dede, 1987). Tool software such as word processors and spreadsheets are examples of empowering environments. The computer, as an
empowering environment, helps the student by eliminating routine tasks and allowing the student to concentrate on higher order meanings. For example, having a student use a word processor to write a paper allows the student to concentrate on conveying content by eleviating concerns about menial tasks such as rewriting, spelling, and editing.

Dede (1987) defined hypermedia as applications that use a non-linear representation of text, graphics and images on the computer. Dede suggested that information portrayed in this manner could be viewed as realistic extensions of the human mind. Dede argued that hypermedia offered new methods of structured discovery, addressed varied learning styles, motivated students, and allowed teachers to present information as a web of interconnections rather than a stream of facts. Hypermedia applications often contain audio, video and text-based media directly controlled by the student.

Through the use of computer microworlds, Dede (1987) suggested that students could expand their experiences and cognition by using artificial realities. Microworlds can be defined as any simulation in which the user has the capabilities of exploring and manipulating the environment (Dede, 1987). Using microworlds, students experience and explore worlds formerly not available in classrooms. A flight simulator is an example of a microworld. The use of microworlds can help students connect abstract knowledge to real world situations by creating virtual environments where students can test theories and hypotheses that without a computer could not be done.
Prior to Dede’s cognition enhancers, Taylor (1980) proposed a classification system that suggested how the computer could function in education instead of enhance education. Taylor’s categorization defined three roles for the computer in education: computer as a tutor, a tool, and a tutee.

When the computer functions as a tutor, it presents subject matter to the student, and then prompts the student to respond; the student responds, the computer evaluates the student’s response and determines what information to present to the student next. In this manner, the student is tutored or taught by the computer. Most tutorial programs are based upon behaviorist instructional design models and theories in that, the student is given information via the computer, then tested on the same information, resulting in a quantifiable outcome (Perkins, 1992).

According to Taylor, when functioning as a tool, computer programs, such as word processors and spreadsheets, allow the student to be less concerned with menial tasks and more concerned with the content of the final product. Also when using the computer as a tool the student can be more expedient in finishing class work (Taylor, 1980).

Lastly, Taylor defined the role of the computer in education as that of a tutee. At the tutee level, the student tutors or teaches the computer. To teach the computer, the student must learn a language that the computer understands. Taylor (1980) noted several educational benefits in using the computer as a tutee. First, for the student to teach the computer, he or she
must first understand it. Second, when teaching the computer, the student learns how the computer works and the workings of his or her own thinking. Finally, Taylor noted that expensive software was not needed, nor was time spent searching for the software or money to acquire it. "Learners gain new insights into their own thinking through learning to program.... As a result, extended use of the computer as a tutee can shift the focus of education in the classroom from end product to process, from acquiring facts to manipulating them" (Taylor, 1980, p.4).

In an effort to define appropriate classroom uses of computers, Perkins (1992) looked at the basic features of a learning environment. Perkins concluded that classroom learning consists of five facets: information banks, symbol pads, construction kits, phenomenaria, and task managers. Perkins stated, these five facets "... provide a grid for describing how information processing technologies [computers] can figure into the instructional process" (1992, p. 46).

The first facet of Perkins' taxonomy is the information bank. The information bank in the classic classroom is the text. An information bank is any resource that serves as a source of explicit information about a topic (Perkins, 1992). This can be the classroom text, an encyclopedia, a dictionary, or the teacher. When using a computer, the task of acquiring information often is more accessible and faster than traditional information banks. In addition, with the use of telecommunication technologies, students can
connect to vast databases of information that would not ordinarily be available in the classroom.

The second facet that Perkins described was a symbol pad, which in a classic classroom is any surface used for the construction and manipulation of symbols. This device can be as simple as a notebook or as advanced as a laptop computer. Perkins (1992) explained that the symbol pad serves to support student’s short term memory in recording ideas, creating outlines and manipulating or formulating equations. Through the use of information technologies, such as word processors and drawing programs, students’ possibilities and capabilities can be expanded by allowing them to be less concerned with the process and more concerned with the product.

Construction kits can be any apparatus that is used to build something, such as Legos, Tinker Toys, and Erector Sets (Perkins, 1992). As the third facet, Perkins described these kits as environments for students to experiment with theories such as physics, mathematics, and science. With access to information technologies, students can explore, assemble, and experiment with more abstract objects such as numbers, commands in a programming language, or animals in a simulated world (Perkins, 1992).

“Part of many learning environments is what might be called a ‘phenomenarium,’ an area for the specific purpose of presenting phenomena and making them accessible to scrutiny and manipulation” (Perkins, 1992, p. 47). With the advent of computers, flexible resources for exploring and
manipulating phenomena exist. Students can use microworlds to explore the results of global warming or overpopulation. Sim City is an example of phenomenarium, in which the user manipulates the growth of a city and has to account for the problems that occur as a result of its growth.

The final facet of Perkins' taxonomy is the task manager. In the classic classroom the task manager consists of the process of completing a task and receiving feedback. It can be accomplished either through probing questions from the teacher, quizzes, tests, or exercises at the end of textbook chapters. Information technologies control for this through the use of tutorial programs, where the learner receives information and then is tested on that same information, similar to classic computer-aided instruction (Perkins, 1992).

Skeptical of the validity of the classification systems of the time, Thomas and Boysen created a system in which the classifying variable was the state of the learner with respect to the knowledge to be acquired. Thomas and Boysen argued that a classification of software would not suffice. "... since student learning is the ultimate purpose of utilizing computers for instruction, a taxonomy should focus on the needs of the learner. It should provide guidance for the development of lessons and their instructional use" (Thomas & Boysen, 1984, p. 15). The Thomas and Boysen Taxonomy consists of five categories: experiencing, informing, reinforcing, integrating and utilizing. Based on the student's knowledge with respect to the subject, each
of the five categories represents a step in the learning process starting with experiencing and ending with utilizing (Thomas & Boysen, 1984).

The first level of the Thomas and Boysen Taxonomy for Instructional Uses of the Computer is experiencing. The computer is used at this level because the student has little or no knowledge of the content being studied. Using the computer in an experiencing manner helps students gain an understanding of a new topic before it is formally introduced. Experiencing helps set the stage and serves as a catalyst for future learning. When choosing a program to be used in an experiencing manner, there are two important conditions upon which success depends: (1) the student should be able to relate to the program, and (2) the program should relate to important intellectual structures or attitudes (Thomas & Boysen, 1984). Experiential programs, such as simulations, can be used to prepare students for deeper understandings, because they allow students to experience worlds formerly unavailable to them in the classroom. Experiential programs should be used prior to formal instruction and serve as the foundation of future lessons (Thomas & Boysen, 1984; Hooper & Thomas, 1989; Hooper & Sugrue, 1991).

The second level of the Thomas and Boysen Taxonomy is informing. The computer is used at this level because the learner has some experience with the subject, but can benefit from acquiring more detailed information about the topic being studied. Thomas and Boysen suggested that when using the computer in an informing manner, the computer helps to supplement or
replace the textbook and support the initial formal introduction to a topic. Technological advances such as the internet and the World Wide Web can be used to collect information and fill the gaps between new knowledge and old.

The third level of the Thomas and Boysen Taxonomy is reinforcing. At this level the student has had experience with the topic, acquired at least the basic level of information about the topic, and is prepared to work with and practice the concepts involved in understanding the subject matter. Using the computer for reinforcing helps the learner to strengthen the knowledge that has already been acquired. An example of software used at this level is drill and practice, in which the user is given questions or exercises to complete. Reinforcing software often is designed to track the progress of the student and present harder questions when correct answers are given and easier questions when incorrect answers are given.

The fourth level of the Thomas and Boysen Taxonomy is integrating. At the integrating level, the learner is linking previously unrelated ideas to concepts that recently have been learned resulting in new and more expandable knowledge; in so doing, the computer can be used to help make these connections. Also at the integrating level, students may connect classroom knowledge with real world situations to solve problems. For example, the student can use a program such as Hot Dog Stand in which the user needs to make appropriate business choices (i.e., buying price, selling price, competition's prices) to make a profit and keep the business afloat.
Manipulating information in problem solving programs help the students to develop and add utility to their knowledge.

The final level of the Thomas and Taxonomy is utilizing. At this level the learner has gained a full conceptualization and understanding of the topic and is prepared to use this knowledge to acquire new and more advanced knowledge and experiences. Utilizing the computer as a tool helps to build, organize, and make student’s previously learned knowledge concrete. Tool software, such as databases and word processors, are programs that can be used at this level. Classroom use of these programs permits students to pay more attention to the subject being studied and to work with more complex assignments and problems. In addition, use of tool software also helps students gain computer literacy (Thomas & Boysen, 1984).

In the Thomas and Boysen Taxonomy, a single computer program can be used at many levels and in many different ways contingent upon the state of the student. If a program is used prior to formal instruction (experiencing), the student be introduced to the topic of study in preparation for forthcoming formal instruction. If the same computer program is used after formal instruction, the student will reinforce concepts learned during formal instruction. It is important to recognize that informing and reinforcing programs are usually based on behavioristic or teacher-directed instructional theories, whereas, experiencing, integrating and utilizing programs are learner-directed and constructivist-based. It is these, more advanced, student-
directed uses of the computer that force the student to hypothesize about the nature of the content being studied and ask “what if?”. Moreover, it is through learner-directed computer use that the highest levels of learning are achieved (Thomas & Boysen, 1984). “The computer is ‘cognitive plastic’, able to be formed in any manner we choose to assist us in our thinking” (Thomas & Boysen, 1984 p. 26).

The existence of instructional models for classroom computer use will not cause teachers to use computers in the classroom. There are many factors effecting the teachers’ use of computers in the classroom. The instructor’s epistemological beliefs effect pedagogical beliefs which determine how teachers teach. How teachers teach will, without question, effect how computers are used in the classroom. But, the underlying factor effecting how teachers use computers in the classroom is the teacher’s existing attitudes and beliefs towards computers (Chiou, 1995; Clement, 1981; Davidson & Ritchie, 1994).

Inservice And Preservice Teachers' Attitudes And Beliefs About Computer Use In The Classroom

Several research studies have examined beliefs and attitudes that inservice and preservice teachers possess about computers in the classroom. These studies suggest that, with regard to computers, teachers have: high anxiety (Koohang, 1987), low confidence (Dupagne & Krendl, 1992; Koohang,
1987), uncertainty, fear, and hostility (Chin & Horton, 1993). Teachers have many concerns involving the use of the computer in the classroom (Parker, 1997). They are skeptical about the value of computers in education (Chin & Horton, 1993; Staman, 1990) and are concerned about: the possible impact computers can have on education (Staman, 1990); competition between the computer and the teacher (Davidson & Ritchie, 1994); lack of time in a class session to work with computers (Bosch, 1993; Dupagne & Krendl, 1992; Kerr, 1991; Rossberg & Bitter, 1988); and their lack of computer experience (Jacobson & Weller, 1988; Stevens, 1980). In addition, teachers expressed concern about the computer replacing the teacher in the classroom (Davidson & Ritchie, 1994). These beliefs and attitudes tend to effect how teachers use the computer in the classroom (Chiou, 1995; Clement, 1981; Davidson & Ritchie, 1994).

Although many teachers hold negative attitudes towards computers and computer use in the classroom, many also advocate the computer’s use (Dupagne & Krendl, 1992; Koohang, 1987). Often, however, this endorsement is given only after teachers have had experience with or formal instruction about computers and computer use in education (Dupagne & Krendl, 1992; Koohang, 1987). Dupagne and Krendl (1992) and Koohang (1987) noted that computer experience often fosters positive attitudes towards computers; moreover, the lack of computer instruction often accounts for teachers’ low confidence level when they initiate computer activities. This feeling of low
confidence often results in high anxiety towards computers (Koohang, 1987; 1989). High anxiety can lead to negative attitudes and eventually negatively influence the learning process (Koohang, 1987; 1989).

“Students studying to become teachers are not only in the role of learners, but also are pivotal in determining the future role of computers in education” (Byrum & Cashman, 1993, p. 262). If the future of computers in education is to meet the expectations of theorists and educational futurists, the next generation of teachers must be prepared to use the computer as a tool for enhancing their teaching capabilities as well as enhancing student learning.

Byrum and Cashman (1993) surveyed 436 preservice teachers to examine their perceptions of: their preparation and training, exposure to and modeling of computers in educational settings, the computer’s value in education, and inhibiting factors effecting future usage of computers in the classroom. They found that the majority of preservice teachers believed they were prepared to use computers. Their preparedness was expressed in categories such as: tool software, electronic communication, drill and practice software, classroom integration and software selection. With respect to the value of computers in education, Byrum and Cashman (1993) found that the majority of subjects believed that there was not an adequate supply of “excellent” software for instructional use and that drill and practice software would be the most appropriate for instruction. In addition, Byrum and
Cashman (1993) found that preservice teachers believed the most inhibiting factor to the future use of computers in education was the lack of computer access in the classroom.

After receiving formal instruction about computers, preservice teachers maintained a traditional view of a teacher-centered classroom and preferred to use the computer as a supplement to instruction (Byrum & Cashman, 1993). Similar to Koohang (1987), Byrum and Cashman (1993) suggested that this attitude toward computer use was influenced by insufficient computer modeling and inadequate experience with computer use in instructional situations.

For teachers to use computers effectively in instruction, there must be a change in the perceived role of the teacher and the computer (Cuban, 1986; Bednar, Cunningham, Duffy & Perry, 1992). Such a change may be difficult given the widespread use and acceptance of the teacher-centered model of instruction. Computer use in the classroom should not be viewed merely as a way to reinforce behavioristic teaching methods, rather computer use should change the nature of what is taught, what is learned, and how learning occurs (Thompson, 1989).

Conceptions and Preconceptions

To assist preservice teachers in (developing) changing their beliefs about teaching and learning, it is necessary to understand their (pre) current
conceptions about computer use in the classroom. A conception is the act of or power of creating or conceiving an idea or notion (Ferguson, 1995). Thus, a preconception can be defined as an idea or opinion formed in advance. According to constructivism and the conceptual change theory, individuals develop their conceptions through personal observation and experiences (Hewson & Hewson, 1984). Over time, these conceptions are strengthened and as a result, they are very resistant to change (Meyer & Woodruff, 1997). The conceptual change theory describes a process whereby rational beings may alter or abandon existing conceptions for ones that are widely supported by empirical evidence (Posner, Strike, Hewson, & Gertzog, 1982). For this research conceptual change theory serves as the theoretical foundation.

Conceptual change occurs in four stages through which individuals need to progress through to change their conceptions; they are dissatisfaction, intelligibility, plausibility, and fruitfulness.

1. The student must become dissatisfied with his or her current conception; he or she must experience the limitations of his or her conception to solve the problem.

2. The new conception must be intelligible to the student; the student must be able to understand how the procedures of the new conception solve the current problem.
3. The new conception must be plausible: the new conception must be believable by the student as a method to solve the specific problem as well as related problems within the domain.

4. The new conception must be fruitful: the new conception must be practical in solving the problem in order for a student to adopt it (Posner et al., 1982)

Individuals will adopt a new conception if they become dissatisfied with their existing conception, find or develop a new conception that makes sense and solves the current problem, and also solves other related problems (Posner, et al., 1982; Hargrave, 1993; Kenton, 1997).

Summary

In the field of education, there exists two dominant theories of learning and teaching to which most teachers subscribe: behaviorism and constructivism. Behaviorism is grounded in systematic, teacher-directed instruction (Evans & Nation, 1996; Wallace, 1996; Gagne, 1985). Constructivism is based on student-centered knowledge construction (Burden & Byrd, 1994; Bransford, Franks, Vye & Sherwood, 1989; Bruner, 1973; Perkins, 1992). Teachers tend to adhere to behaviorism or constructivism based upon their beliefs about knowledge acquisition (Dupagne & Krendl, 1992). For example, if a teacher believes that knowledge is acquired through discovery
and experimentation, the teacher most likely would teach in a student-centered or constructivist manner.

In the field of instructional technology, there are several models that describe or prescribe computer use in the classroom. These models illustrate how widely accepted instructional theories, epistemologies and the computer can be used in unison to enhance student learning experiences. Often, portions of these models are based upon both behaviorist and constructivist teaching styles.

Many teachers believe that students learn best through knowledge transfer. As a result, many instructors teach in a behaviorist manner (Dupagne & Krendl, 1992); this effects how the computer is used in the classroom. For example, a teacher using behaviorist teaching methods is likely to use the computer solely to reinforce previously learned knowledge (i.e., drill and practice).

In addition to teachers' beliefs about knowledge acquisition is the teacher's attitudes towards computers (Chiou, 1995). Kerr (1991) argued that, regardless of the technology, teaching in today's classroom looks remarkably like it did at the beginning of this century. Thus, for teachers to use computers to transform instruction, they need to change their concept of the teacher's role in the classroom (Cuban, 1986). Moreover, for this change to occur, teacher educators must start at the preservice level, because the
preparation of preservice teachers is pivotal in determining the future role of computers in education (Byrum & Cashman, 1993).
CHAPTER III. METHODOLOGY

Over the next decade more than two million teachers will be recruited and hired by America’s schools. “More than half of the teachers who will be teaching ten years from now will be hired during the next decade” (Darling-Hammond, 1996 p. 194). Because preservice teachers play a major role in the future of education, it is important to examine preservice teachers’ beliefs and preconceptions about the role of the computer in learning and the factors that influence their preconceptions. Identifying these preconceptions may enable teacher educators to design and implement instruction that will help preservice teachers develop more comprehensive conceptions of the role of the computer in the classroom. In this chapter the methodology used to conduct this research study is described. This chapter contains the following sections: the sample, the research procedure, the instruments, the limitations, the results of the pilot study, data analysis procedures, and the summary.

Sample

The sample for this study was 289 preservice teachers who attended a major midwestern university. The subjects were enrolled in an introductory instructional technology course and had not taken a college level course of this nature prior to the study. The course was a requirement for all students in the teacher preparation program. The subjects represented a wide variety
of educational specialization areas (i.e., mathematics, science, social studies, special education) as well as academic teaching level interests (i.e., early childhood, elementary, secondary). Most of the subjects were undergraduates in a four year, teacher preparation program. Descriptive data about the sample appear in Table 1.

Table 1. Frequency distributions of the sample: Gender, major, teaching level interests, and area of specialization

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Valid percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>187</td>
<td>67.0%</td>
</tr>
<tr>
<td>Male</td>
<td>92</td>
<td>33.0%</td>
</tr>
<tr>
<td>Education major</td>
<td>210</td>
<td>75.3%</td>
</tr>
<tr>
<td>Non education major</td>
<td>69</td>
<td>24.7%</td>
</tr>
<tr>
<td>Elementary Education</td>
<td>98</td>
<td>46.7%</td>
</tr>
<tr>
<td>Secondary Education</td>
<td>41</td>
<td>19.5%</td>
</tr>
<tr>
<td>Early Childhood Education</td>
<td>26</td>
<td>12.4%</td>
</tr>
<tr>
<td>English</td>
<td>22</td>
<td>14.7%</td>
</tr>
<tr>
<td>Science</td>
<td>18</td>
<td>12.0%</td>
</tr>
<tr>
<td>Math</td>
<td>20</td>
<td>13.3%</td>
</tr>
<tr>
<td>Foreign Language</td>
<td>18</td>
<td>12.0%</td>
</tr>
<tr>
<td>History</td>
<td>32</td>
<td>21.3%</td>
</tr>
</tbody>
</table>

(N = 279)

The subjects were enrolled in a sophomore level college course for education majors. The course, Introduction to Instructional Technology, has approximately 250-300 students enrolled each semester. Each student is required to attend two one-hour lectures and a two hour hands-on laboratory each week. The lectures are for large group instruction with approximately
100-150 students per lecture; the laboratory sessions are designed for hands-on experience with approximately 20-25 students enrolled per section. The purpose of the course is for preservice teachers to develop an understanding of and appreciation for the role of instructional technology in teaching and learning. The course goals are as follows; after completing the course, students should be able to: determine effective applications of instructional technology in learning and teaching, acquire skills to use instructional technology in teaching and learning, and develop a personal philosophical position about instructional technology. During the course, students gain knowledge of and skills in using computer-related technology such as: telecommunications, multimedia, tool software, software selection, software ethics and equity, problem solving software, and video production. Throughout the course, students complete several projects that help them to strengthen their computer literacy as well as develop their views of integrating the computer into the classroom (Schmidt & Volker, 1997). The syllabus for the Introduction to Instructional Technology course appears in Appendix A.

Research Procedure

During the first week of the 1997 fall semester, 289 preservice teachers enrolled in the Introduction to Instructional Technology course were asked to participate in the study. Each student enrolled in the course was informed
verbally and in writing that participation in the study was voluntary and that their participation would in no way effect their final grade in the course.

During the first week of lecture, each student was given the Preservice Teacher Perceptions of the Impact of Computer Use on Learning Scale (PTPICL) and asked to complete it. During the second week of class, students completed the Attitudes About Reality survey (AAR) and the Beliefs About Effective Computer use for Learning assignment (BACL) in their laboratory section.

The survey instruments were administered at two separate times because of class duration and classroom factors. It was estimated that it would take the subjects approximately fifty minutes to complete the three instruments (i.e., one entire lecture session). This would not be beneficial for the students or the instructors. Moreover, the researcher thought that if the instruments were given in a single class session, the subjects would rush to complete it as they approached the end of class time. This could result in unreliable data. Lastly, it was believed that since the AAR and the BACL were not related to or dependent upon the PTPICL, administering the instruments at two separate times would solve the time factor and generate more reliable data. Every survey was coded so that each subject's corresponding portions of the instrument could be compiled for data analysis. Two hundred and seventy nine (279) of the two hundred and eighty nine (289) surveys
distributed were completed and returned. The final survey response rate was ninety six percent (96.5%).

Instruments

The data were collected through the use of three instruments: the PTPICL, the AAR scale and the BACL. A detailed description of each appears below. The selection and creation of the three instruments was based upon a review of the literature concerning factors effecting teachers' attitudes and beliefs about classroom computer use.

The Preservice Teacher Perceptions of the Impact of Computer Use on Learning Scale

The PTPICL was comprised of five sections: background information, attitudes about computers in general, attitudes towards computers in education, computer proficiency, and impact of computer use on learning.

Background Information

The purpose of the background information section was to collect demographic information about the preservice teachers who comprised the sample; it contained twelve items such as age, gender, and major.

Experience With Computers in Education

The experience with computers in education section contained fourteen items that addressed preservice teachers' experience with computers
in both undergraduate and K-12 education. The purpose of this section was to collect information about the subjects' experience with teachers who modeled computer use in the classroom. This section contained two multiple choice and twelve Likert scale items. Using the Likert scale below, the subjects were asked to indicate how frequently computer-related technologies were modeled by former and present teachers:

0. Never - never used
1. Occasionally - occasionally used (once or twice a term)
2. Often - often used (once a month)
3. Regularly - regularly used (once a week or more)

Several of the items for this section were adapted from the Iowa Survey of Computer-Related Technology Use by K-12 Teachers (Schmidt, 1991). For this section, computer-related technologies was defined as constantly evolving forms of computers, peripherals and supporting software used to enhance learning (Schmidt, 1991).

Attitudes About Computers in General

The purpose of the attitudes about computers in general section was to gather information about the attitudes preservice teachers had toward computers. This section consisted of fourteen items. Using the Likert scale below, the subjects were asked to identify the level to which their personal opinions about computers were consistent with each statement:
Attitudes Toward Computers in Education

The purpose of the attitudes toward computers in education section was to acquire information about the subjects' attitudes toward computers in education. In this section, the subjects were given examples of computer use in the classroom; the respondents were to indicate to what extent they agreed or disagreed with each of the twenty-one items using the following Likert scale:

0. - I don’t know
1. - strongly disagree
2. - disagree
3. - agree
4. - strongly agree

Several of the items for this section were adapted from the Iowa Survey of Computer-Related Technology Use by K-12 Teachers (Schmidt, 1991).
Computer Proficiency

In the computer proficiency section of the survey, the subjects were to rate their level of proficiency in using various computer-related technologies. Several items for this section were adapted from the Iowa Survey of Computer-Related Technology Use by K-12 Teachers (Schmidt, 1991). The section consisted of four categories with a total of twenty one items. The categories were computer-based instruction, computer tool software, telecommunications, and other. The subjects rated their proficiency based on the following Likert scale:

0. Unfamiliar - I don't know what this item is.
1. No proficiency - I have no proficiency with this item, I know what it is but I don't know how to use it.
2. Low proficiency - I have little proficiency with this item, and I could use instruction.
3. Medium proficiency - I have some proficiency with this item, but I could use some instruction.
4. High proficiency - I have very high proficiency with this item.

Impact of Computer Use on Learning

This section of the PTPICL was designed to gather information about preservice teachers' preconceptions of the impact of computer use on learning. This section contained twenty five items (five items based on each of the five categories of the Thomas and Boysen Taxonomy, 1984). The
subjects were asked to indicate whether or not they considered each statement to be an effective use of the computer to impact student learning. The subjects were then asked to indicate the level to which they agreed or disagreed with each statement based upon the following scale:

1. Slightly (agree or disagree),
2. Moderately (agree or disagree),
3. Strongly (agree or disagree).

This resulted in six possible answers for the subjects to choose from. In analyzing the data, the answers were weighted on a contingency scale ranging from one (1) to eleven (11) (i.e., strongly disagree = 1, moderately disagree = 3, slightly disagree = 5, slightly agree = 7, moderately agree = 9, strongly agree = 11). The purpose of this weighted scale was to create more distinct differences between the subjects' choices. This technique allowed the researcher to more easily decipher the subjects' beliefs about computer use in the classroom and how they believed these specific uses of the computer impacted student learning. A description of the processes used to validate this section of the survey is included in Appendix B.

**Attitudes About Reality Scale**

Because Dupagne and Krendl (1992) found that teachers' epistemological beliefs tended to effect their beliefs about effective computer use in the classroom, this instrument was selected for use in this research
use in the classroom, this instrument was selected for use in this research study. The items in this instrument were adapted from the Attitudes About Reality scale developed by Unger (1986). This scale was designed to measure subjects' epistemological beliefs using a continuum that ranged from social constructionist to logical positivist beliefs (Unger, Draper and Pendergrass, 1986). The subjects were to rate the level to which they agreed or disagreed with each of the forty items using the following seven point Likert scale:

1. Strongly disagree with this statement,
2. Moderately disagree with this statement,
3. Slightly disagree with this statement,
4. Exactly neutral with this statement,
5. Slightly agree with this statement,
6. Moderately agree with this statement,
7. Strongly agree with this statement,

**Beliefs About Effective Computer Use for Learning Assignment**

The BACL consisted of one open-ended item in which the subjects were requested to write an example of how they would incorporate the computer into a lesson. This item was used to collect narrative data about the subjects' conceptions about effective computer use in the classroom prior to receiving formal instruction. The data generated by the BACL were not analyzed in this thesis.
Results of the Pilot Study

During the summer 1997 semester, the PTPICL was administered to 33 subjects enrolled in the Introduction to Instructional Technology course. The students were asked to complete the survey and to make comments about items they didn't understand. The time each student needed to complete the instrument was documented. In addition, the PTPICL was given to professionals in the field of educational technology who were asked to review the survey and provide suggestions about revisions and additions. Revisions and additions were suggested and made to the survey accordingly.

The Iowa State University Committee on the use of Human Subjects in Research reviewed and approved this research study. A copy of the approved human subject form appears in Appendix C. In addition, a copy of the instruments used in this research study can be found in Appendix D.

Limitations of the Study

The subjects for this study were Iowa State University undergraduate students. Because the majority of Iowa State University students are Iowa natives, their K-12 educational experience is based on midwestern values, this may cause the results to be less generalizable to the national preservice teacher population. Undergraduate students' experience and knowledge of educational disciplines and the field of education in general may be a factor as well.
Finally, the taxonomy upon which part of the instrument was based is also a limitation. The Thomas and Boysen Taxonomy contains five specific categories, and the data were configured around those categories, thus limiting the range of responses from which the subjects had to choose.

Analysis of the Data

Personnel from the Center for Technology in Learning and Teaching (CTLT) at Iowa State University assisted with the coding of the data collected from the survey instruments. Data were analyzed through the use of the appropriate SPSS procedures. Descriptive statistics were computed on the PTPICL as well as analyses of variances, correlations, and t-tests.

The AAR data were used to produce epistemology scores for each of the subjects. Descriptive statistics were then generated based on the logical positivist through social constructionist continuum. These data also were correlated with the Impact of Computer Use in Learning (ICL) section of the PTPICL.

Summary

In this chapter a description of the methods used to implement this research study were presented. During the first week of the fall 1997 semester, 289 preservice teachers enrolled in a college level introductory to instructional technology course were asked to participate in this research
study. Each subject was given the PTPICL, the AAR and the BACL and asked to complete them.

The instruments contained items relating to several constructs believed to effect teacher use of the computer in the classroom; they were: computer proficiency, epistemological beliefs, experience with computers in education, attitudes towards computers, attitudes towards computers in education, and beliefs about the impact of computer use on learning. Two hundred and seventy nine (279) of the two hundred and eighty nine (289) surveys distributed were completed. The final survey response rate was 96.5%. In addition, the instruments had a Cronbach alpha reliability coefficient of $r = .8252$ for the PTPICL and $r = .6372$ for the AAR scale.
CHAPTER IV. RESULTS AND FINDINGS

The data collected through the Preservice Teacher Preconceptions of the Impact of Computer use on Learning scale (PTPICL) and the Attitude About Reality (AAR) scale were used to compute descriptive statistics about the sample. Specifically the data describe the participants: background, experience with computers in education, attitudes about computers in general, attitudes about computers in education, computer proficiency, beliefs about the impact of computer use on learning, and attitudes about reality. In this chapter, the results of the study are presented.

Description of Respondents

The first section of the PTPICL was used to collect demographic information about the 279 undergraduate students enrolled in the Introduction to Instructional Technology course. Of the 279 subjects, sixty seven percent (67%) were female and thirty three percent (33%) were male. The majority of the subjects were between the ages 17-24 (87.9%), less than ten percent (8.7%) were between the ages 25-32, and only three percent (3.4%) were between the ages 33-42. More then sixty percent (63.5%) of the respondents were sophomores or juniors, ten percent (10%) were first year students, fourteen percent (14.3%) were seniors, and six percent (6.5%) were fifth year seniors. Seventy five percent (75.3%) of the respondents indicated
they were education majors; less than one quarter (24.7%) were not education majors. Of the non-education majors, seventy one percent (71.2%) indicated they were planning to earn a teaching license. More than seventy percent (72.1%) of the 279 respondents indicated that, after graduation, they plan to teach at the K-12 level. Twelve percent (12.2%) of the subjects indicated they plan to enroll in graduate school after graduation, and eight percent (8.2%) planned to enter the business world (Table 2).

Table 2. Frequency Distributions: The respondents’ academic level, major, and plans after graduation

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Valid percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>freshman</td>
<td>28</td>
<td>10.0%</td>
</tr>
<tr>
<td>sophomore</td>
<td>90</td>
<td>32.1%</td>
</tr>
<tr>
<td>junior</td>
<td>87</td>
<td>31.2%</td>
</tr>
<tr>
<td>senior</td>
<td>40</td>
<td>14.3%</td>
</tr>
<tr>
<td>fifth year senior</td>
<td>18</td>
<td>6.50%</td>
</tr>
<tr>
<td>Elementary Education</td>
<td>98</td>
<td>46.7%</td>
</tr>
<tr>
<td>Secondary Education</td>
<td>41</td>
<td>19.5%</td>
</tr>
<tr>
<td>Early Childhood Education</td>
<td>26</td>
<td>12.4%</td>
</tr>
<tr>
<td>Educational Computing Minor</td>
<td>24</td>
<td>8.70%</td>
</tr>
<tr>
<td>plan to teaching K-12</td>
<td>199</td>
<td>72.1%</td>
</tr>
<tr>
<td>plan to go to graduate school</td>
<td>34</td>
<td>12.3%</td>
</tr>
</tbody>
</table>

n=279
The data about the subjects' computer experience indicated that thirty-five percent (35.5%) of the subjects had no formal computer instruction and sixty-four percent (64.2%) of the subjects had formal computer instruction before completing this survey. Of those who had formal computer instruction (n=179), more than seventy-five percent (75.5%) reported that their first formal computer instruction was in high school. Less than five percent (4.7%) received computer instruction in a community college, five percent (5.4%) received computer instruction in a university, and fifteen percent (15.5%) had attended a computer workshop or received computer instruction through some other means.

The subjects were asked to indicate how frequently they used computers and for what purpose they used computers. Forty-four percent (44.8%) indicated they used computers approximately once a day. Twenty-two percent (22.6%) of the subjects indicated they use computers more than once a day, twenty percent (20.4%) indicated they use computers once a week, ten percent (10.1%) indicated they use computers once or twice a week, and two percent (1.8%) indicated that they use the computer once or twice a semester.

Eighty-two percent (82.1%) of the subjects indicated they used the computer for communication (i.e., e-mail, internet); eighty-four percent (84%) indicated they used the computer for homework and word processing; sixty-two percent (62.3%) indicated they used the computer to find information; forty-seven percent (47.8%) indicated they used the computer for
entertainment, and less than five percent (4.3%) indicated they used the computer for programming.

Respondents' Experience With Computers in Education

Section two of the PTPICL was used to collect data about the preservice teachers' experience with computers in both K-12 and undergraduate schooling. Fifty four percent of the respondents (54.5%) reported that computer-related technologies were used by teachers in their K-12 schooling; forty five percent (45.5%) indicated that their K-12 teachers did not use computer-related technologies. Of the respondents who indicated that their K-12 teachers used computers, forty percent (39.6%) indicated that the computer was used occasionally, and twenty nine percent (29%) indicated that the computer was used regularly.

Forty percent (40.7%) noted that the computer never was used for student presentations, and thirty eight percent (38%) indicated that the computer was used occasionally for student presentations. Forty three percent (43.6%) indicated that the computer was used occasionally for student activities, and thirty one (31.5%) indicated that the computer was used often for student activities.

When asked how often the computer was used to access information, thirty percent (30%) indicated never, thirty percent (30%) indicated occasionally, and twenty four percent (24.7%) indicated that the computer was
used often to access information. In addition, more than half of the subjects (64.7%) indicated that the computer never was used to communicate. Almost fifty percent (49.9%) indicated that the computer was used regularly for homework or to create a product (Figure 1).

The subjects were asked about their experience with computer use in their college courses. Eighty two percent (82.1%) of the respondents indicated that computer-related technologies were used in their undergraduate classes; eighteen percent reported that computer-related technologies were not used in their college courses. Of those students (n = 229) who reported that computers were used in their college courses for teacher presentations, thirty nine percent (39%) indicated that computers were used regularly; twenty nine percent (29.4%) indicated they were used often and, twenty seven percent (27.2%) indicated occasionally. Forty four percent (44.5%) of the subjects indicated that the computer was used for student presentations occasionally, and thirty eight percent (38.8%) indicated that it never was used for student presentations. Thirty eight percent (38%) of the subjects indicated that computers were used for student activities occasionally. When asked about using the computer to access information, thirty five percent (35.7%) indicated the computer was used occasionally and thirty two percent (32.2%) indicated often. Thirty seven percent (36.6%) of the subjects noted that the computer was used regularly to communicate; and more than fifty percent
Figure 1. Teacher Computer use in K-12 Environment

Scale: 0 = never used, 1 = used occasionally, 2 = used often, 3 = used regularly

Figure 2. Teacher Computer Use in Undergraduate Environment

Scale: 0 = never used, 1 = used occasionally, 2 = used often, 3 = used regularly
(56.1%) of the subjects indicated that the computer was used regularly to create a product (i.e., write a paper) (Figure 2).

In summary, the students enrolled in the introductory instructional technology course were female (67%), education majors (75.3%) between the ages of 17-24 (87.9%) who planned to teach after college graduation (72.1%). Moreover, the respondents were in their sophomore (32.1%) or junior year of college (31.2%) and had formal computer instruction (64.4%) prior to completing the survey. Finally, the majority of the respondents indicated that computers were used in their K-12 schooling (54.4%) and in their undergraduate courses (82.1%).

Research Question Results

The purpose of this study was to investigate preservice teachers’ preconceptions about the role of the computer in learning and teaching and identify and examine factors that effect preservice teachers’ preconceptions about computer use in the classroom. Below are the results of the four research questions created for use in this study.

Research Question 1

What category of the Thomas and Boysen Taxonomy is most representative of the preservice teacher population?
The data generated by the Impact of Computer Use on Learning (ICL) section of the PTPICL were used to address this research question. As described in Chapter III, this section of the survey consisted of five items for each level of the Thomas and Boysen Taxonomy for a total of twenty five items. Subjects' responses to each item were weighted on a contingency scale using the following system: strongly disagree=1, moderately disagree=3, slightly disagree=5, slightly agree=7, moderately agree=9, strongly agree=11. A mean score for each Thomas and Boysen category was generated for each participant and the sample as a whole. The data revealed that the categories with the highest means were integrating (8.6) and reinforcing (8.5) (Table 3).

Table 3. Means and Standard Deviations of Respondents' Ranking of Thomas and Boysen Taxonomy Categories

<table>
<thead>
<tr>
<th>Thomas and Boysen Levels</th>
<th>n</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinforcing</td>
<td>277</td>
<td>8.5018</td>
<td>1.612</td>
</tr>
<tr>
<td>Integrating</td>
<td>276</td>
<td>8.6469</td>
<td>1.602</td>
</tr>
<tr>
<td>Experiencing</td>
<td>276</td>
<td>6.9025</td>
<td>2.107</td>
</tr>
<tr>
<td>Utilizing</td>
<td>276</td>
<td>6.6833</td>
<td>1.578</td>
</tr>
<tr>
<td>Informing</td>
<td>277</td>
<td>6.2202</td>
<td>1.871</td>
</tr>
</tbody>
</table>

A paired t-test was computed to determine if there was a significant difference between the two category means. Results of the paired t-test showed no significance (p=.066) between the reinforcing and integrating categories (Table 4). Histograms illustrating the distributions of the respondents' ranking of the Thomas and Boysen categories appear in Appendix F.
Table 4. T-Test Comparison of Thomas and Boysen Taxonomy Categories

<table>
<thead>
<tr>
<th>Category</th>
<th>df</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinforcing</td>
<td>276</td>
<td>8.5018</td>
<td>1.612</td>
<td>-1.84</td>
<td>.066</td>
</tr>
<tr>
<td>Integrating</td>
<td></td>
<td>8.6469</td>
<td>1.601</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*** = p>.001 ** = p>.01 * = p>.05

Research Question 2

Will preservice teachers with high computer proficiency scores conceptualize more advanced ways of using the computer in the classroom?

To determine the effects of computer proficiency, the subjects were asked to rate their proficiency with computers in four categories: computer based instruction, tool software, telecommunications, and other (i.e., HTML, computer hardware). Subjects rated their proficiency using the following five point Likert scale: unfamiliar (0), no proficiency (1), low proficiency (2), medium proficiency(3), high proficiency (4). Overall, the subjects rated themselves moderately proficient with computers (1.930). Specifically, they were moderately with: computer based instructional applications (2.053), telecommunication software (2.050), and tool software (2.120). The respondents had low proficiency in the area of other computer-related technologies (1.459). The subjects were most proficient with word processing (3.344) and email (3.208) applications. The respondents were least proficient in using Hyper Text Mark-up Language (HTML) (.928) and File Transfer Protocol (FTP) (.888) applications (Table 5).
To compare subjects with high computer proficiency and subjects with low proficiency the following scale was used: 0-2 = low computer proficiency (n = 123), 2-4 high computer proficiency (n = 140). Because the respondents as a whole, rated their proficiency with other computer-related technologies (i.e., HTML, computer hardware) low, this section was not included in the subsequent analysis; thus the proficiency scores were computed based on the items in the computer based instruction, tools and telecommunication sections. The mean for this section was 2.068. T-tests were computed to determine if there was any difference in ability to conceptualize advanced ways of using the computer (i.e., experiencing, integrating, and utilizing) between subjects with high computer proficiency and those with low computer proficiency. Results showed that subjects with higher computer proficiency scores conceptualized more advanced ways of using the computer than those who had low computer proficiency score. Specifically, those with high computer proficiency conceptualized using the computer in a utilizing manner (p=.003) and in an experiencing manner (p=.050).
Table 5. Frequencies and Means of Respondents Computer Proficiency

<table>
<thead>
<tr>
<th>Computer-Related Technology</th>
<th>n</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Based Instruction</td>
<td>279</td>
<td>2.053</td>
</tr>
<tr>
<td>Drill and Practice</td>
<td>279</td>
<td>1.832</td>
</tr>
<tr>
<td>Tutorials</td>
<td>279</td>
<td>2.158</td>
</tr>
<tr>
<td>Educational Games</td>
<td>279</td>
<td>2.516</td>
</tr>
<tr>
<td>Problem Solving</td>
<td>279</td>
<td>1.986</td>
</tr>
<tr>
<td>Simulations</td>
<td>279</td>
<td>1.774</td>
</tr>
<tr>
<td>Tool Software</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word Processing</td>
<td>279</td>
<td>3.344</td>
</tr>
<tr>
<td>Databases</td>
<td>279</td>
<td>2.305</td>
</tr>
<tr>
<td>Spreadsheets</td>
<td>279</td>
<td>2.434</td>
</tr>
<tr>
<td>Desktop Publishing</td>
<td>279</td>
<td>1.885</td>
</tr>
<tr>
<td>Graphics/Drawing</td>
<td>279</td>
<td>2.004</td>
</tr>
<tr>
<td>Presentation</td>
<td>278</td>
<td>1.594</td>
</tr>
<tr>
<td>Hypermedia/Multimedia</td>
<td>279</td>
<td>1.208</td>
</tr>
<tr>
<td>Telecommunication Software</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Email</td>
<td>279</td>
<td>3.208</td>
</tr>
<tr>
<td>Internet/WWW</td>
<td>279</td>
<td>2.889</td>
</tr>
<tr>
<td>Networking LAN/WAN</td>
<td>279</td>
<td>1.219</td>
</tr>
<tr>
<td>FTP</td>
<td>278</td>
<td>.888</td>
</tr>
<tr>
<td>Other Computer Related Technologies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance Education</td>
<td>279</td>
<td>1.233</td>
</tr>
<tr>
<td>Programming</td>
<td>279</td>
<td>1.029</td>
</tr>
<tr>
<td>CD-ROM</td>
<td>278</td>
<td>2.216</td>
</tr>
<tr>
<td>Hardware</td>
<td>277</td>
<td>1.910</td>
</tr>
<tr>
<td>HTML</td>
<td>279</td>
<td>.928</td>
</tr>
<tr>
<td>Computer proficiency overall</td>
<td>278</td>
<td>1.930</td>
</tr>
<tr>
<td>Computer proficiency without other category</td>
<td>278</td>
<td>2.068</td>
</tr>
</tbody>
</table>

Scale:

0 = I don't know
1 = no proficiency
2 = low proficiency
3 = medium proficiency
4 = high proficiency
Research Question 3

Will preservice teachers with high epistemology scores (social constructionist or constructivist perspectives) conceptualize more advanced ways of using the computer in the classroom?

To answer this question, data from the 40 item Attitudes About Reality (AAR) scale were examined. This instrument was based on a seven point Likert scale ranging from strongly disagree (1) to strongly agree (7). A mean AAR score was calculated for each subject. The respondents scores ranged from 2.78 to 5.00 with a mean score of 3.88 (four (4) was the mid-point on the AAR scale). Because the majority of the scores fell in the middle of the scale (i.e., eclectic), for comparison purposes, the sample was separated into three epistemological groups: eclectic behaviorist, eclectic, and eclectic constructivist (Hannafin & Freeman, 1995). The eclectic behaviorist group consisted of subjects whose scores ranged from 2.78 to 3.5 (n = 33); the eclectic group consisted of subjects whose scores ranging from 3.53 to 4.00 (n = 130), and the eclectic constructivist group consisted of subject whose scores ranging from 4.03 to 5.00 (n = 59).

An analysis of variance (ANOVA) test was computed to determine if there were significant differences between the three groups on the five categories of the Thomas and Boysen Taxonomy. The data indicated that significant differences existed between eclectic constructivist individuals and both eclectic behaviorist and eclectic individuals for conceptualizing the use
of the computer in a utilizing manner. In addition, the data indicated that significant differences existed between eclectic constructivist individuals and eclectic behaviorist individuals on the experiencing level (Table 6).

Research Question 4

Will subjects with low computer attitude scores be able to conceptualize more advanced ways of using the computer in the classroom?

The attitudes towards computers in general and attitudes towards computers in education sections of the PTPICL were used to collect data about the respondents’ attitudes. Responses in these sections were based on a five point Likert scale ranging from I don’t know (0) to strongly agree (4). Overall, the participants had held moderately negative attitudes toward computers in general with a mean score of 2.2 and computers in education with a mean score of 1.9.

To determine if subscales existed within the attitudes about computers in general section, a rotated varimax factor analysis was computed in the fourteen items from the section. The factor analysis of the attitudes about computers in general section resulted in two factors reflecting subjects' attitudes towards computers: comfortable with computers and confused by computers. The comfortable with computers factor resulted in a mean score of 2.93 and consisted of four items. The confused by computers factor resulted
in a mean score of 1.97 and consisted of six items. The factor items, loadings, and reliability coefficients appear in Appendix F.

The frequency distribution on the confused about computers factor indicated that 117 respondents were not confused about computers and 161 were confused about computers. The frequency distribution on the comfortable with computers factor indicated that 243 respondents were comfortable with computers and 33 respondents were not. These data suggest that many of the respondents were confused by computers and were comfortable with them.

Table 6. Analysis of Variance: Attitudes About Reality and Utilizing and Experiencing Levels of the Thomas and Boysen Taxonomy

<table>
<thead>
<tr>
<th>Attitude Group</th>
<th>n</th>
<th>Mean</th>
<th>S.D.</th>
<th>F Ratio</th>
<th>F Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Utilizing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Eclectic Behaviorist</td>
<td>33</td>
<td>6.636</td>
<td>1.732</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Eclectic</td>
<td>120</td>
<td>6.627</td>
<td>1.381</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Eclectic Constructivist</td>
<td>59</td>
<td>7.281</td>
<td>1.416</td>
<td>5.555</td>
<td>.0045**</td>
</tr>
<tr>
<td><strong>Experiencing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Eclectic Behaviorist</td>
<td>33</td>
<td>6.224</td>
<td>2.216</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Eclectic</td>
<td>120</td>
<td>7.012</td>
<td>2.015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Eclectic Constructivist</td>
<td>59</td>
<td>7.422</td>
<td>2.053</td>
<td>3.619</td>
<td>.0285*</td>
</tr>
</tbody>
</table>

**p=<.01 * p=.05

Scheffe' test indicates significant difference for utilizing between groups 3 & 1 and 3 & 2 at the .05 level.

Scheffe' test indicates significant difference for experiencing between groups 3 & 1 at the .05 level.
To determine if there were significant differences between subjects who were and were not confused with computers, a t-test was computed. The t-test showed that subjects who were confused about computers had significant differences in their beliefs about how the computer should be used in the classroom for the informing, reinforcing and utilizing categories of the Thomas and Boysen Taxonomy (Table 7). To determine if there were significant differences between subjects who were comfortable with computers and subjects who were not, a t-test was computed. The results of the t-test showed that there was no significance between students who were comfortable with computers and subjects who were not.

Table 7. T-test of Confusion Factor and Thomas and Boysen Taxonomy Categories

<table>
<thead>
<tr>
<th>Category</th>
<th>df</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utilizing</td>
<td>229</td>
<td>6.3590</td>
<td>1.677</td>
<td>2.91</td>
<td>.033*</td>
</tr>
<tr>
<td>Reinforcing</td>
<td>238</td>
<td>8.2457</td>
<td>1.674</td>
<td>2.17</td>
<td>.031*</td>
</tr>
<tr>
<td>Integrating</td>
<td>256</td>
<td>8.4923</td>
<td>1.562</td>
<td>1.38</td>
<td>.167</td>
</tr>
<tr>
<td>Informing</td>
<td>231</td>
<td>5.9145</td>
<td>1.987</td>
<td>2.22</td>
<td>.027*</td>
</tr>
<tr>
<td>Experiencing</td>
<td>245</td>
<td>6.6137</td>
<td>2.138</td>
<td>1.95</td>
<td>.052</td>
</tr>
</tbody>
</table>

*** = p>.001  ** = p>.01  * = p>.05

To determine if subscales existed within the attitudes about computers in education section, a rotated varimax factor analysis was computed on the twenty one items from the section. The factor analysis resulted in four factor reflecting subjects' attitudes about computers in education: computers should be used in the classroom, computers are an unnecessary luxury in the
classroom, computers are better than teachers, and computers should be used for rewards.

The computers should be used in the classroom factor consisted of four items and resulted in a mean score of 3.12. The computers are an unnecessary luxury in the classroom factor consisted of three items and resulted in a mean score of 1.50. The computers are better than teachers factor consisted of four items and resulted in a mean score of 1.43. The computers should be used for rewards factor consisted of two items and resulted in a mean score of 1.53. Because the latter two factors (computers are better than the teacher and computers should be used for rewards) did not clearly denote positive or negative attitudes about computer use in education, they were not used to address the research question. The factor items, loadings, and reliability coefficients appear in Appendix F.

To determine if there were significant differences between subjects who thought computers should be used in the classroom and those who did not, the mean scores computed for each subject on the computers should be used in the classroom factor were used. Respondents with a mean 0-2 comprised those who did not think computers should be used in education (n = 14). Respondents with means of 2.1-4 comprised those who thought computers should be used in the classroom (n = 263). A t-test was then computed to compare these groups on each level of the Thomas and Boysen Taxonomy. Subjects who reported that computers should be used in the classroom
significantly conceptualized the use of the computer in an informing ($p=.001$), an integrating ($p=.002$), and in a reinforcing manner ($p=.026$) higher than subjects who thought computers should not be used in the classroom.

To determine if there were significant differences between subjects who thought computers were an unnecessary luxury in the classroom and those who did not, the mean scores computed for each subject on this factor were used. Respondents with a mean score of 0-2 comprised those who thought computers were not an unnecessary luxury in the classroom ($n = 264$). Respondents with mean scores of 2.1-4 comprised those who thought computers were an unnecessary luxury in the classroom ($n=13$). A t-test was computes to compare these groups on each level of the Thomas and Boysen Taxonomy. The results of the t-test showed that subjects who did not consider a computer to be an unnecessary luxury in the classroom were able to conceptualize the use of the computer in an integrating manner ($p=.020$) more significantly than students who thought the computer was an unnecessary luxury in the classroom.

Summary

The purpose of this chapter was to report the results of the study. Two hundred and seventy nine preservice teachers participated in the study. The majority of the respondents were female and were in their sophomore and
junior years of college. Approximately three fourths of the respondents indicated that they plan to teach at the K-12 level after college graduation.

This research study addressed preservice teachers' preconceptions about the role of the computer in the classroom. The results of this research showed that the participants reported reinforcing and integrating uses of the computer in the classroom as having the most impact on student learning. The data from this study indicated that several factors influenced the participants' ability to conceptualize advanced ways of using the computer in the classroom, they included: computer proficiency, beliefs about knowledge acquisition, and attitudes toward computers.
CHAPTER V. SUMMARY, DISCUSSION AND RECOMMENDATIONS

The purpose of this chapter is to discuss the results of the study. This chapter begins with a summary of the study, followed by a discussion of the results, and recommendations for preservice preparation and future studies in this area.

Summary

Researchers and practitioners alike believe that for technology to transform education, more attention must be given to the teacher and not the technology (Thompson, 1989). The key factor influencing the use of the computer in the classroom is the teacher (Papert, 1993). For teachers to use computers effectively in instruction, inservice and preservice teachers must change their conceptions of learning, teaching and computers (Cuban, 1986). Identification of preservice teachers' preconceptions about the role of the computer in the classroom is the first step towards helping preservice teachers change these conceptions.

During the first week of the fall 1997 semester, 289 preservice teachers at a major mid-western university who were enrolled in an introduction to instructional technology course participated in a study designed to identify their preconceptions about the role of the computer in the classroom.
Two hundred and seventy nine students completed the three survey instruments (PTPICL, AAR, BACL) for a response rate of 96.5%. The instruments contained items relating to several constructs believed to effect teacher use of the computer in the classroom; they were: computer proficiency, epistemological beliefs, experience with computers in education, attitudes towards computers, attitudes towards computers in education, and beliefs about the impact of computer use on learning.

The results of the study indicated that prior to formal instruction, preservice teachers conceptualized reinforcing and integrating (as defined by the Thomas and Boysen, 1984) as the most effective ways of using computers in the classroom to impact student learning. The respondents with high levels of computer proficiency more significantly conceptualized advanced ways of using the computer in the classroom than respondents with low levels of computer proficiency. Moreover, students who viewed knowledge acquisition from a constructivist perspective more significantly conceptualized advanced ways of using the computer in education than subjects with eclectic or behaviorist perspectives. Finally, students attitudes about computers in general and in education effected their ideas about the role of the computer in the classroom.
Discussion of the Results

As suggested by Hewson and Hewson (1984) in their work in science education, students develop their ideas about phenomena through observations and experiences. Many researchers have reported that common uses of the computer in education are reinforcing activities. That is, those activities designed to strengthen students' understanding of concepts taught in formal instruction are not new to education (Becker, 1991). The results of this study support the conclusions that preservice teachers', prior to formal instruction, conceptualize the use of the computer as a reinforcement to formal instruction. It is interesting to note that the students also conceptualized integrating as an appropriate use of the computer. However, there was no significant difference in their rating of reinforcing and integrating activities ($p = .066$). Thus, they may not have distinguished any difference between the reinforcing and integrating categories of the Thomas and Boysen taxonomy. The clarity of these categories, as conveyed in the survey items, may have been a limitation of the study.

Although examined as independent constructs in this study, many researchers suggest that attitudes toward computers and computer proficiency are related. Overall the subjects' attitudes towards computer use in the classroom were moderately negative. Previous research studies have found that preservice teachers and inservice teachers expressed attitudes towards computer use in the classroom such as: high anxiety (Koohang, 1987), low
confidence (Dupagne & Krendl, 1992; Koohang, 1987), uncertainty, fear and hostility (Chin and Horton, 1993). Subjects in this research study trusted computers, did not feel nervous about computers, were not threatened by computers, did not lack confidence with computers, and overall felt comfortable with using computers. Although the subjects did not feel uncomfortable working with computers, they still held poor attitudes toward computers. Only one third (35%) of the subjects felt lost, confused and frustrated when using the computer.

It should be noted that attitudes towards computers change after receiving formal computer instruction and after subjects have had experience with computers (Dupagne & Krendl, 1992; Koohang, 1987; Byrum and Cashman, 1993). Results of this study showed that sixty four percent (64%) of the subjects had received formal computer instruction, primarily in high school (75.3%). In contrast to Koohang and others, results of a t-test comparing subjects with formal instruction and subjects without formal instruction showed no significant difference in computer attitudes at the .05 level.

Stevens (1980) attributed poor attitudes towards computer use in the classroom to low computer proficiency. Participants in this study were asked to rate their computer proficiency using a five point Likert scale ranging from unfamiliar (0) to high proficiency (4). Overall the subjects rated themselves with medium proficiency (1.930). Similar to Stevens (1980), results of a t-test
comparing subjects who were comfortable with computers and subjects who were uncomfortable with using computers showed significant differences \( p = .000 \). In addition, subjects who were confused about using computers had significantly lower computer proficiency than subjects who were not confused when using computers \( p = .000 \). Finally, the results of t-tests also showed that subjects with high computer proficiency rated using the computer in an experiencing \( p = .05 \) and utilizing \( p = .003 \) manner significantly higher than subjects with low computer proficiency.

Research has shown that beliefs about knowledge acquisition effect the manner in which teachers teach (i.e., behaviorist, constructivist). Moar and Taylor (1995) reported that most teachers teach in a didactic, behavioristic manner. In addition, Hannafin and Freeman (1995) and Moar and Taylor (1995) examined the effects of epistemological beliefs on teachers' use of computers in the classroom. Moar and Taylor's research showed that epistemological beliefs tend to effect how teachers use computers in the classroom; moreover, because many instructors teach in a behavioristic manner, the computer tends to be used most often for reinforcement activities. This research has found that most preservice teachers have eclectic views toward knowledge acquisition. Moreover, subjects who had more constructivist views toward knowledge acquisition were able to conceptualize more advanced ways of using the computer in the classroom than subjects with behaviorist views toward knowledge acquisition. These results are
consistent with other researchers (Dupagne & Krendl, 1992, Moar & Taylor, 1995, Hannafin & Freeman, 1995) who have noted that the computer is well suited for instructors who teach using a constructivist framework.

Recommendations

The purpose of this study was to investigate preservice teachers' preconceptions about the role of the computer in teaching and learning and to examine and identify factors that effect preservice teachers perceptions of computer use in the classroom. Several recommendations based on this study are made for the preparation of preservice teachers. In addition, further studies that build on the results of this study are suggested.

The first recommendation for preservice teacher preparation is to increase and strengthen preservice teachers' access to computers. The results of this study indicate that subjects with computers at home and those with computer experience have higher levels of computer proficiency and can conceptualize more advanced ways of using the computer in the classroom than those with less computer experience (Appendix G). Increased levels of access to and experience with computers may reduce preservice teachers' reluctance to use the computer and increase their willingness to experiment with new applications and uses of the computer.

The second recommendation for preservice teacher preparation is for teacher educators in preservice teacher preparation classes to model more
advanced ways of using the computer to impact student learning. Research
indicates that humans learn a great deal from watching others. The results of
this study support the conclusion that subjects who attend classes in which
the computer is used to enhance student learning have higher computer
proficiency and can conceptualize more advanced ways of using the computer
in the classroom (Appendix G).

The third recommendation for preservice teacher preparation is to
teach in a more learner-centered manner. Learner-centered teaching models
the creation of an environment which supports advanced ways of using the
computer; moreover, teaching in this manner supports the development of
more self-constructed knowledge and experiences. In addition, the data
suggests that subjects with more constructivist beliefs about knowledge
acquisition can conceptualize more advanced ways of using the computer in
education.

Because preservice teachers and computers are integral parts of the
future of education more research that investigates preservice teachers'
preconceptions about computer use in the classroom should be conducted.
Specifically, further documentation of preconceptions held by preservice
teachers is needed. Follow-up studies to this research described here should
closely evaluate the differences between the integrating and reinforcing items
of the impact of computer use on learning section of the PTPICL. In both
validating the ICL section and the results of the research, it was evident that
the examples of computer use were perceived by the respondents to be similar. More explicit uses of the computer for these categories of the Thomas and Boysen Taxonomy may result in stronger differences. It is also recommended that this research be conducted in a longitudinal manner in which the factors found to effect preservice teachers' preconceptions are controlled for.

In conclusion, this assessment of preservice teachers' preconceptions about computer use in this classroom serves as a basis for designing instruction that will help preservice teachers to develop more comprehensive conceptions of the role of the computer in learning and teaching. With a national push to restructure education and increase the use of computer-related technology in the classroom, it is imperative to prepare preservice teachers with the knowledge and skills needed to use computer-related technologies effectively to enhance student learning.
APPENDIX A. INTRODUCTION TO INSTRUCTIONAL TECHNOLOGY

COURSE SYLLABUS
This course is designed as an overview of instructional technology used in educational learning and teaching environments. Instruction is designed to give students experience in using in a variety of instructional technology used in educational settings. Some of the course topics include the use of tool software, interactive multimedia, digital video and audio, and the Internet and World Wide Web. The ethical and equitable use of instructional technology is also discussed.

Instructional technology not only applies to hardware and software, it pertains to a process. New ways of teaching and learning have been made possible by new equipment. Increased attention to student-centered instruction, cooperative learning, and authentic assessment have accompanied the expanded concept of "instructional technology."

This course combines contemporary hardware, software, and pedagogical techniques that teachers and students use.

Purpose and Goals—The purpose of the course in instructional technology is for you to develop an understanding and appreciation of the role of instructional technology in learning and teaching. Strive for these goals and objectives:

1. **Determine effective applications of instructional technology in learning and teaching.**
   - Students will:
     - develop concepts about instructional technology in their own way and at their own rate.
     - participate in several types of technology based instructional models.
     - use instructional technology to develop authentic products.
     - observe a variety of exemplary teaching methods that infuse instructional technology to enhance learning.

2. **Acquire skills to use instructional technology for learning and teaching.**
   - Students will:
     - use a word processor.
     - use email.
     - use a distance education system.
     - design and develop a personal home page for the world wide web.
     - design and develop desktop published documents.
     - organize and manipulate data using a spreadsheet; graph information from a spreadsheet.
     - collect, organize and manipulate data using a database.
     - design and edit a videotape (analog or digital).
     - design and develop an interactive multimedia project.
     - develop problem solving skills using various software applications.
     - use print and electronic information resources.
     - evaluate instructional technology materials.
     - acquire and prepare images for use in learning and teaching environments.

3. **Develop a personal philosophical position about instructional technology.**
   - Students will:
     - evaluate appropriate uses of instructional technology.
     - explore societal issues related to technology, such as ethics and equity.
Textbook and Lab Manual Used for Course


...a word about this manual for laboratory work

These exercises have been designed for the introductory course in instructional technology offered through the Curriculum and Instruction Department in the College of Education at Iowa State University. Many of the procedures needed as you work with technology are included here as “recipes” to produce materials. For those procedures that can be carried out only at a CTLT Laboratory workstation the instructions are not in this manual, but are posted at the workstation. Where processes need explaining, short descriptive sections are provided in this manual.

The Lab/Lecture Connection

Topics for the laboratory exercises usually will be presented first in the lecture/demonstrations. The lectures will prepare you to complete the lab exercises for the next week. It is your responsibility to attend lecture so when you go to lab you will be able to spend the majority of time completing the assignments. Laboratory instructors will pick up where the lecture leaves off; they will not repeat the lecture.

How labs work

Students use our computers in Lagomarcino Hall on a first-come, first-served basis. Color ink-jet and laser printers are available free of charge on the premises. Please print out only one copy using these printers; there is a Xerox machine available in the CTLT (N031) to make multiple copies. There is a $1.00 charge for all color laser copies payable at the CTLT service desk.

Your Work During the Laboratory Session

Some lab exercises are designed for individual work, while others require you to work in a small group. It is our intent to give you time to get a good start on your assignments in lab, but extra time outside of class may be required to finish some assignments—using the facilities in Lagomarcino Hall or elsewhere on campus. If you own a camera, tape recorder, camcorder, computer or other type of instructional technology hardware, please use it to complete assignments for this course.

The Role of Your Laboratory Instructor

Our method of being helpful to you is to facilitate your learning by offering suggestions on how to solve problems you may encounter. You must ultimately be the one who knows how to use the hardware and software; we cannot learn it for you. (This includes reading the procedure sheets carefully, reading the text, reading instruction and software manuals, talking to other students, and trial-and-error experimentation). Often, students become impatient with us if we don't “just do it” for them; we try our best to help you learn on your own.
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<tr>
<th>WEEK</th>
<th>LECTURE</th>
<th>ASSIGNMENT</th>
<th>LAB</th>
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<td>1. 8/25-29</td>
<td>#1 Intro—How course is organized</td>
<td>Chp. 1</td>
<td>Lab #1: N066 Lagomarcino</td>
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<td></td>
<td>What is instructional technology?</td>
<td>pp. 1-26</td>
<td>- Course Introduction - Explain projects &amp; assignments</td>
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<td>Computer Bits &amp; Bytes</td>
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<td>- Computer basics</td>
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<td></td>
<td>#2 Distance Education</td>
<td>Chp. 9</td>
<td>- Review word processing &amp; graphics</td>
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<td></td>
<td>• Background</td>
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<td>• Components of Distance Education</td>
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<td>Research Survey</td>
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<td>2. 9/1-5</td>
<td>#3 Communication Technologies and the Internet</td>
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<td>• WWW</td>
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<td>• Search Strategies</td>
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<td>- Student Introductions</td>
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<td></td>
<td>#4 Communication Technologies and the Internet</td>
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<td>- Work on Computer Basics Assignment</td>
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<td></td>
<td>• Evaluation of Web Sites</td>
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<td>- Research Survey (Part II)</td>
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<td>• Home page Development, HTML</td>
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<td>3. 9/8-12</td>
<td>#5 Communication Technologies and the Internet</td>
<td>Lab #3: N066 Lagomarcino</td>
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<td></td>
<td>• Video Conferencing</td>
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<td>Computer Basics Assignment Due</td>
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<td>• Home page Development (cont.)</td>
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<td>- Begin home page &amp; Internet Assignment</td>
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<td>#6 Sound and Imaging Technology</td>
<td>Lab #4: N066 Lagomarcino</td>
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<td>• Analog &amp; digital sound</td>
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<td>- Work on home page &amp; Internet</td>
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<td>• Analog &amp; digital images</td>
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<td>Assignment</td>
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<td>#7 Visual Literacy</td>
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<td>#8 Creating a Videotape</td>
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<td>Internet/Homepage Assignment Due</td>
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<td></td>
<td>• Scripting</td>
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<td>- Videotape production preparation</td>
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<td>• Filmic Techniques</td>
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<td>4. 9/15-19</td>
<td>#9 Videotape production</td>
<td>Lab #6: N031 Lagomarcino</td>
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<td></td>
<td>• Digital vs. Analog</td>
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<td>Video script due</td>
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<td>• Filmic Techniques (cont.)</td>
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<td>- Scripting conferences during lab</td>
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<td>#10 Learning Theories &amp; Technology Integration Models</td>
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<td>• constructivism &amp; direct instruction</td>
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<td>- Hypermedia Project Fair</td>
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<td>#11 Learning Theories &amp; Technology</td>
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<td>(Browse &amp; critique hypermedia projects)</td>
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<td>Integration Models</td>
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<td>Critique sheets due at the end of lab</td>
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<td>#12 Hypermedia in Teaching &amp; Learning</td>
<td>Lab #8: N066 Lagomarcino</td>
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<td></td>
<td>• What is Hypermedia?</td>
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<td>Video Production &amp; Screenwriting</td>
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<td>#13 Hypermedia Production</td>
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<td>- Screenwriting conference during lab</td>
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<td>• Planning &amp; Preparation</td>
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<td>• Concept maps &amp; flow charts</td>
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<td>#14 Hypermedia Production (cont.)</td>
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<td>• Introduction to Hyperstudio</td>
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**SEQUENCE OF TOPICS**

Fall, 1997
8. 10/13-17 #15 NO LECTURE
   ITEC/lASCD Conference
#16 Issues in Technology
   - Work on Hypermedia Project
   • Equity
   QUIZ #1 - 25 points - everything up to now

9. 10/20-24 #17 Issues in Technology
   • Ethics
#18 Introduction to Problem Solving
   • Technology's Role
   • Problem Solving Software
   QUIZ #1 - 25 points - everything up to now

10. 10/27-31 #19 Problem Solving (cont.)
    • Problem Solving Strategies
    • Introduction to Logowriter
#20 Problem Solving (cont.)
    • Using Logowriter

11. 11/3-7 #21 Taxonomies of Software
    Chp. 4
    p. 85-100
#22 Desktop Publishing
    Chp. 6
    p. 157-160

12. 11/10-14 #23 Databases in Teaching & Learning
    Chp. 5
    p. 141-155
#24 Spreadsheets in Teaching & Learning
    Chp. 5
    p. 134-141

13. 11/17-21 #25 Evaluating & Selecting Instructional Technology
    Chp. 4
    p. 116-126
#26 Networking
   • How Does it Work?
   • Set-Up
   QUIZ #2 - 25 points - everything since quiz #1

14. 12/1-5 #27 Optical Technology & Others
   • Laserdisc & CDs
#28 Integrating Technology into the Content Areas
   Chp. 7
   p. 177-194
   Chp. 11-15
   (as needed)

15. 12/8-12 #29 Future Trends of Technology
    • General Characteristics
    • Examples
#30 Emerging Technologies
   • Artificial Intelligence
   • Virtual Reality
   Chp. 10
   p. 239-253

16. 12/15-19 FINAL EXAM
APPENDIX B. DOCUMENTATION OF HUMAN SUBJECTS APPROVAL
Checklist for Attachments and Time Schedule. The following are attached (please check):

12. x Letter or written statement to subject indicating clearly:
   a) the purpose of the research
   b) the use of any identifier codes (names, numbers), how they will be used, and when they will be removed (see item 17)
   c) an estimate of time needed for participation in the research
   d) if applicable, the location of the research activity
   e) how you will ensure confidentiality
   f) in a longitudinal study, when and how you will contact subjects later
   g) that participation is voluntary; nonparticipation will not affect evaluations of the subject

13. Signed consent form (if applicable)

14. Letter of approval for research from cooperating organizations or institutions (if applicable)

15. x Data-gathering instruments

16. Anticipated dates for contact with subjects:
   First contact: 8/97       Last contact: 9/97

17. If applicable: anticipated date that identifiers will be removed from completed survey instruments and/or audio or visual tapes will be erased: 8/98

18. Signature of Departmental Executive Officer

19. Decision of the University Human Subjects Review Committee:
   X Project Approved       Project Not Approved       No Action Required

Patricia M. Keith, Committee Chairperson (signature or committee chairperson)
APPENDIX C. COVER LETTER AND RESEARCH INSTRUMENTS
Computers have become commonplace in our personal as well as professional lives. It is important for educators to know how to effectively use computers in the classroom. The purpose of this study is to gather information about preservice teachers’ preconceptions of the role of the computer in teaching and learning.

This survey has been designed to gather information about preservice teachers’ background, experience with computers in education, attitudes towards computers in general and in education, computer proficiency, perceptions of the role of the computer in education and beliefs about knowledge acquisition.

Your participation in this survey is voluntary but very critical to this study. The data collected through the use of this survey will have a significant contribution to the preparation of future teachers and their use of technology in the classroom. It is important that you complete the survey based on your opinions and experiences to accurately represent the preservice teacher population. Responding to this survey will take approximately twenty minutes and arrangements have been made for you to complete the survey during class time.

Be assured that your answers will be handled with strict confidence. Only group data will be reported; no individual respondent will be identified in any reports. The answers given by you in this survey will in no way affect your grade in this class. To separate your survey from your classmate, we are asking you to provide the last four digits of your social security number and you birth date. This method of coding was chosen because it is unique to you and can be easily remembered. All codes will be removed and surveys will be destroyed after the data has been analyzed.

We thank you for your time and will be happy to furnish you with additional information and results of the study if you are interested.

Respectfully,

William A. Gaderá
Principal Investigator
515-294-6280

Dr. Constance Hågrøve
Major Professor
515-294-5343
The purpose of this survey is to gather information about preservice teachers' perceptions and beliefs about computers in education. There are seven sections in this survey: background, experience with computers in education, attitudes about computers in general, attitudes about computers in education, computer proficiency, and perceptions of the role of computers in the classroom.

Your participation in this survey is voluntary. All of your responses on this survey will be kept strictly confidential. Only group data will be reported; no individual respondent will be identified in any reports. The survey will take approximately 30 minutes to complete. Thank you for participating in this survey.

To separate your survey from your classmates, please provide the last four digits of your social security number and your birth date.

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### Section I: Background Information

The purpose of this section is to gather information about you and your career plans. Please answer each question or statement by choosing the answer that most appropriately describes you. If there is a blank, please write the answer on the line provided.

1. How old are you? ______

2. What year are you in college?
   a. first year
   b. sophomore
   c. junior
   d. senior
   e. fifth year senior
   f. other (please specify) _____________

3. What is your gender?
   a. female
   b. male

4. Is your major Education?
   a. yes (go on to question 4b)
   b. no (go on to question 4d)
4b. What area of Education are you in?
   a. El Ed
e. Sp Ed
   b. Sec Ed
   f. Itch
c. ECE
g. FCS
d. Ag Ed
   h. Other

4c. What is your content area of specialization (Science, Math)?

(Continue on to question 5)

4d. If your major is not Education, what is your major?

4e. If your major is not education are you earning a teaching certificate/licensure?
   a. yes
   b. no

5. Do you plan to earn the Educational Computing Minor?
   a. yes
   b. no

6. What are your plans the first year after graduation from college?
   a. go to graduate school
   b. teach in K-12 education
   c. work in the business sector
   d. join the military
   e. other (please specify)

7. What type of student do you consider yourself to be?
   a. "A" student
   b. "B" student
   c. "C" student
   d. "D" student
   e. other (please specify)

8. Before enrolling in this class, have you had formal instruction on how to use a computer?
   a. yes
   b. no, self-taught (go to item 9)
   c. no, taught by a friend or other (go to item 9)
   b. no, no instruction at all (go to item 9)
8b. If yes, from where did first you receive formal computer instruction?
   a. high school course
   b. community college course
   c. workshop
   d. videotape or television lesson
   e. university course
   f. other (please specify) _______________

9. How often do you use a computer (for any reason)?
   a. more than once a day
   b. usually once a day
   c. usually once a week
   d. once or twice a month
   e. once or twice a semester

10. For what purposes do you regularly use a computer (i.e. 3 or more times per week)?
    10a. to communicate with others via email
    10b. to complete homework (i.e. word processor)
    10c. for entertainment (games)
    10d. to find information (i.e. internet)
    10e. to write computer programs
    10f. other (please specify) _______________

11. Do you own a computer?
   a. yes
   b. no

12. Did you have a computer at home when you were growing up?
   a. yes
   b. no

Section II: Experience with the computer in education
The purpose of this section is to gather information about your experiences with computers in education. For this section, computer-related technology refers to constantly evolving forms of computers, peripherals and supporting software used to enhance learning. For each item, choose the answer that most appropriately describes your experiences. If there is a blank, please write the answer on the line provided.

1. In your undergraduate courses, did any of your instructors in non-computer-related courses use computer-related technology?
   a. yes
   b. no (go to item 8)
1b. If yes, in how many non-computer courses were computer-related technologies used by the instructor?
   a. one
   b. two
   c. three
   d. four or more

Questions 2-7
Using a scale where
   0 = never used,
   1 = occasionally used (once or twice a term),
   2 = sometimes used (once a month),
   3 = regularly used (once a week or more),
indicate the level to which your personal experience is consistent with each statement.

   0 = never, 1 = occasionally, 2 = often, 3 = regularly

In your undergraduate courses, how often were computer-related technologies used:
2. for teacher-delivered presentations. 0 1 2 3
3. for student-delivered presentations. 0 1 2 3
4. for student activities 0 1 2 3
5. to access information (CD-ROM, internet). 0 1 2 3
6. to communicate (email). 0 1 2 3
7. to create a product (write a paper, do a project). 0 1 2 3

8. In your K-12 schooling, did any of your instructors in non-computer related courses use computer-related technology?
   a. yes
   b. no (go to section III)

8b. How many non-computer courses have you attended in which computer-related technologies were used by the instructor?
   a. one
   b. two
   c. three
   d. four or more
Questions 9-14
Using a scale where
0 = never used,
1 = occasionally used (once or twice a term),
2 = sometimes used (once a month),
3 = regularly used (once a week or more),
indicate the level to which your personal experience is consistent with each statement.

In your K-12 schooling, how often were computer-related technologies used:
9. for teacher-delivered presentations. 0 1 2 3
10. for student-delivered presentations. 0 1 2 3
11. for student activities. 0 1 2 3
12. to access information (CD-ROM, internet). 0 1 2 3
13. to communicate (email). 0 1 2 3
14. to create a product (write a paper, do a project). 0 1 2 3

Section III: Attitudes about computers in general
The purpose of this section is to gather information about your attitudes toward computers. Using a scale where 0 = I don’t know, 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree, indicate the level to which your attitudes are consistent with each statement.

0 = I don’t know, 1 = strongly disagree, 2 = disagree,
3 = agree, 4 = strongly agree

1. Computers make me nervous. 0 1 2 3 4
2. I can’t understand how a computer works. 0 1 2 3 4
3. I don’t trust computers. 0 1 2 3 4
4. I am learning how to use computers only because I have to. 0 1 2 3 4
5. Once you understand the basics, computers are easy to use. 0 1 2 3 4
Section IV: Attitudes about computers in education

The purpose of this section is to gather information about your attitudes toward computers in education. Using a scale where 0 = I don’t know, 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree, indicate the level to which your attitudes are consistent with each statement.

0 = I don’t know, 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree

1. The primary reason for using computers in the classroom is to develop students’ keyboarding skills. 0 1 2 3 4

2. Computer-related technologies are an important part of the future for improving the quality of education. 0 1 2 3 4
0 = I don't know, 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree

3. Computer-related technologies should be used to improve learning throughout the curriculum.
   0 1 2 3 4

4. Computer-related technologies are unnecessary luxuries in school settings.
   0 1 2 3 4

5. Computer-related technologies are of little value in education because they can be used to teach only one or two subjects.
   0 1 2 3 4

6. Computers should be used, mainly, to supplement the curriculum.
   0 1 2 3 4

7. Computers will soon replace the teacher.
   0 1 2 3 4

8. Overall, I think the computer is a very important tool for instruction.
   0 1 2 3 4

9. Computer-related technologies are of little use in the classroom because they are too difficult to use.
   0 1 2 3 4

10. Computers are useful when teaching thinking and problem solving skills.
    0 1 2 3 4

11. Children should be taught how to use computers so they will know how to use them when they enter the business world.
    0 1 2 3 4

12. The computer gives better feedback to a student than a teacher does.
    0 1 2 3 4

13. Without the use of the computer, students often obtain knowledge they never use.
    0 1 2 3 4

14. It is more important for students to practice their handwriting skills, when learning to write stories, than to use a word processor.
    0 1 2 3 4

15. The computer is more effective than a teacher in providing individual feedback.
    0 1 2 3 4

16. Computers can give a student a better basic understanding of a topic than a lecture can.
    0 1 2 3 4
0 = I don't know, 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree

17. A computer simulation program can help a student understand a new concept better than a teacher. 0 1 2 3 4

18. Anything that can be done in education with a computer can be done just as easily without one. 0 1 2 3 4

19. Computers should not be used in the classroom. 0 1 2 3 4

20. Computers should be used by students who complete their school work early. 0 1 2 3 4

21. Computers should be used primarily to help "slow" students keep up with the rest of the class. 0 1 2 3 4

Section V: Computer Proficiency

The purpose of this section is to gather information about your skill and level of proficiency in using various computer applications. Indicate your level of proficiency with each item using a scale where:

0 = Unfamiliar - I do not know what this item is;
1 = None - I have no proficiency. I know what this item is, but I don't know how to use it;
2 = Low - I have little proficiency with this item, and I could use instruction;
3 = Medium - I have some proficiency with this item, but I could use some advanced instruction;
4 = High - I have very high proficiency with this item.

0 = unfamiliar, 1 = no proficiency, 2 = low proficiency, 3 = medium proficiency, 4 = high proficiency

Computer Based Instruction

1. Drill and Practice 0 1 2 3 4

2. Tutorials 0 1 2 3 4

3. Educational Games 0 1 2 3 4

4. Problem Solving 0 1 2 3 4

5. Simulations 0 1 2 3 4
0 = unfamiliar, 1 = no proficiency, 2 = low proficiency, 3 = medium proficiency, 4 = high proficiency

Computer Tool Software
1. Word Processing
2. Database
3. Spreadsheets
4. Desktop Publishing
5. Graphics/Drawing programs
6. Presentation software (e.g. Power Point)
7. Hypermedia/ Interactive Multimedia (e.g. Hypercard, Hyperstudio, Linkway)

Telecommunications
1. e-mail
2. internet (e.g. WWW)
3. networking (e.g. LAN, WAN)
4. File Transfer Protocol (FTP)

Other
1. Distance Education (e.g. ICN, C U See Me)
2. Programming (e.g. Logo, C++, BASIC, Pascal)
3. CD-ROM
4. Computer hardware (e.g. modem, scanner)
5. Hyper Text Mark-up Language (HTML)
Section VI: Impact of computer use on learning

The purpose of this section is to gather information about your perceptions of the impact of computer use on learning. Below are statements of computer use in the classroom. Using a scale where A = agree, D = disagree, indicate whether you consider each statement to be an effective use of the computer to impact student learning. Also, indicate the level to which you agree or disagree with each statement using the following scale:

1 = little impact on learning; students may acquire knowledge and technology skills.
2 = moderate impact on learning; students will obtain content knowledge and comprehension.
3 = strong impact on student learning; students will develop high-order thinking skills.

Student learning is positively impacted when:

1. Students use a computer program that simulates how electrons flow through a circuit before a lecture.

2. Using a computer to replace a textbook to introduce new information.

3. Using the card catalog or reader’s guide to find information instead of a computer because the computer makes finding information too easy.

4. Using the computer to review the learning objectives of formal instruction.

5. Using a computer program to practice basic math concepts after instruction.

6. Using computers to help students build and expand upon previously developed concepts.

7. Using a computer to learn about a topic instead of learning about the topic via a lecture.
**Student learning is positively impacted when:**

8. Using a computer for desktop publishing in a science classroom.
   
   | A = Agree | 1 | 2 | 3 |
   | D = Disagree | 1 | 2 | 3 |

9. Using a computer to reinforce previously learned topics instead of teacher-directed review activities.
   
   | A = Agree | 1 | 2 | 3 |
   | D = Disagree | 1 | 2 | 3 |

10. Using a computer to convey information traditionally conveyed with a book.

   | A = Agree | 1 | 2 | 3 |
   | D = Disagree | 1 | 2 | 3 |

11. Students use a computer prior to formal instruction (making the teacher’s job easier).

   | A = Agree | 1 | 2 | 3 |
   | D = Disagree | 1 | 2 | 3 |

12. Using a computer to collect and acquire information when researching a topic.

   | A = Agree | 1 | 2 | 3 |
   | D = Disagree | 1 | 2 | 3 |

13. Using calculators to manipulate mathematical data.

   | A = Agree | 1 | 2 | 3 |
   | D = Disagree | 1 | 2 | 3 |

14. Using the computer to introduce a student to a new idea before formally teaching it in the classroom.

   | A = Agree | 1 | 2 | 3 |
   | D = Disagree | 1 | 2 | 3 |

15. Using a computer to practice math problems instead of flash cards.

   | A = Agree | 1 | 2 | 3 |
   | D = Disagree | 1 | 2 | 3 |

16. Using the computer to help students bring together topics and ideas that they might not have otherwise connected.

   | A = Agree | 1 | 2 | 3 |
   | D = Disagree | 1 | 2 | 3 |

17. Using the computer as an environment for students to expand build upon their basic problem-solving skills to address real-world problems (e.g. global warming).

   | A = Agree | 1 | 2 | 3 |
   | D = Disagree | 1 | 2 | 3 |
Student learning is positively impacted when:

18. Replacing a book with a computer to obtain information.  
   | A = Agree | 1 = Slightly | 2 = Moderately | 3 = Strongly |
   | D = Disagree |                          |                 |               |
   | A --> | 1 2 3 |                          |                 |               |
   | D --> | 1 2 3 |                          |                 |               |

19. The computer is used as an object for students to express, reflect and develop their thinking skills.  
   | A = Agree | 1 = Slightly | 2 = Moderately | 3 = Strongly |
   | D = Disagree |                          |                 |               |
   | A --> | 1 2 3 |                          |                 |               |
   | D --> | 1 2 3 |                          |                 |               |

20. Students use a word processor to write a story instead of pen and paper.  
   | A = Agree | 1 = Slightly | 2 = Moderately | 3 = Strongly |
   | D = Disagree |                          |                 |               |
   | A --> | 1 2 3 |                          |                 |               |
   | D --> | 1 2 3 |                          |                 |               |

21. Students work with a computer program that simulates photosynthesis before the instructor formally teaches it in a science class.  
   | A = Agree | 1 = Slightly | 2 = Moderately | 3 = Strongly |
   | D = Disagree |                          |                 |               |
   | A --> | 1 2 3 |                          |                 |               |
   | D --> | 1 2 3 |                          |                 |               |

22. Using a computer database to develop students' organizational skills instead of having students use notecards.  
   | A = Agree | 1 = Slightly | 2 = Moderately | 3 = Strongly |
   | D = Disagree |                          |                 |               |
   | A --> | 1 2 3 |                          |                 |               |
   | D --> | 1 2 3 |                          |                 |               |

23. The computer is used to help students connect ideas and topics together.  
   | A = Agree | 1 = Slightly | 2 = Moderately | 3 = Strongly |
   | D = Disagree |                          |                 |               |
   | A --> | 1 2 3 |                          |                 |               |
   | D --> | 1 2 3 |                          |                 |               |

24. The student works with a simulation program before formal instruction.  
   | A = Agree | 1 = Slightly | 2 = Moderately | 3 = Strongly |
   | D = Disagree |                          |                 |               |
   | A --> | 1 2 3 |                          |                 |               |
   | D --> | 1 2 3 |                          |                 |               |

25. Using computers for drill and practice.  
   | A = Agree | 1 = Slightly | 2 = Moderately | 3 = Strongly |
   | D = Disagree |                          |                 |               |
   | A --> | 1 2 3 |                          |                 |               |
   | D --> | 1 2 3 |                          |                 |               |
The purpose of this portion of the survey is to gather information about preservice teachers’ epistemological beliefs and beliefs about computer use in the classroom. There are two sections to this part, Attitudes About Reality and Beliefs About Effective Computer Use for Learning Narrative.

Your participation in this survey is voluntary. All of your responses on this survey will be kept strictly confidential. Only group data will be reported; no individual respondent will be identified in any reports. The survey will take approximately 20 minutes to complete. Please answer all items to the best of your ability. Thank you for participating in this survey.

To separate your survey from your classmates, please provide the last four digits of your social security number and your birth date.

To separate your survey from your classmates, please provide the last four digits of your social security number and your birth date.

Section I: Attitudes About Reality
The following 40 items represent statements about the way the world works. You will probably find that you agree with some of the statements and disagree with others, to varying extents. Please indicate your reaction to each statement according to the following scale:

1 = Strongly disagree with this statement
2 = Moderately disagree with this statement
3 = Slightly disagree with this statement
4 = Exactly neutral with this statement
5 = Slightly agree with this statement
6 = Moderately agree with this statement
7 = Strongly agree with this statement

1. Who has power is a central issue in understanding how society works.
2. It is maladaptive to refuse to conform to the demands of society.
3. Science has underestimated the extent to which genes affect human behavior.
4. Some nonconformity is necessary for social change to occur.
5. The way scientists choose to investigate problems is influenced by the values of their society.
6. If one works hard at solving a problem, one can usually find the answer.
7. If everyone learns what is important to them, the world would take care of itself.
8. Most sex differences have an evolutionary purpose.
9. People who achieve success usually deserve it.
10. The saying “You shall know the truth and the truth shall make you free” is still valid today.
11. The more technology we develop the better our science will be.
12. Accidental solutions to problems are very rare.
13. At the present time, people are recognized for their achievements regardless of their race, sex, or social class.

14. People cannot be trained to be creative - they are either born that way or not.

15. People who demand social change are usually those who have been ineffectual in present society.

16. The facts of science change over time.

17. The United States has the most equal society in the world.

18. Once a scientific fact is discovered it remains part of that science from then on.

19. We communicate much more information to each other than we are aware of doing.

20. Personality characteristics account for most differences in human behavior.

21. Important ideas are most likely to originate from prestigious institutions.

22. Effort can often make up for an absence of talent in an area.

23. It is more important to be liked than to be powerful.

24. Biological sex, sex role, and sexual preference are highly related to each other in normal people.

25. The mother-infant relationship is a key to understanding adult behavior.

26. People who are part of minority groups should not have to worry about other people in these groups who are less successful than they are.

27. Unconscious motivations are very important for understanding human behavior.

28. Deviance is not a particular kind of behavior, but a perception by others that that behavior is socially unacceptable.

29. Society must protect itself from those who do not accept its rules.

30. Famous people's research is frequently cited in order to lend prestige to the findings of less renowned researchers.

31. Most people would cooperate with each other if only they understood that everyone would benefit by such actions.

32. Scientific merit is determined by the excellence of the work done.

33. It is important to decrease the distance between the "real world" and the scientific laboratory.

34. A great deal can be learned about human behavior by studying animals.

35. Those who are nonconformists during one period of history are often found to be innovators by future eras.

36. The acceptability of evidence is related to the importance of the person who discovers it.
37. It is better not to know too much about things that cannot be changed. 1 2 3 4 5 6 7

38. Physiological differences limit the degree to which males and females can learn to be similar to each other. 1 2 3 4 5 6 7

39. People who have the least to lose in a relationship will be more likely to get their way in that relationship. 1 2 3 4 5 6 7

40. Most social problems are solved by a few very qualified individuals. 1 2 3 4 5 6 7

Section II: Beliefs About Effective Computer Use for Learning Assignment

The purpose of this section is to collect narrative information about your beliefs about effective computer use for learning. Please write your answer to the question on the lines provided below.

Select a discipline (i.e., math, science, English) and describe an example of how you would incorporate the computer into a lesson.
APPENDIX D. VALIDATION OF "IMPACT OF COMPUTER USE ON LEARNING" SECTION OF THE RESEARCH INSTRUMENT
Validation of “The Impact of Computer Use on Learning” Scale

The “Impact of Computer use on Learning” (ICL) section of the survey was considered an integral part. This section of the survey was used to decipher subject’s opinion of effective computer use for learning. A committee of four experts in computer use in education met to discuss, revise and categorize the items in this portion. During the first meeting, the committee examined and categorized each item of the section. The items were organized based on the five categories of the Thomas and Boysen Taxonomy (1984). Revisions and additions to the section were made according to the comments received by those on the committee and a second meeting was scheduled.

During the second meeting the committee again examined and categorized the items. The survey was again discussed, revisions and additions were suggested. The revisions, additions and recommendations were made to the section accordingly. This procedure was done a total of four times. After each meeting, the items and the correlating categories that the experts chose were placed into a spread sheet resulting in a category score for each item. After the fourth meeting, questions with low scores were eliminated and five items from each category with scores of eight or higher were kept resulting in the final section of the instrument.
APPENDIX E. THOMAS AND BOYSEN FREQUENCY DISTRIBUTION
HISTOGRAMS
Scale:
Use of the computer in this manner will positively impact student learning.
1 - strongly disagree, 3 - moderately disagree, 5 - slightly disagree,
7 - slightly agree, 9 - moderately agree, 11 - strongly agree

Figure 3. Distribution of Respondents Ranking: Utilizing
Scale:
Use of the computer in this manner will positively impact student learning.
1 - strongly disagree, 3 - moderately disagree, 5 - slightly disagree,
7 - slightly agree, 9 - moderately agree, 11 - strongly agree

Figure 4. Distribution of Respondents Ranking: Reinforcing
Use of the computer in this manner will positively impact student learning.  
1 - strongly disagree, 3 - moderately disagree, 5 - slightly disagree,  
7 - slightly agree, 9 - moderately agree, 11 - strongly agree

Figure 5. Distribution of Respondents Ranking: Integrating
Scale:
Use of the computer in this manner will positively impact student learning.
1 - strongly disagree, 3 - moderately disagree, 5 - slightly disagree,
7 - slightly agree, 9 - moderately agree, 11 - strongly agree

Figure 6. Distribution of Respondents Ranking: Informing
Use of the computer in this manner will positively impact student learning. 
1 - strongly disagree, 3 - moderately disagree, 5 - slightly disagree,
7 - slightly agree, 9 - moderately agree, 11 - strongly agree

Figure 7. Distribution of Respondents Ranking: Experiencing
APPENDIX F. ATTITUDE FACTOR ITEMS, LOADINGS, AND RELIABILITY COEFFICIENTS
Factors and Factor Loadings for Attitudes About Computers in General

**Factor 1. Confused about computers factor** (r = .784)

Item 1 - Computers make me nervous. (.738)

Item 2 - I can't understand how a computer works. (.660)

Item 4 - I am learning how to use computers only because I have to. (.631)

Item 7 - I often become lost, confused, and frustrated when I use computers. (.654)

Item 11 - I lack confidence in using computers to complete my work. (.655)

**Factor 2. Comfortable with computers** (r = .673)

Item 5 - Once you understand the basics, computers are easy to use. (.544)

Item 8 - Without computers, many things in life would be difficult and time-consuming to accomplish. (.679)

Item 10 - I am comfortable using computer-related technologies for my work. (.517)

Item 13 - The computer is useful for accessing and organizing information. (.775)
Factors and Factor Loadings for Attitudes About Computers in Education

Factor 1. Computers should be used in education \((r = .693)\)

Item 2 - Computer-related technologies are an important part of the future for improving the quality of education. \((.720)\)

Item 3 - Computer-related technologies should be used to improve learning throughout the curriculum. \((.737)\)

Item 8 - Overall, I think the computer is a very important tool for instruction. \((.713)\)

Item 11 - Children should be taught how to use computers so they will know how to use them when they enter the business world. \((.558)\)

Factor 2. Computers are an unnecessary luxury in education \((r = .547)\)

Item 4 - Computer-related technologies are unnecessary luxuries in school settings. \((.646)\)

Item 5 - Computer-related technologies are of little value in education because they can be used to teach only one or two subjects. \((.658)\)

Item 19 - Computers should not be used in the classroom. \((.528)\)

Factor 3. Computers are better than teachers \((r = .576)\)

Item 12 - The computer gives better feedback than a teacher does. \((.672)\)
Item 13 - Without the use of the computer, students often obtain knowledge they never use. (.509)

Item 15 - The computer is more effective than a teacher in providing individual feedback. (.698)

Item 17 - A computer simulation program can help a student understand a new concept better than a teacher. (.562)

Factor 4. Computers should be used for reward (r = .520)

Item 20 - Computers should be used by students who complete their work early. (.797)

Item 21 - Computers should be used primarily to help "slow" students keep up with the rest of the class. (.720)
APPENDIX G. ADDITIONAL EXAMINATION OF INDEPENDENT VARIABLES
Additional Examination of Independent Variables

In addition to the variables identified when the study was designed, the researcher used many of the demographic characteristics as independent variables to further calculate the results, including: gender, year in college, and formal instruction. To determine if a significant difference existed between groups in the areas of computer proficiency, attitudes about computers in general, attitudes about computers in education, attitudes about reality, and beliefs about computer use for learning a series of t-tests and analyses of variances were computed.

A t-test was computed to compare differences between gender on computer proficiency. The t-test showed that males tended to rate themselves significantly higher than the females in terms of their proficiency with computer based instruction programs ($p=.037$), telecommunication software ($p=.036$), and other computer related technologies (i.e., programming software, HTML, computer hardware) ($p=.034$). Furthermore, males had significantly more positive attitudes towards computer use in general than did the female respondents ($p=.012$).

Because the distribution of respondents across year in college was even, the researcher thought that year in college and gender with year in college were important independent variables to examine. Lower division respondents were those who were in their first or sophomore year of college ($n = 117$). Upper division respondents were those in their junior year of
college or higher (n = 159). To determine if differences existed between lower and upper division students on computer proficiency attitudes toward computers, attitudes toward computers in education, and attitudes about reality t-tests were computed. The t-test showed that lower division students tended to rate themselves with significantly higher computer proficiency for telecommunication software (p=.035) than did upper division students. Moreover, lower division students also had significantly higher attitudes about reality (p=.003) than did the upper division students. Thus, the first year and sophomore students held more constructivist world views than the junior and seniors. To compare differences between year in college and gender, a Scheffe' analysis of variance was computed. Results showed that lower division males tended to rate themselves with higher computer proficiency scores for telecommunication software, computer based instruction software, and other computer-related technologies at the .05 level. In addition first and second year females tended to rate themselves with higher attitudes about reality at the .05 level.

To examine the effects of frequency of computer use, an analysis of variance was computed. The independent variable (frequency of computer use) consisted of four levels: use the computer more than once a day, use the computer once a day, use the computer once a week, use the computer once a month. Results showed that in all areas of computer proficiency, subjects who used the computer once a day or more had significantly higher computer
proficiency scores than those who used the computer less often at the .05 level. Frequency of computer use did not result in significantly higher attitudes towards computer use.

To determine the effects of formal computer instruction a t-test was computed to compare those who had received formal computer instruction and those who had not. Results showed that subjects who received formal computer instruction rated their computer proficiency, in all categories, higher than those who had not received formal computer instruction (Table 8).

Data involving computer ownership showed that more than fifty percent (51.4%) of the respondents had a computer when they were growing up and forty six percent (46.4%) currently own a computer. Subjects who reported that they had a computer and have a computer currently (n=75) were compared with subjects who did not have a computer growing up and do not have a computer currently (n=80). Results of a t-test showed that participants who had a computer growing up and currently have a computer can conceptualize all five of the Thomas and Boysen categories significantly higher than participants who did not have a computer growing up and do not have a computer currently (Table 9). In addition, subjects who both had and have computers tended to rate themselves with significantly higher computer proficiency scores across all categories than those who did not have computers (Table 10).
Table 8. Comparison of Subject Who Received Formal Computer Instruction

<table>
<thead>
<tr>
<th>Computer proficiency categories</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer based instruction</td>
<td>276</td>
<td>4.47</td>
<td>.000***</td>
</tr>
<tr>
<td>Tool software</td>
<td>276</td>
<td>6.63</td>
<td>.000***</td>
</tr>
<tr>
<td>Telecommunication software</td>
<td>276</td>
<td>4.76</td>
<td>.000***</td>
</tr>
<tr>
<td>Other computer related technologies</td>
<td>276</td>
<td>5.16</td>
<td>.000***</td>
</tr>
</tbody>
</table>

*** = p>.001  ** = p>.01  * = p>.05

Table 9. Comparison of Subjects Who Had Computers Growing Up and Have Computers Currently and Thomas and Boysen Categories

<table>
<thead>
<tr>
<th>Thomas and Boysen levels</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiencing</td>
<td>153</td>
<td>2.92</td>
<td>.004**</td>
</tr>
<tr>
<td>Informing</td>
<td>153</td>
<td>2.69</td>
<td>.008**</td>
</tr>
<tr>
<td>Reinforcing</td>
<td>152</td>
<td>3.55</td>
<td>.001***</td>
</tr>
<tr>
<td>Integrating</td>
<td>152</td>
<td>3.29</td>
<td>.001***</td>
</tr>
<tr>
<td>Utilizing</td>
<td>152</td>
<td>3.20</td>
<td>.002**</td>
</tr>
</tbody>
</table>

*** = p>.001  ** = p>.01  * = p>.05

Table 10. Comparison of Subjects Who Had Computers Growing Up and Have Computers Currently and Computer Proficiency Categories

<table>
<thead>
<tr>
<th>Computer proficiency categories</th>
<th>df</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer based instruction</td>
<td>154</td>
<td>5.43</td>
<td>.000***</td>
</tr>
<tr>
<td>Tool software</td>
<td>154</td>
<td>6.81</td>
<td>.000***</td>
</tr>
<tr>
<td>Telecommunication software</td>
<td>154</td>
<td>5.65</td>
<td>.000***</td>
</tr>
<tr>
<td>Other computer related technologies</td>
<td>154</td>
<td>6.90</td>
<td>.000***</td>
</tr>
</tbody>
</table>

*** = p>.001  ** = p>.01  * = p>.05

In summary, male respondents had higher computer proficiency than females; younger subjects had higher computer proficiency and more constructivist views about knowledge acquisition; subjects who received
formal computer instruction had higher computer proficiency and subjects who had a computer while growing up and have a computer currently had higher computer proficiency and significantly conceptualized all levels of the Thomas and Boysen Taxonomy better than subjects who never owned a computer.
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These are the people that without their help, this project would have never been completed. And, these are the people who I appreciate the most, for their caring, sharing, reinforcing and effort to help me to reach this lofty goal.

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Secondly, I have to thank all my friends and co-workers at The Center for Technology in Learning and Teaching for their tips, suggestions, insights and especially their help with my data input. Thanks Rhea, Hong, Kay, Muktha, Jeff, Carline, Marv, Dr. Schmidt, Dr. Bradshaw, Dr. Volker, Dr. Thompson, Dr. Thomas, and Dr. Boysen. I also have to thank Wayne for knowing when to bring me a drink and when to leave me alone. And, Sara for her delightful distractions. Thanks.

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