LEARNING STYLES, SELF-EFFICACY, AND SATISFACTION WITH ONLINE LEARNING: IS ONLINE LEARNING FOR EVERYONE?

Debra Gallagher

A Dissertation

Submitted to the Graduate College of Bowling Green
State University in partial fulfillment of
the requirements for the degree of

DOCTOR OF EDUCATION

May 2007

Committee:

Dr. Rachel Vannatta, Advisor

Dr. Judith Edminster
Graduate Faculty Representative

Dr. Doug Garman

Dr. Terry Herman

Dr. Barbara Moses

Dr. Judith Zimmerman

ABSTRACT

Rachel Vannatta, Advisor

This causal-comparative study examined learning style differences in and computer self-efficacy and satisfaction with online professional development. Thirty teachers enrolled in a Lesson Lab BreakThrough Mathematics online course completed three different instruments: Kolb's Learning Style Inventory (Kolb, 1999); Computer Usage Self-Efficacy Scale (Cassidy & Eachus, 2002); and Web-Based Learning Instrument (Chang & Fisher, 2003).

Kolb's Learning Style inventory divulged the percentage of participants with the Assimilator learning style was much higher than the other three learning styles—Accommodator, Diverger, and Converger. Analysis of Variance (ANOVA) was used to examine group differences in computer self-efficacy and satisfaction with online professional development. T-test of related samples compared pre- and post-computer self-efficacy scores. The results indicated a significant increase from pre- to post- survey ($p = .027$). Pearson Correlation revealed no significant relationship between computer self-efficacy (pre or post) and satisfaction with online learning.

The results of this study revealed participants in an online course do not differ significantly by learning style, with respect to computer self-efficacy and satisfaction with online learning. However, computer self-efficacy increased significantly from pre- to post- survey.

I dedicate this dissertation to my wonderful parents. My mother, Carolyn Goldsmith, is my best friend and has always been “The Wind Beneath My Wings”. My late father, Ernest Goldsmith, Sr., always supported me with love and led by example.

ACKNOWLEDGMENTS

I would like to thank to everyone who has assisted me along the journey of completing this dissertation.

I would like to give my sincere thanks to the following people:

Jack, Colleen, and Molly Gallagher, my family, for their support and understanding of my absence from family time as I worked on my lifelong goal of completing my doctorate.

Carolyn Goldsmith, my mother and friend, for all of the time she spent listening and supporting me through many difficult times.

Dr. Rachel Vannatta, my doctoral committee chair, for her excellent guidance, support, and patience.

Dr. Patrick Pauken for all the extras you do to make this program excellent.

Dr. Barbara Moses, Dr. Terry Herman, Dr. Judith Zimmerman, Dr. Judith Edminster, and Dr. Doug Garman, my doctoral committee, for all the support and suggestions throughout this process.

All my professors in the Educational Administration and Leadership Studies department. You all made this an interesting and worthwhile program.

The members of my cohort. This long journey was much easier because of you.

My colleagues and friends in Life Science, Dr. Dan Brahier, Mrs. Janet Emerine, Dr. Lena Ballone-Duran, Dr. Tracy Huziak-Clark, Dr. Jodi Haney, Dr. Juli McArthur, who were supportive, encouraging, and wonderful friends.

The teachers in the Lesson Lab BreakThrough Mathematics online courses for taking the time to complete the surveys and provide the feedback I needed to complete my dissertation.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I. INTRODUCTION

Introduction to the Problem

The No Child Left Behind (NCLB) Act (2001) mandates a highly qualified teacher in every classroom by the year 2006. One way for teachers to achieve and maintain high quality status is through professional development opportunities in which teachers learn how to improve in content and pedagogy (Guskey, 2002; Loucks-Horsley, 1997; Sparks & Hirsh, 2004). Ongoing professional development is an important factor in preparing and maintaining highly effective teachers (Ingvarson, 1998; Willis, 2002). In most states, ongoing professional development is required for renewal of teaching certificates or licenses, since quality professional development leads to improved practice and increased student achievement (Guskey, 2002; Spark & Hirsch, 2004).

Because of the mandates of NCLB (2001) and the desire for more teachers to stay abreast of current research and best practice, the need for professional development will increase greatly (National Staff Development Council, 2001). One of the greatest challenges in providing professional development will be to find a variety of approaches that will be able to reach the 2.4 million teachers in 85,000 schools in the United States (Corcoran, 1995). Business and industry are moving away from face-to-face training and moving toward electronic delivery; in fact, technology based training is expected to increase to 55% of all training (NSDC, 2001). Education will likely follow the influence of business and increase the amount of professional development opportunities offered electronically.

Professional development to date has been little more than random, one-time workshops or seminars individually selected by educators or school districts to meet the requirement of continuing education hours (Corcoran, 1995; Loucks-Horsley, 1997; Sparks & Hirsh, 1997).

Unfortunately, one-shot workshops fail to produce results (NSDC, 2001). Change in professional development requires multiple opportunities to learn and practice new behaviors, which involves more than a one-shot workshop (Loucks-Horsley, 1997).

Legislation in many states requires educators to set goals and create an Individual Professional Development Plan (IPDP) that outlines the types of professional development in which the educator plans to participate during the school year to improve classroom teaching (NSDC, 2001; Ohio Department of Education, 2001). Professional development is needed to raise academic standards and enhance teachers' knowledge in subject matter and teaching strategies (Corcoran, 1995). Currently, professional development is primarily limited to conferences, workshops, and courses, but efforts are being made to transform professional development by trying new approaches (Corcoran, 1995). Spark and Hirsh (2004) and others have called attention to the need for a better system of professional development. Lesson Lab's BreakThrough Mathematics is an approach to professional development that focuses on providing teachers with a deep content knowledge in mathematics by observing and analyzing classroom practices and then embedding these ideas in their own teaching (Lesson Lab, Inc., 2006).

Although numerous opportunities to attend professional development sessions are available, many barriers exist that prevent teachers from engaging in these activities. These barriers include but are not limited to: 1) fragmented and insufficient time to engage in professional development due to family, work, or social commitments (Evans & Haase, 2001; U.S. Department of Education, 2000), 2) the high cost of professional development to the teacher and to the school district (NSDC, 2001), 3) distant geographical locations of course (Evans & Haase, 2001), and 4) frequency of course offerings (Evans & Haase, 2001). Educators have

many responsibilities in and out of school vying for their time, and added professional development spreads the little time they have very thin. Financially, the driving expenses and childcare encumbered to attend professional development opportunities may strain an educator's budget. One type of professional development delivery that can address several of these barriers is online professional development.

Recently, the online delivery system of professional development has gained interest among teachers, administrators, and professional development providers (Poftak, 2003). Teachers can participate in professional development from the comfort of their own home at a time that is convenient to them (Buerck, Malmstrom, & Peppers, 2003; DeWert, Babinski, & Jones, 2003; Huang, 2002). Well-designed online professional development can be highly effective, and administrators say that online professional development suits their needs as well (Tyre, 2002). Online delivery can be a viable option for teachers to obtain the professional development hours required; however, it is unclear if online delivery is suitable for all teachers.

Rationale

Professional development offers teachers the opportunity to complete coursework to obtain highly qualified status, renew their teaching licenses, and to move up on the salary schedule. Many teachers cannot participate in traditional face-to-face professional development because of time constraints, family obligations, or transportation issues. Online learning is one approach to professional development which allows teachers and instructors to communicate at their convenience (Hew, Knapczyk, & Frey, 2005) while achieving the same rigorous standards as face-to-face instruction (Evans & Haase, 2001).

Successful online learners possess several characteristics. Online learners need to be continuous, self-directed learners, highly motivated, and possess appropriate technology skills

(Boyd, 2004; Evans & Haase, 2001; Palloff & Pratt, 2003). The successful online learner may not be familiar with all types of technology but they are willing to take the initiative and motivated to learn what they do not know (Evans & Haase, 2001).

The convenience of online learning can be a great benefit, but all teachers may not feel comfortable or successful learning online (Boyd, 2004; Hew, Knapczyk, & Frey, 2005; Loucks-Horsley, 1997). Teachers may not have the necessary characteristics of successful online learners: basic technological skills, self-directed learning, and intrinsic motivation (Boyd, 2004).

Learning style may also determine the success of online learners. Learners who prefer reading and reflective analysis, such as the Assimilating Learner in Kolb's model of learning styles (Schaller & Allison-Brunnell, 2003) may be more successful with online learning than other types of learners, such as learners with Accommodating or Divergent learning styles (Schaller & Allison-Brunnell, 2003). However, online courses such as Lesson Lab's BreakThrough Mathematics include a variety of activities ranging from solving problems individually to interacting with other participants on a discussion forum. These different activities allow participants with different learning styles the chance to succeed with activities that are aligned to their particular style and also to provide opportunities to develop other learning style skills. (See Appendix H)

Another possible factor in success with online learning is computer self-efficacy. Cassidy and Eachus (2002) report that computer self-efficacy is the major factor in frequency and success with computer use. One measure of computer self-efficacy is the Computer User Self-Efficacy Scale (CUSE), which is designed to measure computer self-efficacy in adult learners (Cassidy & Eachus, 2002).

Many studies have defined effective professional development (Guskey, 2002; Loucks-Horsley, 1997; Spark & Hirsch, 2004). Several studies have also addressed the advantages and disadvantages of different delivery models of professional development (Graham, 2004; Meyer, 2003). However; very few studies have examined the relationship between learning style, computer self-efficacy and satisfaction with online professional development (Barnes, Preziosi, & Gooden, 2004; McCartney & Shannon, 1999).

Teachers could save time and frustration if they understood the criteria for being successful in an online course. Information about the relationship between learning styles, computer self-efficacy and satisfaction with online learning could be valuable to support which delivery system of professional development is offered by school systems, educational service centers and state and national education organizations.

In order to provide the best professional development for every teacher to achieve the high level of quality mandated by NCLB (2001), providers need to plan quality professional development that provides a delivery system in alignment with each teacher's learning style (NSDC, 2001).

Purpose of the Study

The primary purpose of this causal-comparative study was to examine learning style differences in and computer self-efficacy and satisfaction with online professional development. Participants consisted of 30 teachers enrolled in Lesson Lab, an online professional development program. The first variable, learning style, based on Kolb's Learning Style Inventory categorized teachers as Converger, Diverger, Assimilator or Accommodator learners. The dependent variables were computer self-efficacy and satisfaction with online learning. Computer self-efficacy, defined as how teachers perceive their ability to use computers was measured using the

Computer Usage Self-Efficacy Scale (Cassidy & Eachus, 2002). Satisfaction with online learning, defined as satisfaction in four core areas of online professional development-Access, Interaction, Response, and Results-was measured using the Web-Based Learning Environment Instrument (Chang & Fisher, 2003).

Research Questions

The following research questions were addressed in this study:

1) Do computer self-efficacy and satisfaction with online professional development differ by learning style preference, previous computer experience, grade level, teaching experience, gender, previous computer courses, and age among K – 12 teachers?
2) Does computer self-efficacy increase from the beginning to the end of an online course?
3) Is computer self-efficacy significantly related to satisfaction with online professional development?

Significance of the Study

This causal-comparative study of learning styles, computer self-efficacy and satisfaction of online professional development will make a contribution to the knowledge and practice of professional development providers for K-12 educators. The high cost of professional development, the increased demands on teacher's time, and the availability of technology have created a need for online professional development. The capacity or ability to offer online professional development provides educators with access to more opportunities than they would have in their own local school districts (NSDC, 2001; Yang & Liu, 2004). Teachers participating in online professional development save time by eliminating travel time to a

university or other meeting place and can take advantage of numerous courses offered worldwide.

Many studies have examined adult learning styles. However, few studies have examined the relationship between learning styles, computer self-efficacy, and satisfaction with online professional development. Not all learners may be comfortable with online learning (NSDC, 2001), and there may be only certain kinds of learners that choose to learn using an online format (Boyd, 2004; Oh, Lim, & French, 2004; Schaller & Allison-Brunnell, 2003). This study could assist teachers in the decision-making process for choosing between online, blended, or face to face delivery systems of professional development. Teachers choosing a delivery system that best suits them are more likely to be satisfied with the course. When participants are satisfied with online courses, they are more likely to be successful and complete the course (Palloff & Pratt, 2003).

The results of this study could provide insight into whether a relationship exists between learning styles and attitudes toward online professional development. Such information would be useful to school administrators, educational service centers, other professional development providers, and classroom teachers when planning professional development. Furthermore, this information would allow curriculum directors and other professional development planners to provide teachers with the best delivery system for their learning style, which would lead to more effective teaching and learning.

Definitions of Terms

Accommodator Learning Style- interested in doing things, carrying out plans and involving themselves in new experiences, rely on and at ease with people but sometimes impatient and pushy, solve problems in trial-and-error manner (Kolb, 2000). [See Table 2, p. 28]

Assimilator Learning Style - excel in inductive reasoning, less interested in people and more concerned with abstract concepts (Kolb, 2000). [See Table 2, p. 28]

Computer self-efficacy - the belief a person has about their own abilities to use a computer (Cassidy & Eachus, 2002).

Converger Learning Style - best with conventional learning in situations with a single correct answer or solution to a problem, prefer dealing with things rather than people (Kolb, 2000). [See Table 2, p. 28]

Diverger Learning Style - interested in people, imaginative and aware of their emotions, and have broad cultural interests (Kolb, 2000). [See Table 2, p. 28]

E-learning - electronically-assisted learning (NSDC, 2001).

Highly Qualified Teacher - a teacher that meets the three essential criteria: (1) attaining a bachelor's degree or better in the subject taught; (2) obtaining full state teacher certification; and (3) demonstrating knowledge in the subjects taught (NCLB, 2001).

Learning style - the way you prefer to approach new information (Conner, 2004).

Online course - a course in which no more than one face to face meeting is required (Howland & Moore, 2002).

Online Learning - opportunity to acquire knowledge or skills in a Web-based environment through various online activities or events (James & Bailey, 2002).

Professional development - those processes and activities designed to enhance the professional knowledge, skills and attitudes of educators so that they might, in turn, improve the learning of students (Guskey, p.16).

Satisfaction of online learning - positive perceptions of four areas of online learning environment: Access, Interaction, Response, and Results as scored on a 5-point Likert Scale (Chang & Fisher, 2003).

Self-efficacy - the beliefs a person has about their capability to successfully perform a behavior or task in ways that give them control over the events in their lives (Bandura, 1999).

Assumptions

The underlying assumption of this study was that the participants answered the survey questions honestly. It was assumed that the participants understood the meaning of the items on each of the surveys and possessed the computer skills to accurately complete the online surveys.

Limitations

A limitation of this study was the small sample size, which limited the generalizability of the findings to the larger population of teachers.

Delimitations

This study was limited to the teachers who were enrolled in the online delivery of Lesson Lab's BreakThrough Mathematics. The participants had a choice of delivery; therefore, all learning styles may not be present. The participants choosing online delivery most likely had past experience with technology, which could result in high computer self-efficacy scores. Furthermore, the facilitators may differ in facilitation style, which could affect the outcome of the satisfaction surveys. These are uncontrollable variables.

Organization of the Remaining Chapters

The presentation of this study consists of five chapters. Chapter 2 is a review of related literature. Chapter 3 describes the methodology used in this causal/comparative study. Chapter

4 presents the results of the study. Chapter 5 includes conclusions, discussion of results, recommendations, and suggestions for further study.

CHAPTER II. LITERATURE REVIEW

Professional development for teachers is no longer just an option but mandated by state and national legislation. Teachers are expected to continue learning to meet professional development requirements of school districts and credential requirements. A variety of professional development opportunities are available to teachers in several different modes of delivery. Effective professional development should take into account the particular needs of the adult learner and make learning accessible to them (Butler, 1992) by considering the following:

1) adult learners have different needs than children,
2) professional development is changing,
3) several delivery methods of professional development are available,
4) different learning styles are present in adult learners, and
5) the demand for online professional development is increasing.

This chapter presents a summary of the literature related to the professional development of educators. Specifically, the following areas will be discussed: 1) adult learning; 2) professional development for educators; 3) delivery methods of professional development (face-to-face, online or blended); 4) learning styles and online learning; 5) computer self-efficacy; and 6) satisfaction with online learning.

Adult Learning

The concept of adult learning is a relatively new concept, approximately 30 years old or so (Lawler, 1991). In the late twentieth century, adult learning was a highly researched topic but mostly in the fields of psychology and educational psychology. This research viewed adult learning as behaviorist and was most often based on research with children (Merriam, 2001).

Researchers such as Lawler (1991, 2003) discovered that adult learning is different than that of children.

Malcolm Knowles (1978) coined the term *andragogy* to describe adult learning. Understanding andragogy is important in order to provide the best learning environment for adult learners. Research on andragogy suggests that adult learners have several commonalities as they are typically: self-directed, rich in diverse life experiences, internally motivated, problem centered in their approach to learning, and base learning needs on changing social roles (Boulton-Lewis, et al, 1996; Huang, 2002; Knowles, 1978; Merriam, 2001).

Once providers of professional development understand the adult learner, they need to follow the learning principles for professional development as set forth by Lawler and King (2000). Professional development should be provided in a way that creates a climate of respect by encouraging active participation, which builds on life experiences. Participants need to be able to make connections between the educational experience and real life and this should be accomplished in an inquiry-based, collaborative setting (Lawler & King, 2000). Adult learning does not necessarily depend on classroom learning, but rather on everyday life experiences (Merriam, 2001).

Adult learners are highly autonomous, self-directed and motivated and learn best when learning is related to real life experiences (Ellis, 2002; Huang, 2002). Demands of jobs and personal schedules make it difficult for adults to participate in traditional professional development activities. Forsyth's (2002) education survey indicated that 43% of the participants answering the survey had not attended a professional development session recently because of offerings at inconvenient times or location. However, 57% said they would be interested in professional development if it were offered online. Online professional development allows

learning to be time and place independent (Buerck, et al., 2003; DeWert, et al., 2003; Huang, 2002). Online professional development provides a more learner-centered environment and the use of technology offers benefits such as lower costs, increased retentions and convenience and transcends geographical barriers (Buerck, et al., 2003).

Adult learners can be successful if barriers and motivators are addressed. Barriers to adult learning include lack of time, money, childcare, transportation and other scheduling problems. If these barriers are lessened and motivators such as programs that are high interest and beneficial for the learner are increased, then adult learners can perform better and the benefits will be longer lasting (Lieb, 1991).

Professional Development for Educators

Shifts in Professional Development

Professional development has changed a great deal over the past ten years, largely because of the standards movement (Willis, 2002). Much of what was done in the past in the name of professional development was haphazard, with no real focus or goal and not directly related to student learning. The old model of professional development was designed to provide knowledge to teachers by the experts in the field of education, usually a one-shot-deal with a hit-or-miss approach (Sparks & Hirsh, 1997). With this approach, significant gaps in professional development still remain (Wenglinsky, 2000). Government requirements for teachers to have Individual Professional Development Plans to renew licensure could help fill these gaps, but only if the material is presented in a meaningful way. Teachers need to deepen their content knowledge and pedagogical skills in order to keep up with these new requirements (Corcoran, 1995) and well-structured professional development can provide the opportunity for this to happen.

Professional development today is more focused on goals and standards, student learning, and an ongoing process involving more than just an individual teacher or administrator. The success of professional development is no longer judged on the number of teachers and administrators participating but whether it alters instructional behavior in ways that benefit students (Sparks & Hirsh, 1997).

The focus of professional development is changing, and the implementation may change as well. Sparks and Hirsh (1997) have identified numerous ways in which the implementation of professional development must change (Table 1).

Table 1

Shifts in Professional Development

Old Model	New Model
Individual development	Individual and organizational development
Fragmented, piecemeal improvement efforts	Clear, coherent, strategic plan
District-focused	School-focused
Focus on adult needs and satisfaction	Focus on student needs and learning outcomes
Training conducted away from the job	Multiple forms of job-embedded learning
Transmission of knowledge and skills by the "experts"	Study by teachers of the teaching and learning process
Generic instructional skills	Generic and content-specific skills
Trainers	Consultants, planners, facilitators
Provided by one or two departments	Performed by all administrators and teacher leaders
Directed toward teachers as primary recipients	Improvement in performance for everyone who affects student learning
"Frill" that can be cut during difficult financial times	Indispensable process

Note: From *A new vision for staff development* by Sparks & Hirsh, 1997, ASCD.

Sparks and Hirsh (1997) assert that professional development should be results driven, constructivist, and interconnected. The focus of professional development should be on student learning and how the professional development will alter instructional behavior of teachers that benefits students. Participants create their own knowledge and collaborate with peers to make

sense of teaching and learning. Finally, professional development providers should also understand that change in any part of the system will affect other parts of the system (Senge, 1990).

When one visualizes what professional development for the 21st century should look like, one does not see a program being measured for its happiness quotient or educators receiving credit for seat time (Sparks & Hirsh, 1997). Instead, a picture of professional development certainly includes alignment with the desired results for students and time and money set aside for well-planned, team oriented, administration supported practices. Meaningful, life-long learning that will enhance teaching and improve student learning is the goal for the 21st century.

King's (2002) research indicates that radical alterations of teaching perspectives and practice are possible and that professional development can be used to cultivate new views of teaching and learning. Offering various deliveries of professional development may provide more opportunities for teachers to achieve the professional development goals necessary for licensure.

Evaluating Professional Development

Guskey and Sparks (2002) describe a theoretical model that shows a relationship between professional development activities and improvement in student learning. There are three major categories in this model that describe the multitude of factors that influence professional development: 1) content characteristics, 2) process variables, and 3) context characteristics.

Content refers to the *what* of professional development. This includes knowledge, skills and understandings, and is the foundation for professional development (Guskey & Sparks, 2002). When asked, "What do teachers need to learn from professional development?" James Stigler (2005) noted three things that professional development should include: 1) how to

analyze practice, their own and other teachers, 2) exposure to alternative ways of teaching, and 3) assistance in deciding when to employ these methods. Lesson Lab's Breakthrough Mathematics modules, a set of mathematics professional development modules, were designed around these three items. National Council of Teachers of Mathematics (NCTM) was one of the first teacher associations to create a document that demonstrates how teaching standards need to be embedded in the teaching of a subject (Ingvarson, 1998). The *NCTM Standards* identify what teachers of mathematics should know and be able to do.

Process refers to the *how* of professional development-the types of professional development and the way it is implemented (Guskey & Sparks, 2002). Examples of process could include action research, lesson study, peer coaching, individually guided activities, and mentoring. The process of professional development should match the style that is expected of students in the classroom such as active, not passive, learning.

Context refers to the *wh*o, *where*, and *when* of professional development (Guskey & Sparks, 2002). The bottom line here is how student learning is impacted. Teachers, administrators and parents all influence student learning, with teachers being the primary influence.

No matter what type of professional development is provided, evidence of effectiveness for classroom practice and student learning is necessary. In the past, professional development activities were measured by how much people "liked" it (Hirsh & Sparks, 1999). Today, with more emphasis on student learning, standards, tighter budgets, and teacher accountability for professional development, a more effective type of evaluation is needed. Guskey (2002) outlines five critical levels of evaluation to improve professional development programs. These levels include: 1) participant's reactions, 2) participant's learning, 3) organization support and change,

4) participant's use of new knowledge and skills, and 5) student learning outcomes. As the levels of evaluation progress, the difficulty of obtaining documentation of the success at that level increases. This process of evaluating professional development programs requires success at one level before achieving success at the next.

The first two levels, participants' reactions and participants' learning, are relatively easy to measure at the end of the session with paper and pencil questionnaires. Even the third level, organization support and change, although a little more time-consuming, can be measured with a questionnaire or interviews. The last two levels, use of new knowledge and skills and student learning outcomes, are the most difficult to assess and the most likely not to be assessed.

Understanding systems-thinking helps us see that changes in one area can lead to changes elsewhere in the organization (Senge, 1990). Small changes in one area may exacerbate the situation by creating negative effects elsewhere in the system. These negative effects may not be noticed immediately, which may mask the connection to the original change.

Professional development must be viewed systemically as Senge (1990) points out when he states:

> nonsystemic ways of thinking are so damaging specifically because they consistently lead us to focus on low-leverage changes: we focus on symptoms where the stress is greatest. We repair or ameliorate the symptom. But such efforts only make matters better in the short run, at best, and worse in the long run. (p. 114)

Sparks and Hirsh (1997) state that educational leaders typically approach reform in a piecemeal fashion rather than a systematic approach.

Guskey and Sparks (2002) assert that one of the major differences between *promising* and *insufficient* professional development programs is the participation or lack of participation,

respectively, of administration. If teachers learn new skills but are not supported by administration and the system, over time the use of these new skills will diminish and the teacher will revert back to the old ways of doing things. Professional development must be a combination of individual and organizational growth. Professional development has to be a concerted effort of the teacher, not just top-down initiatives from administration.

Traditionally, professional development has been aimed at *quick-fix* strategies (Sparks, 1996). These workshops may include goals such as: increasing scores on proficiency tests or decreasing grade retention. Professional development was designed to help teachers and administrators achieve these goals along with providing contact hours for licensure renewal. Although increased test scores and decreased grade retention sometimes occur, these are usually temporary and do not address the larger problem at hand. Change takes time; there is no *quick-fix*. Administrators, school board members, and teachers can no longer view professional development as a frill, but must view it as an essential and indispensable part of the school reform process (Sparks, 1996). Professional development must include active study and continue over a period of time, making direct connections with the teachers' practice, and attend to pedagogy and content (Loucks-Horsley, 1997).

Delivery Methods of Professional Development

Professional development can be delivered in various forms: face-to-face, online, and blended. Face-to-face requires participants to meet in person at a given location and time. Online delivery is done totally online, in which participants are not required to meet at a specific given time or place. Blended delivery is a combination of face-to-face and online. The participants meet for part of the time at a given place and time, but the rest of the time the work is completed where and when the participant chooses.

Teachers and school districts trying to stay in compliance with government mandates for professional development want to use their resources in the most productive way. Each delivery style has advantages and disadvantages that teachers and school districts should be aware of before making decisions about the type of professional development provided.

Face-to-Face

Face-to-face delivery includes various types of professional development, such as: workshops, common planning time, lesson study, action research; but one thing is constant, the participants meet physically at a given place and time, a facilitator presents information to the participants and the participants interact with the presenter and each other.

Advantages of face-to-face delivery are numerous. One advantage is that participants learn better when they learn together and support each other in planning and looking at students work (Sparks & Hirsh, 2004). A second advantage of face-to-face delivery is it frequently provides participants with better feedback and provides more engaging participation in class discussions (Oh, Lim, & French, 2004). Thirdly, face-to-face delivery allows interaction between teachers and between teacher and instructor (Loucks-Horsley, 1997). Finally, face-to-face is an effective delivery system for teaching problem-solving (Kapp & McKeague, 2002).

Unfortunately, there are also disadvantages with face-to face professional development. Time and money required for travel, expenditure of money for child care, parking fees, gas, substitute teachers and other related expenses are a few things that make face-to-face professional development problematic for certain participants. Fragmented sessions, isolation from actual classroom practices, and lack of follow-up by teachers, are also disadvantages with face-to-face delivery (Yang & Liu, 2004). With respect to race, status, age, disability and gender, face-to-face can also be viewed as a disadvantage because participants may be viewed

differently or have different expectations placed on them because of these characteristics (Loucks-Horsley, 1997). Finally, much of the class time (up to 40%) in a face-to-face environment is spent on non-instructional tasks, such as one participant dominating discussion, which can slow down learning (Kapp & McKeague, 2002).

Online

Demands of jobs and personal schedules often make it difficult for adults to participate in traditional, face-to-face professional development activities. In contrast, online professional development allows learning to be time and place independent (Buerck, et al., 2003; DeWert, et al., 2003; Huang, 2002). Online professional development provides a more learner-centered environment. The use of technology offers benefits such as: lower costs to the participants (i.e. travel, childcare), increased retention and convenience, and transcends geographical barriers (Buerck, et al., 2001).

"The process of accumulating knowledge about teaching will be greatly enhanced by technology" (Stigler & Hiebert, p.165). Teachers can easily obtain information about curriculum, lesson plans, and teaching strategies from all over the world. Technology, including online learning, could enhance professional development and make it more accessible to all educators. Online professional development can also address the barrier of inconvenient time by allowing participants to complete coursework at a time that is convenient for them. Well-designed online professional development can be highly effective, and administrators say it suits their needs (Tyre, 2002) because it does not require time and money for travel or the added expense of substitute teachers.

"The role of technology is the same as the instructor's: to be a facilitator in online learning" (Huang, 2002). Facilitators create a safe environment for learners to share ideas and

ask questions and monitor quality of learning. Participants share information, reflect and communicate with others through e-mail, listservs, and chat rooms.

Muir (2001) explains the strengths and weaknesses of online learning as follows:

Advantages include:

- Learning can take place anywhere
- Learning can take place anytime and at any pace.
- There is a synergy between the learner, instructor and environment.
- High quality dialogue can be maintained because it is not restricted by a traditional classroom or time models.
- The environment can be student centered, in that instructors can focus on an individual's learning styles and issues with greater ease.
- There is great access to a larger variety of quality resources.
- There is a level playing field for all learners, regardless of visual or physical handicap, location or learning schedule.
- Teachers can use creative teaching methods in delivering material.

The disadvantages include:

- Equity and accessibility to technology in that not all students can afford top-of-the-line computers with multi-media accessibility.
- Computer literacy—students have different degrees of familiarity with the computer, Internet and software programs. This can adversely impact their ability to participate to the fullest.

- Limitations of technology—there are some things a computer simply cannot do such as real-life simulations, chemical laboratory experiments, and medical dissections.
- Lack of essential online qualities—without the necessary direction, teaching strategies and integration of student learning strategies, learning styles cannot be fully utilized and learning is limited.
- Levels of synergy—face-to-face or voice-to voice contact is still useful to establish synergy, trust and mentor effectiveness.
- Some courses (activity, hands-on subjects) can't be taught online—some topics such as music, physical fitness and art are very difficult to teach online. (p. 7)

Some of the features of online learning that draw individuals to online courses, such as course convenience and family demands, are also the same features that interfere with their ability to complete the course (Carr-Chellman, 2000). Technology use in professional development could also be a disadvantage if participants are not familiar with the technology needed for the course and do not feel comfortable troubleshooting if something goes wrong. Online learning makes professional development available to teachers who are living in rural areas, homebound due to health, responsible for family and must be at home, and who personally prefer online (Loucks-Horsley, 1997; Yang & Liu, 2004).

Online learning can be a transformative experience (Mezirow, 1997). Teachers process information and explore the meaning that information has for the teacher's life and question where the ideas came from, which transforms that teacher into a reflective thinker. This reflective thinking and collaborative learning are included in transformative learning and differentiates the online community from just a group of individuals taking a class online (Palloff

& Pratt, 2003). Thought-provoking questions lead teachers to respond not only to the question, but to the responses of other students. Hudson (2002) describes the process:

> Adult collaborative learning has much in common with thesis writing. It is not spoon-fed problem solving and knowledge assimilation but rather a process of finding and sharing information from almost limitless information resources, and above all, learning the skills of *making that process manageable.* Unlike traditional classroom work, this is a process of meta-learning, or learning how to learn. It involves skills of problem formulation and problem manageability, not just problem solving. It means setting up information structures, not just using the structure provided by a textbook; evolving and exchanging skills, not just applying taught skills to one's own work; using heuristic exploratory analysis, not just algorithms supplied by the curriculum; constructing testing models, not just absorbing them from others' seeing performance in terms of group outcomes rather than personal outcomes; and creating action maps, not just following directions. (pp. 193-194)

The online learner must exhibit certain skills, three important ones being self-discipline, self-motivation, and computer literacy (Boyd, 2004; Resta, Wang, & Hao, 2003). Palloff and Pratt (2003) extend this list to describe an online learner as someone who:

1. needs to have access to computer and modem or high speed connection and the skills to use them
2. open minded
3. not hindered by the absence of auditory or visual cues
4. self-motivated and self-disciplined
5. willing to commit a significant amount of time to their studies

6. can and does work collaboratively
7. critical thinker
8. ability to reflect
9. believes high quality learning can happen anywhere, anytime (pp. 5-8).

Self-regulation or self-direction and computer literacy appear to be the common themes when describing an online learner.

Online versus Face-to-Face

Much of the current research comparing online delivery to traditional face-to-face delivery of professional development to determine if one delivery system is better than the other is based on the assumption that traditional delivery is effective (Diaz, 2000; O'Lawrence, 2006). However, before determining which delivery method proves to be more effective, criteria should be established that focuses on participant characteristics such as motivation and learning styles (Diaz, 2000).

Most of the research comparing online delivery to face-to-face delivery shows no significant difference in student success in a course, regardless of the type of delivery (Diaz, 2000). The difference is not in the technology but in the instructional strategies. Comparing online to face-to-face delivery should focus on student success in a course, not on the delivery system (Diaz, 2000; O'Lawrence, 2006). Creating a successful learning environment for student success, online or face-to-face, requires high quality professional development. Spicer (2002) defines high quality professional development as "relevant content offered in a sustained experience with active learning by participants" (p. 3).

Numerous studies have attempted to determine if face-to-face delivery differs from online delivery for facilitating student learning (Diaz, 2000). In fact, an entire Web site, *No*

Significant Difference Phenomenon Web site, is dedicated to collecting studies that show both no significant and significant differences in face-to-face and online learning. Over 300 studies are available on this site and more are posted regularly.

Tucker (2001) examined differences in pre-test and post-test scores, final exam grades, homework grades, final course grades as well as learning styles and age of 47 undergraduate students; distance learners and face-to-face learners. Significant differences were found in post-test scores, final exam scores, and age. The online learners had significantly higher post-test scores and final exam scores than the face-to-face learners. Age was also significantly different for the two groups. The online learners had an average age of 38 and the face-to-face learners had an average age of 21. All other areas studied revealed no significant differences. Both groups preferred well-organized course work and expected a B for their course grade. In contrast to Tucker's findings, Coates, et al (2004) found a significant difference in final grades for online and face-to-face macro economics course. The results of this study revealed final scores for the online class were lower than the face-to-face scores. However, even in the attempt to account for several variables that could affect the significance of final results, the researchers bias may cause them to overlook the possibility that the students in the online classes could perform the same in a face-to-face class. Additionally, the study included participants and instructors from different institutions, and used different textbooks and grades, not only by institution but by course delivery--online or face-to-face. Even in light of these important differences, including the fact that one class was micro and not macro economics, Coates, et al (2004) conclude that teaching undergraduate macro economics classes online is a "bad idea".

While many studies revealed no significant differences in student learning outcomes in an online versus a face-to-face course, demographic data and learning styles differed significantly.

Diaz and Cartnal (1999) reported that the online group had a higher percentage of females and were above 26 years of age. They also found that online learners who possessed a more independent and conceptual learning style had higher scores in the course and learners with the lowest scores had a more social and conceptual learning style and were more dependent learners who required more structure and guidance throughout the course (Diaz & Cartnal, 1999).

Blended

Blended or hybrid delivery of professional development includes both online and face-to-face components. A single delivery system--face-to-face or online--limits a learning program (Singh, 2003). Any combination of online and face-to-face can be used to deliver this type of program. The blended approach has significant advantages over either of the other two approaches, utilizing the best of face-to-face and online delivery (Kapp & McKeague, 2002). Blended delivery can be completed in half the time at half the cost and is not only more efficient, but more effective (Singh, 2003).

King (2002) conducted a qualitative case study with 15 students who participated in a "hybrid" class (six classes were held face-to face and eight were online) over a five-week period. Participants ranged from novice to experienced technology users. In-service and pre-service teachers with a mean of 5.8 years experience participated in this case model. The purpose of the study was to explore the viability of the hybrid format. The participants provided extensive data that included 450 online discussion postings, 105 journal postings, and 12 self-reflection summaries. These data were analyzed for emergent themes and revealed "substantial dialogue and a rich learning experience can be created in online classrooms" (King, p. 236). Based on King's (2002) research, hybrid classes can offer a format that allows the technology to become almost transparent, while allowing for collaborations and rich content delivered by informed

instructors and for developing communities of lifelong learners. The hybrid class provides the best practices of online and face-to-face learning environments.

Learning Styles and Online Learning

Few studies have been conducted on the relationship of learning style and distance learning (Boyd, 2004) and fewer studies have examined the relationship of learning styles and computer self-efficacy (Cassidy & Eachus, 2002). Fewer studies, if any, have considered the relationship between learning styles, computer self-efficacy and satisfaction with online learning. Numerous learning style and personality inventories have been developed through the years. Some of these include the Myers-Briggs type indicator, Howard Gardner's multiple intelligences, Honey and Mumford's social approach to learning, and McCarthy's 4-Mat system (Barnes, Preziosi, & Gooden, 2004). One of the most widely known instruments is David Kolb's learning style inventory (Barnes, et al., 2004; Lee, 2004). One study using Kolb's Learning Style Inventory analyzed student success in a distance learning environment and found that students who looked for more abstract concepts and needed less concrete experiences did better in a distance learning environment (Dille & Mezack, 1991).

Kolb's Learning Style Inventory presents four modes of individual learning: concrete experience, reflective observations, abstract conceptualization and active experimentation. These modes translate into four learning styles: Accommodator, Diverger, Assimilator, and Converger (Barnes, et al., 2004). A description of the four styles is found in Table 2.

Table 2

Kolb's Learning Styles

Learning style	Learning characteristic	Description
Converger	Abstract conceptualization + active experimentation	· strong in practical application of ideas · can focus on hypo-deductive reasoning on specific problems · unemotional · has narrow interests
Diverger	Concrete experience + reflective observation	· strong in imaginative ability · good at generating ideas and seeing things from different perspectives · interested in people · broad cultural interests
Assimilator	Abstract conceptualization + reflective observation	· strong ability to create theoretical models · excels in inductive reasoning · concerned with abstract concepts rather than people
Accommodator	Concrete experience + active experimentation	· greatest strength is doing things · more of a risk taker · performs well when required to react to immediate circumstances · solves problems intuitively

Note: From "David A. Kolb on experiential learning". *The encyclopedia of informational educational*.M.Tennet, As cited in M. Smith, (2001).http://www.infed.org/b-explrn.htm

The emphasis of Kolb's Learning Theory is on experience in the learning process and identifies two dimensions of learning: processing and perception (Schaller & Allison-Brunell, 2003). Each dimension has two extremes: perception ranges from concrete experience (CE) to abstract conceptualization (AC); and processing ranges from active experimentation (AE) to reflective observation (RO). To determine the learning style, the following calculations are done:

AC – CE = AE – RO =

Finally, the two scores are placed on the grid (Fig. 1) to determine learning style; Quadrant I-Diverging, Quadrant II-Assimilating, Quadrant III-Converging, and Quadrant 4-Accommodating (Kolb, 1999; Smith, 2001).

Figure 1. Kolb's Learning Style Quadrants.

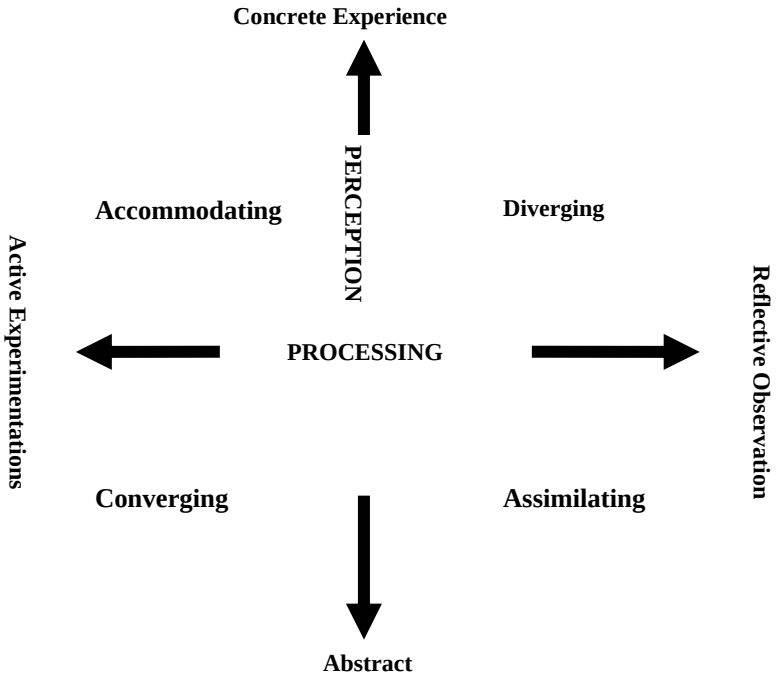


Figure 1. Adapted from Kolb, et al. (1999)

Buerck, et al. (2003) compared final grades of students enrolled in a computer science course, face-to-face lecture-based or online Internet-based. The students completed Kolb's Learning Style Inventory and self-selected enrollment in face-to-face lecture-based or online Internet-based section of the course. Twenty-nine students successfully completed the course. The final sample included 16 participants in the face-to-face lecture-based section and 13 participants in the online Internet-based section. All of the participants were employed full time (40+ hours/week). The results of the study showed no difference in grades between the face-to-

face lecture-based or online Internet-based students. The study also showed a significant difference between learning styles of students in the two different environments using the Chi-Square Homogeneity statistic. The Converger learning style was most likely to enroll in the online environment, whereas students with the Assimilator learning style were more likely to enroll in face-to-face lecture-based learning environment. The study did not evaluate the relationship of learning style and decision to enroll in a particular type of instruction, web-based or face-to-face. The results of Buerck, et al. (2003) were based on students' self-selection of the presentation style of the course. If participants had been assigned to take face-to-face lecture-based or online Internet-based with no regard to learning styles, the results may have been drastically different.

Schaller and Allison-Brunell (2003), however, indicate that the Assimilating Learners are more likely to prefer reading and reflective analysis of online learning, whereas, the Accommodating Learners that prefer social environments and the Divergent Learners who need brainstorming and personal feedback may not be accommodated in an online environment. In contrast to these findings, Resta, Wang and Cen (2003) found that Divergers were the only group that showed a positive correlation between learning environment and learning style. However, findings from a study by Oh, Lin, and French (2004) indicated that learning styles were not correlated with instructional delivery mode. Instead, preferred instructional mode was positively correlated with levels of competency in using computer technology ($r = 0.35$, $p < 0.01$) and attitudes toward online learning ($r = 0.463$, $p < 0.01$). In addition, students who are comfortable using computer technology tended to have positive attitudes toward online education (Oh, Li, & French, 2004).

Diaz and Cartnal (1999) compared the learning styles of students in online and face-to-face health education classes using the Grasha-Riechmann Student Learning Style Scales (GRSLSS). The GRSLSS measures six social learning styles: Independent, Dependent, Avoidant, Competitive, Collaborative, and Participant. Diaz and Cartnal (1999) found the only significantly different scores were between Independent and Dependent learning styles, the students enrolled in the distance learning class had higher Independent scores and lower Dependent scores. These findings are not surprising since online learners are generally self-disciplined and self-motivated (Resta, Wang, & Hao, 2003; Boyd, 2004).

Professional development, regardless of delivery style, is not a one-size-fits-all. Students that drop out of online courses are not necessarily high-risk students, but it may be the case that their preferred learning style is not matched with online learning (Diaz & Cartnal, 1999; Palloff & Pratt, 2003). Instructors of online and face-to-face professional development sessions may want to utilize learning style inventories to assist in class preparation so each student has the opportunity to be successful.

Studies have addressed teaching online courses to meet various learning styles (Diaz & Cartnal, 1999; Lee, 2004), and others have examined the relationship between learning styles and individuals choosing online learning (Oh, Lim, & French, 2004; Resta, Wang, & Cen, 2003), but few have compared an individual's learning style to their computer self-efficacy and satisfaction with online learning courses.

Computer Self-Efficacy

Decisions to take courses online may be related to learning style, but an individual's computer self-efficacy may be more of a factor in the decision to take an online course. Individuals who feel they will be successful on a given task are more likely to be successful,

while individuals who believe they will fail often do (Lee & Witta, 2001; Ross, Gray & Hannay, 2001). Individuals with high self-efficacy have more perseverance to endure obstacles and setbacks of difficult undertakings (Bandura, 1994). Online learning requires individuals to use technology and not all teachers are familiar with the technology needed. Wang and Newlin (2002) found that computer self-efficacy was related to the reason why students choose to take an online course. Students having higher computer self-efficacy enrolled in an online course because they were curious about taking a course like this as opposed to students taking online courses solely because of availability, who had lower levels of self efficacy (Wang & Newlin, 2002).

Cassidy and Eachus (2002) state that computer self-efficacy has been reported as a major factor in understanding frequency and success with which individuals use computers and that individuals with high efficacy used computers more and enjoyed using them. "Self-efficacy can be defined as the beliefs a person has about their capabilities to successfully perform a particular behavior or task" (Cassidy & Eachus, 2002, p. 135). Howland and Moore (2002) found that students who had positive online experiences reflected higher levels of independence and responsibility for learning; whereas, students who had negative online experiences expected the instructor to provide all of the necessary information rather than take self-responsibility. Experience with technology affects students' beliefs, expectations, and attitudes about online learning (Kurubacak & Baptiste, 2002). Similar findings by Papasratorn & Wangpipatwong, (2006) suggested that computer self-efficacy and computer attitude are important determinants of outcomes in e-learning courses, therefore; students with low computer self-efficacy may feel uncomfortable in an e-learning course, which may affect the expected outcomes. Boverie, et al

(1998) also found as students became more computer self-efficacious, the more satisfied they were with an online course.

An and Frick (2006) found similar results in a study of students taking computer mediated communication classes. Most of the 105 students surveyed appeared to be comfortable using computer technology, had access to computers and believed they were self-directed learners. A significant correlation existed between perceived comfort with technology and comfort with computer mediated communication (An & Frick, 2006).

Computer self-efficacy may not be high at the beginning of an online course, but as Lee and Witta (2001) found in a study of sixteen students enrolled in an online class, self-efficacy changed significantly from the beginning to the end of the semester course. Teachers must have the ability to overcome the obstacles of online learning and not become frustrated and give up, thus, high computer self-efficacy is desirable for an online course.

Satisfaction with Online Learning

More professional development opportunities are being offered online as a result of the Internet. Student satisfaction with online learning is important for the successful completion of the course (Chang & Fisher, 2003). An instrument was designed by Chang and Fisher (2003) to capture students' perceptions of this online learning environment. The *Web-Based Learning Environment Instrument (WebLEI)* was designed to measure students' satisfaction with online learning using a four part scale: Access, Interaction, Response and Results.

Warrick (2005) used the WebLEI and surveyed three groups of online learners--Expert Mentors, Facilitators, and Instructor--and found that overall satisfaction in all areas of the WebLEI were similar except for the Results section. The scores for the Expert Mentors groups responded to the Results section more positively than the other two groups (Warrick, 2005).

Availability and access are important to the success of online workshops (Yang & Liu, 2004). Frequency of moderator discussion affects teachers' comfort with discussion forums and frequency of use (Yang & Liu, 2004).

Simpson and Du (2004) found in their correlational study that learning style, as determined by Kolb's Learning Style Inventory, was most significant in explaining the enjoyment level in a distance learning environment. Most of the students in the sample were Convergers or Assimilators. The converging students liked the course the most and the assimilating participants liked the course the least. Learning style and class participation had a significant impact on the students' enjoyment level with the class (Simpson & Du, 2004).

Yang and Liu (2004) found that the reasons for the popularity of their online workshop included convenience of the online delivery, a focus on teachers' needs, and maintaining licensure or gaining certification. The survey in Yang and Liu's (2004) study revealed that most of the participants were satisfied with the online workshop and some of the participants claimed that the online workshop increased their technological competence.

Summary

The need for professional development is increasing as teachers try to stay abreast of educational best practices and research (NSDC, 2001). The focus of professional development is moving away from an individual, fragmented transmission of knowledge to coherent, school-focused, job-embedded learning (Sparks & Hirsh, 1997).

To date, much of the professional development offered has been face-to-face and a "one-shot" deal, but technology is quickly becoming an integral part of professional development. "The process of accumulating knowledge about teaching will be greatly enhanced by technology" (Stigler & Hiebert, 1999, p. 165). Teachers can easily obtain information about

curriculum, lesson plans, and teaching strategies from all over the world. Technology, including online learning, could enhance professional development and make it more accessible to all educators. It is the lack of experience with technology that becomes problematic in the delivery of online professional development (McKinzie & McCallie, 1999).

As more professional development is offered online, issues such as learning styles, computer self-efficacy, and satisfaction with online learning arise. Some teachers may feel comfortable with the online delivery of professional development, but others may have leaning styles that are not aligned with the skills required to be successful in an online course. In addition, computer self-efficacy may be lower for teachers with little computer experience, which could prevent them from attempting an online course (Lee & Witta, 2001). Learning styles and computer self-efficacy may also have an effect on the teachers' overall satisfaction with an online course. Research into learning styles and preferred learning environments should be conducted to increase the understanding of such relationships (Buerck, et al., 2001).

Teachers have limited time and resources and yet still need to meet the professional development requirements of school districts and states. Online learning is one possible way for teachers to manage their time and still achieve the professional development they need. Institutions need to move to a more flexible approach to learning (Forsyth, 2002) to provide various deliveries of professional development.

CHAPTER III. METHODOLOGY

This chapter describes the research design, participants, data collection instruments, variables, materials, procedures used to collect the data, and data analysis procedures.

Participants

This study sought participation from 46 teachers enrolled in one or more of the 6-week BreakThrough Mathematics modules, an online professional development program, during the 2005-2006 school year. Thirty teachers (65%) participated by completing one or more of the four surveys. Forty-seven percent (n=14) of the teachers participating completed all four or the surveys. The participating teachers were from school districts throughout Ohio, grades K-12, 89% from public schools. The teachers ranged in age from 22-51, with the mean age of 37. Eighty-three percent of the participants were female. All of the participants owned their own computer.

The participants taught grades K-3 (29%), 4-9 (61%) and 10-12 (11%). Participants included high school and middle school mathematics teachers, elementary teacher who taught mathematics as well as other subjects, and special needs teachers. Participants enrolled in the class for several reasons. A few of these reasons cited were: 1) to gain more mathematical knowledge and understanding, 2) to obtain highly-qualified status, or 3) simply to experience an online course for the first time. Participants were selected using a purposive sample; individuals were chosen because they were enrolled in an online professional development course, Lesson Lab's BreakThrough Mathematics.

Lesson Lab's BreakThrough Mathematics (2006) is a scientifically-based research model that focuses on "providing teachers with a deep knowledge of a select number of concepts—along with opportunities to observe and analyze classroom practice using the concepts, and then

develop effective ways to teach them to students" (p. 5). The 6-8 week courses are organized around topics which were identified as important in local, state, and national mathematics standards. Each Lesson Lab BreakThrough Mathematics (2006) module provided opportunities for teachers to deepen their knowledge of:

1. critical concepts in mathematics,
2. how students understand and learn about these concepts, and
3. strategies for teaching and modeling these concepts—often using multiple approaches. (p.6)

Teachers participating in these courses linked what they were learning in the course to their own practice in the classroom. Each module was divided into two sections-- content exploration and lesson analysis. The modules provided teachers the opportunity to participate in a variety of activities which included analyzing classroom lessons, planning lessons, and implementing the lessons in their classroom. Participants in the course become familiar with the concepts in a variety of ways such as conventional reading about the mathematical concepts, watching and analyzing video professional development sessions and classroom teaching, collaborating with other participants through forums for discussion, and reflective analysis (Appendix H). These various activities not only hold great potential for improving teaching but also allow participants with different learning styles to engage in activities that align with their learning style and also challenge them to participate in activities to strengthen other learning style skills.

Research Design

The design of this study was quantitative causal-comparative as it examined the differences among the four learning styles of the participants and computer self-efficacy and satisfaction with online professional development. This design involved comparison of four

groups, created by an innate human characteristic, upon the independent variable (learning style) in relation to dependent variables of computer self-efficacy and satisfaction with online learning.

Instrumentation

Three different instruments were administered during this study: Kolb's Learning Style Inventory (Kolb, 1999), Computer Use Efficacy Scale (Cassidy & Eachus, 2002), and Web-based Learning Environment Instrument (Chang & Fisher, 2003).

Kolb's Learning Style Inventory

Kolb's Learning Style Inventory (LSI) was used to determine the learning style of each participant. The emphasis of Kolb's Learning Theory is on experience in the learning process and identifies two dimensions of learning: processing and perception (Schaller & Allison-Brunell, 2003). Each dimension has two extremes: perception ranges from concrete experience (CE) to abstract conceptualization (AC); and processing ranges from active experimentation (AE) to reflective observation (RO). The Kolb's LSI consists of 12 statements participants rank by number according to how well each ending describes the way they learn. To determine the learning style, the following calculations are done:

Perception: AC – CE =

Processing: AE – RO =

Finally, the two scores were placed on the grid (Fig. 1) to determine each participant's learning style preference; Quadrant I-Diverging, Quadrant II-Assimilating, Quadrant III-Converging, and Quadrant 4-Accommodating (Kolb, 1999; Smith, 2001).

The participants in this study completed the Learning Style Inventory online, therefore, the calculations were done electronically, and results were e-mailed to the researcher in the form

of a graph that illustrated the exact location of the participant on each of the axis and the learning style type.

This instrument was chosen because it is a widely used inventory that measures learning styles of adult learners. Reliability, for each scale, assessed through Cronbach's alpha, was high: .82 for Concrete Experience,.73 for Reflective Observation, .83 for Abstract Conceptualization, .78 for Active Experimentation, .88 for AC - CE, and .81 for AE – RO (Smith & Kolb, as cited in Raschick, Maypole, & Day, (1998).

Computer User Self-Efficacy Scale

The Computer User Self-Efficacy (CUSE) Scale was designed to measure computer self-efficacy in adult learners, using a self-reported scale (Cassidy & Eachus, 2002). The questionnaire is divided into two parts: Part 1 provided demographic information about the individual and individual experiences with computers, and Part 2 elicited more detailed information about computer use through 30 statements scored on a 6-point Likert Scale ranging from strongly disagree to strongly agree. Thirteen of the items were positively worded and the response score was recorded as actual score, seventeen items were negatively worded and were scored in reverse (Table 3). Summing the scores for all 30 items creates a total self-efficacy score. A high total scale score indicated a more positive computer self-efficacy.

Table 3

Sample Items from Computer User Self-Efficacy Instrument

Positively worded statements	Negatively worded statements
1. Most difficulties I encounter when using computers, I can usually deal with.	3. I am very unsure of my abilities to use computers.
2. I find working with computers very easy.	22. Computers are far too complicated for me.
12. I am very confident in my abilities to make use of computers.	25. Sometimes, when using a computer, things seem to happen and I don't know why.
18. Using computers makes learning more interesting.	26. As far as computers go, I don't consider myself to be very competent.
29. I consider myself to be a skilled computer user.	28. I find working with computers very frustrating.

Note: Sample items taken from Cassidy, S. & Eachus, P. (2002).

Internal reliability (alpha = 0.97) was measured by Cronbach's alpha. Test-retest reliability was also high (alpha=0.97) and statistically significant ($r=.86$, $N=74$, $p<0.0005$) over a one month period.

Construct validity was assessed by the instrument authors comparing self efficacy with self reported measure of computer experience and the number of computer packages used. Both correlations were significant. Criterion validity was assessed by comparing self-efficacy scores across groups, using ANOVA (Cassidy & Eachus, 2002).

Web-Based Learning Environment Instrument

The Web-Based Learning Environment Instrument (WEBLEI) is a 37-item survey. Thirty-two of the items used a 5-point Likert scale response option: Almost Never, Seldom, Sometimes, Often, and Almost Always. The last five items were open-ended questions (Chang & Fisher, 2003).

Chang and Fisher (2003) found reliability coefficients ranged from 0.68 to 0.87. A reliability coefficient of .60 or greater is acceptable (Nunnally, 1967), therefore, this instrument was satisfactory in terms of its internal consistency.

The discriminant validity showed that the mean correlations ranged from 0.37 to 0.49, indicating that the scales of the WEBLEI measure distinct, although somewhat overlapping, aspects of the online learning environment (Chang & Fischer, 2003).

This instrument assessed student perceptions of four core aspects of the Web-based learning environment: Access, Interaction, Response, and Results.

Access refers to the convenience of accessing learning materials at a convenient time. Efficient use of time and also the autonomy to decide when and where to access the course are included in this section. Examples of items included in the Access section are:

1. I can access the learning activities at times convenient to me.
3. I can use time saved in traveling and on campus class attendance for study and other commitments.
7. The flexibility allows me to meet my own learning goals.

The Interaction section of the WebLEI includes collaboration with other participants and interaction with other participants and the facilitator of the course. Feedback from other participants and the facilitator and also reflection are components of the participation in the course, which is reflected in this section. Sample items from the Interaction section are:

9. I communicate with other students in this subject electronically (email, bulletin boards, chat line.)
10. In this learning environment, I have to be self-disciplined in order to learn.
11. I have the autonomy to ask my tutor what I do not understand.

The third section of the WebLEI is Response. The participants' enjoyment, confidence, success and frustration are measured in this section. Sample items include:

18. I felt a sense of satisfaction and achievement about this learning environment.

19. I enjoy learning in this environment.

23. The web-based learning environment held my interest throughout my course of study.

The fourth section of the WebLEI is Results. This section measures the overall evaluation of the design and structure of the course. Items from this section include:

25. The scope or learning objectives are clearly stated in each lesson.

28. Expectations of assignments are clearly stated in my unit.

31. The presentation of the subject content is clear.

The mean score for each section and the overall score for the WebLEI were used to assess overall satisfaction with the online delivery of the BreakThrough Mathematics course and examine the relationship among learning styles of the participants and their computer self-efficacy and overall satisfaction with the course.

Data Collection Procedures

Three instruments were administered online over a two month period. Participants completed the Kolb's Learning Style Inventory and the pre CUSE prior to participating in the online course. At the conclusion of the course the participants completed the post CUSE and the WEBLEI.

The researcher e-mailed each participant a description of the study (Appendix E) and a cover letter (Appendix A) asking for a response to the e-mail as consent to participate. As soon as the participants replied to the e-mail consenting to participation in the study, directions for completing and returning Kolb's Learning Style Inventory and the pre CUSE were e-mailed

(Appendix F). A follow-up message was mailed a week later to those who had not completed the surveys. Participants used their first and last name on all of the instruments for comparison purposes. At the conclusion of the course, an e-mail was sent providing directions for the final two surveys (Appendix G).

The Kolb's Learning Style Inventory was completed online at Hay Group site, http://www.hayresourcesdirect.haygroup.com/lsi/default-new.asp?oz=559, and the pre/post CUSE and WEBLEI were completed on the Bowling Green State University server, http://edhd.bgsu.edu/shelt/precuse.php, and the results stored on the server. All of the instruments were completed online and submitted electronically to the researcher with the exception of Kolb responses, which were submitted to the survey company for analysis.

Reminder messages were e-mailed to participants if they did not complete the surveys within a week after the initial e-mail; both e-mails provided information about how to access and complete the surveys.

Research Questions

1. Do computer self-efficacy and satisfaction with online professional development differ by learning style preference, gender, age, teaching experience, and grade level among K-12 teachers?
2. Does computer self-efficacy increase from the beginning to the end of an online course?
3. Is computer self-efficacy significantly related to satisfaction with online professional development?

Data Analysis Procedures

The Statistical Package for Social Sciences (SPSS) was used for statistical analysis. The data were analyzed using descriptive analysis, ANOVA, t-test of independent and related means, and Pearson correlation.

The raw scores from the Kolb's Learning Style Inventory identified a learning style preference for each participant, and therefore grouped individuals in one of four learning styles. Scores from WebLEI and pre and post Computer User Self-Efficacy survey yielded numeric scores for items, subscales, and total. (Web Learning Environment Instrument) Means and standard deviation were calculated for all subscales and total scores.

Research question 1 examined group differences in computer self-efficacy and satisfaction with online professional development. Analysis of Variance (ANOVA) was used to examine differences between two or more groups (Frankel & Wallen, 2003; Mertler & Vannatta, 2002). Variables that generated three or more groups, and therefore applied ANOVA, were: Kolb's learning style, age, previous computer experience, grade level, and years of teaching. T-test of independent samples was used to examine gender differences. Post hoc tests, also known as multiple comparisons, allowed the researcher to determine specific group differences.

Research question 2 was answered using t-test of related samples to compare pre-CUSE and post-CUSE scores.

Research question 3 was answered using Pearson correlation in examining the relationship between computer self-efficacy and satisfaction with online learning.

Assumptions and Limitations

An underlying assumption of this study was that self-efficacy, learning styles and satisfaction could be identified and understood using CUSE, Kolb's Learning Style Inventory,

and WEBLEI. It was assumed that each participant was honest, trustworthy, and able to understand and complete the instruments.

This study was limited to teachers enrolled in Lesson Lab modules in Ohio. The teachers were offered other delivery options so it was possible only computer self-efficacious individuals enrolled in online courses. In addition, teachers choosing online professional development may not have varied learning styles. Furthermore, not all of the participants had the same facilitator, which could affect the satisfaction score.

Summary

In this study, teachers enrolled in a BreakThrough Mathematics course, in which the delivery style was online, were selected to participate in this causal-comparative research to examine the relationship between learning style differences and computer self-efficacy as well as satisfaction with online learning. Of the forty-six teachers contacted to participate in the study, 65%, (n = 30) agreed to participate and completed one or more or the four surveys, and 47% (n = 14) of the teachers participating completed all four of the surveys. In Chapter 4, the results of this study will be presented.

CHAPTER IV. RESULTS

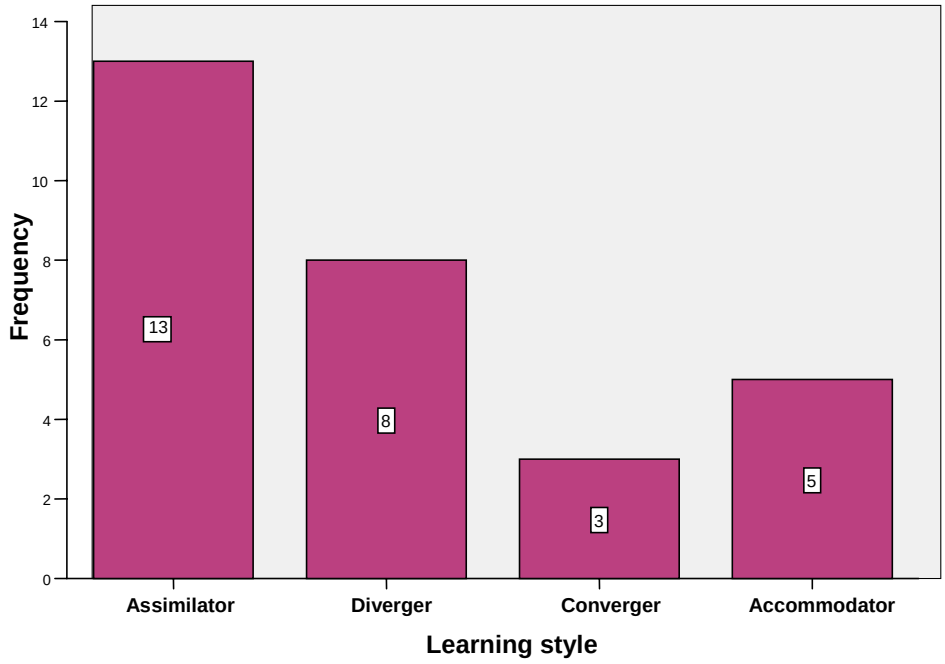
Introduction

This study examined the relationship between the four learning styles as measured by Kolb's Learning Style Inventory (Kolb, 1999) and computer self-efficacy as measured by the Computer User Self-Efficacy Scale (Cassidy & Eachus, 2002) and satisfaction with online learning as measured by the Web-based Learning Environment Instrument (Chang & Fisher, 2003).

The sample for this study included 30 teachers enrolled in a Lesson Lab BreakThrough mathematics course. Fourteen of the 30 teachers completed all four surveys. Ten of the remaining participants completed three of the four surveys. The participants ranged in age from 22 to 51 with the mean age of 37. The gender composition of the participants was 83% female and 17% male. All of the participants reported owning their own computer; 96% reported having some to quite a lot of experience with computers, and 68% have attended a computer-training course. Eighty-nine percent of the participants taught in public schools; 81% taught in small to medium sized schools, and 70% had 15 years teaching experience or less.

The independent variable, learning styles, is characterized by four main learning styles--Assimilator (n=13, 43%), Diverger (n=8, 27%), Converger (n=3, 10%), and Accommodator (n=5, 17%). Figure 1 displays a bar graph of the four learning styles by number of participants.

Figure 2. Participants' learning styles.



The largest group of participants indicated preference of the characteristics of the Assimilator learning style. Individuals with Assimilator learning style are likely to excel in inductive reasoning, be less interested in people, and be more concerned with abstract concepts. The second largest group was the participants with Diverger learning style. Individuals with Diverger learning style are characteristically interested in people, imaginative, aware of their emotions, and have broad cultural interests. Participants with Accommodator learning style made up the third largest group. Accommodators are typically interested in doing hands-on activities, carrying out plans, involving themselves in new experiences, relying on and at ease with people, but sometimes impatient and pushy, solving problems in a trial-and-error manner. The smallest number of participants preferred Converger learning style. Individuals in the Converger group are generally: best with conventional learning in situations with a single correct answer or solution to a problem, and prefer dealing with things rather than people. (Kolb, 2000).

The dependent variables included the pre and post computer self-efficacy, measured by the Computer User Self-Efficacy Scale (CUSE), and satisfaction with online professional development measured by the Web-based Learning Environment Instrument (WebLEI). The CUSE consists of 30 items on a six-point Likert scale and generates a maximum score of 180. Thirteen of the items were positively worded, and seventeen of the items were negatively worded and so were recorded to reverse responses. Scores for each scale of the WebLEI--Access, Interaction, Response, and Results--were generated by calculating the mean for items in each subscale, which utilizes a five point Likert scale. The maximum possible score for each section of the WebLEI was 5. Means and standard deviations for the dependent variables are presented in Table 4. The mean score on the Post CUSE was slightly higher than the mean score on the Pre CUSE. The WebLEI scale with the highest mean was Access, while the lowest mean was reported for Response.

Table 4

Descriptive Table of Dependent Variables

	M	*SD*	*N*
Pre CUSE	132.08	23.64	25
Post CUSE	136.82	22.40	22
WebLEI Access	4.49	.49	16
WebLEI Interaction	4.16	.55	16
WebLEI Response	3.43	.63	16
WebLEI Results	4.19	.48	16
WebLEI Total	4.07	.43	16

Summary of WebLEI Open-Ended Comments

Four open-ended questions on the WebLEI were included at the end of the survey. The following is a brief summary of these results.

Question 1 asked why the participants were studying in an online mode. The majority of responses included convenience and family obligations such as small children which would make taking a face-to-face class impossible. One other response that participants cited as a reason for taking an online course was that it was a new and they had never experienced an online course before.

Questions 2 and 3 asked about the advantages and disadvantages of studying in an online mode. The advantages included time and money savings, and the convenience of being able to work at one's own pace. The disadvantages included lack of face-to-face interaction, distractions, lack of immediate feedback, and difficulty keeping motivated.

Lastly, question 4 asked for suggestions for improving the delivery of an online course. Most of the responses included more interaction and feedback. Overall, the participants stated they enjoyed the course and signed up for other ones.

This chapter presents the remaining research results, which are organized by each of the research questions:

1) Does computer self-efficacy and satisfaction with online professional development differ by learning style preference, age, previous computer experience, grade level, teaching experience, gender and previous computer courses among K-12 teachers?
2) Does computer self-efficacy increase from the beginning to the end of an online course?

3) Is computer self-efficacy significantly related to satisfaction with online professional development?

Research Question 1

Does computer self-efficacy and satisfaction with online professional development differ by learning style preference, age, previous computer experience, grade level, teaching experience, gender, and previous computer courses among K – 12 teachers?

An analysis of variance (ANOVA) was used to determine whether significant learning style differences were found in computer use self-efficacy and satisfaction with online learning. The results are presented for each of the dependent variables: pre self-efficacy, post self-efficacy, WebLEI--Access, Interaction, Response, Results, and Total.

Self-Efficacy Differences by Learning Style

Computer self-efficacy is the belief a person has about their ability to perform a particular behavior or task using the computer (Cassidy & Eachus, 2002). ANOVA results indicate no significant learning style differences in pre treatment computer self-efficacy (see Table 5). Participants with Accommodator learning style reported the highest mean (M=148.00) in computer self-efficacy, while those with the Assimilator learning style had the lowest (M=125.18), but only slightly lower than participants with Converger learning style.

Table 5

Pre-Self-Efficacy Differences by Learning Style

	M	*SD*	*N*	*F*	*p*	*df*
Learning Style				1.09	.377	3,21
Assimilator	125.18	26.88	11			
Diverger	136.57	23.04	7			
Converger	125.67	17.01	3			
Accommodator	148.00	14.40	4			

Post computer self-efficacy scores also revealed no significant differences by learning style (see Table 6). Interestingly, participants with Accommodator learning style reported the highest post self-efficacy means (M=151.33). In addition, the participants with Diverger learning style reported lowest post self-efficacy mean, in contrast to having the second highest mean for the pre computer self-efficacy score, and are the only group that had lower scores on the post computer self-efficacy than the pre computer self-efficacy survey. Although the participants in the Accommodator group had the highest mean score on the post self-efficacy survey, the other three learning styles--Assimilator, Diverger and Converger--had nearly equivalent mean scores.

Table 6

Post Self-Efficacy Differences by Learning Style

	M	*SD*	*N*	*F*	*p*	*df*
Learning Style				.45	.721	3,18
Assimilator	134.44	18.43	9			
Diverger	134.43	28.92	7			
Converger	135.00	27.88	3			
Accommodator	151.33	16.04	3			

WebLEI Access Differences by Learning Style

In an online course it is necessary to have access to computers and web-based learning materials. Scale I of the WebLEI is Access, which evaluates the participants' perception of convenience, efficiency and autonomy of the online course. A high mean score on the Access scale of the WebLEI means participants were satisfied with their opportunity to access and complete the course learning activities at a time and place convenient for them.

When comparing the four learning styles with respect to course access, significant differences were revealed. Participants with the Accommodator learning style reported the highest mean score for this scale and participants with the Diverger learning style reported the lowest mean score (see Table 7).

Table 7

WebLEI Access Differences by Learning Style

	N	*M*	*SD*	*F*	*p*	*df*
Learning Style				4.85	.020	3,12
Assimilator	6	4.48	.60			
Diverger	4	3.94	.42			
Converger	3	4.83	.58			
Accommodator	3	4.88	.27			

WebLEI Interaction Differences by Learning Style

Scale II of the WebLEI is Interaction, which focuses on the participants' perception of participation in the online course. Interacting with the instructor and collaboration with other participants are two of the areas assessed on this scale of the instrument. A high score on the Interaction scale of the WebLEI indicated that the participants were satisfied with the interaction (student to student and student to facilitator) throughout the course.

ANOVA results indicated no significant difference existed among the participants by learning styles on the Interaction scale of the WebLEI; however, participants with Accommodator and Converger learning styles had a higher mean score on this scale than participants with the Assimilator and Diverger learning styles; the mean score in the Diverger group being much lower than Assimilator, Converger, or Accommodator, but still in the range that indicates satisfaction (see Table 8).

Table 8

WebLEI Interaction Differences by Learning Style

	M	*SD*	*F*	*p*	*df*
Learning Style			.60	.626	3,12
Assimilator	4.19	.56			
Diverger	3.85	.61			
Converger	4.30	.59			
Accommodator	4.38	.54			

WebLEI Response Differences by Learning Style

Response is the third scale of the WebLEI. This scale assesses perceived enjoyment and success with online learning. A high score on the Response scale of the WebLEI means that the participants felt a sense of achievement and satisfaction with the online learning course. No significant difference was found among the four learning styles on the Response scale of the WebLEI. However, the participants with Accommodator learning style had a high mean score of 4.00, whereas the participants with Diverger learning style again had the lowest mean score, M=2.97, which falls below the range of satisfaction (see Table 9)..

Table 9

WebLEI Response Differences by Learning Style

	M	*SD*	*F*	*p*	*df*
Learning Style			2.65	.096	3,12
Assimilator	3.25	.42			
Diverger	2.97	.64			
Converger	3.80	.75			
Accommodator	4.00	.45			

WebLEI Results by Learning Style

Participants' satisfaction with goals being met in the online course is measured by Scale IV, Results. A high score on the Results scale of the WebLEI means the participants were satisfied that the learning objectives for the course were met and that they had gained knowledge from the course. No significant difference existed among the Learning Styles with respect to the Results section responses, however, three of the four learning styles had mean scores above 4, indicating that learning objectives and organization of the online materials were satisfactory to the participants (see Table 10).

Table 10

WebLEI Results Differences by Learning Style

	M	*SD*	*F*	*p*	*df*
Learning Style			2.60	.100	3,12
Assimilator	4.35	.31			
Diverger	3.69	63			
Converger	4.34	.32			
Accommodator	4.38	.33			

WebLEI Comprehensive Score Differences by Learning Style

The WebLEI is composed of four scales, each of which convey a score representing satisfaction with one of the four components of online courses. The comprehensive score is the mean of the four scales, communicating overall satisfaction with the online course.

The ANOVA results in Table 11 indicate overall satisfaction with online professional development significantly differs by learning style. Participants with the Accommodator learning style had a mean score of 4.41, which indicated the highest overall satisfaction with the online course and participants in the Diverger learning style group had a mean score of 3.62, which was the lowest of the groups but also indicated satisfaction with the online course.

Although the highest mean in each subscale and the comprehensive scale varied among Assimilator, Converger and Accommodator learning styles, participants with the Diverger learning style consistently had the lowest mean score for all subscales and comprehensive scale of the WebLEI.

Table 11

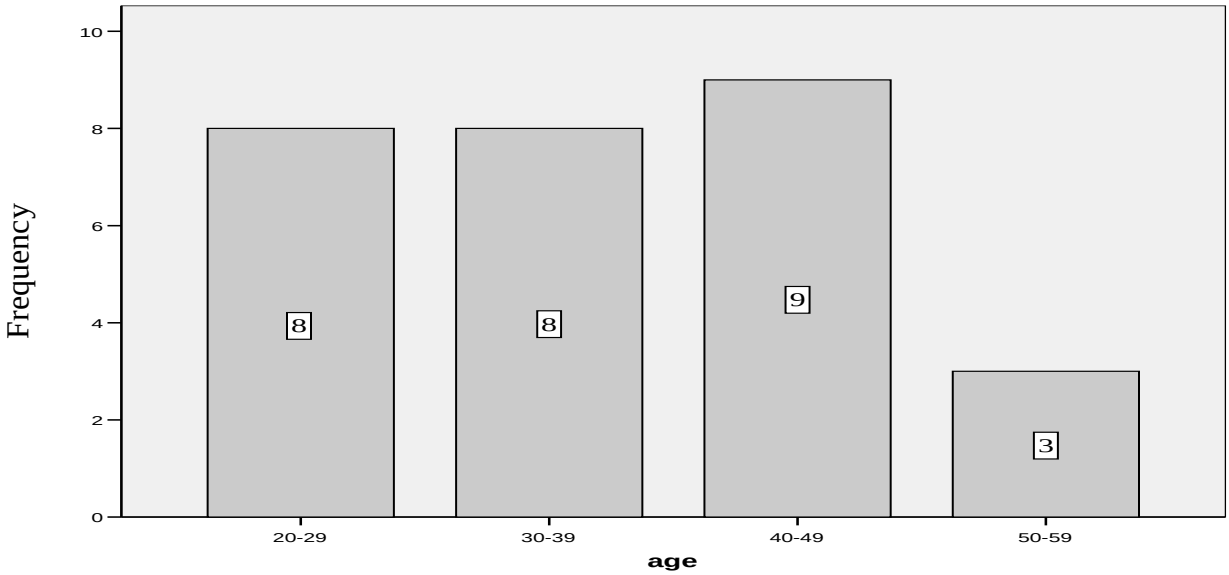
WebLEI Comprehensive Score Differences by Learning Style

	M	*SD*	*F*	*p*	*df*
Learning Style			3.64	.045	3,12
Assimilator	4.07	.29			
Diverger	3.62	.45			
Converger	4.31	.37			
Accommodator	4.41	.28			

Differences by Age Category

Age differences in computer self-efficacy and satisfaction with an online course were also examined. Age categories were grouped in 10 year increments: 20-29, 30-39, 40-49, and 50-59. Membership of age categories is presented in Figure 3.

Figure 3. Participants' age categories.



No significant difference was found across the age categories in computer self-efficacy and online learning. However, the Interaction scale of the WebLEI was the closest to showing significanct differences by age category. The highest mean score (4.45) was from the group 30-39 years old and the lowest mean (3.63) was the 20-29 year old age group (see Table 12).

Table 12

ANOVA Results of Age Differences in Computer Self-Efficacy and WebLEI

	F	*p*	*df*
Pre-CUSE	1.12	.361	3,22
Post-CUSE	.11	.951	3,19
WebLEI Access	.20	.897	3,13
WebLEI Interaction	3.04	.067	3,13
WebLEI Response	.42	.742	3,13
WebLEI Results	1.47	.269	3,13
WebLEI Total	.760	.536	3,13

Differences by Previous Computer Experience

Participants rated their previous computer experience on a scale of 0 (none) to 4 (extensive). All responses ranged between 1 and 3, where 1 indicated very limited experience and 3 indicated quite a lot of experience. Table 13 summarizes the ANOVA results of previous computer experience and pre-computer self-efficacy. The ANOVA results in Table 13 indicate a significant difference in computer self-efficacy with difference in computer experience.

Interestingly, those with very limited computer experience had the highest computer self-efficacy (pre-CUSE), however, this result is exaggerated by the small *N* in the "very limited" group.

Table 13

Previous Computer Experience and Pre Self-Efficacy

	N	*M*	*SD*	*F*	*p*	*df*
Very limited	1	142.71	19.38	8.31	.002	2,23
Some experience	19	129.75	24.10			
Quite a lot of experience	8	127.00	31.43			

Table 14 summarizes the ANOVA results for post self-efficacy score by previous computer experience. A significant difference in computer self-efficacy was revealed among levels of computer experience and interestingly, the gap between the groups was closing from the pre-CUSE to the post-CUSE. The highest mean post self-efficacy was reported by participants with only some previous computer experience

Table 14

Previous Computer Experience Differences in Post Self-efficacy

	M	*SD*	*F*	*p*	*df*
Very limited	135.43	25.96	3.72	.042	2,20
Some experience	140.54	22.37			
Quite a lot of experience	133.00	22.27			

Previous computer experience levels were also compared to satisfaction with online learning as measured by the WebLEI. Results in Table 15 indicated no significant differences for previous computer experience in any of the sections of the WebLEI.

Table 15

Previous Computer Experience and WebLEI

	F	*p*	*df*
WebLEI Access	.54	.597	2,14
WebLEI Interaction	1.43	.272	2,14
WebLEI Response	.66	.554	2,14
WebLEI Results	.29	.756	2,14
WebLEI total	.47	.634	2,14

Grade Level Difference

Grade level differences in computer self-efficacy and online course satisfaction was also examined. Grade level categories were created in alignment with the Ohio licensure grade bands: K-3, 4-9, and 10-12, which eliminated the overlap in grades 4-9 and 7-12. Results in Table 16 illustrate differences across grade levels taught by participating teachers in relation to computer self-efficacy. No significant grade level differences in computer self-efficacy were found.

Table 16

ANOVA Results of Grade Level Differences in Pre/Post Self-Efficacy

	F	*p*	*df*
Pre-CUSE	.83	.447	2,23
Post-CUSE	.19	.832	2,20

Table 17 summarizes the ANOVA results by grade level and overall satisfaction with online learning. Significant grade level differences were found in overall satisfaction of online professional development as assessed on the WebLEI: F (2, 14) = 8.40, $p < .01$. Participants teaching grades 4-9 reported the highest mean score of M=4.28, while participants in grades 10-12 reported the lowest average of M=3.38 with overall satisfaction of the online course.

Table 17

ANOVA Results of Grade Level Differences in WebLEI Comprehensive

	M	*SD*	*F*	*p*	*df*
K-3	3.92	.26	8.40	.004	2,14
4-9	4.28	.30			
10-12	3.38	.45			

Due to the significant differences with respect to grade level and WebLEI scores in Table 17, the researcher further explored the four sections of the WebLEI. Significant grade level differences were revealed in the Access scale of the WebLEI (see Table 18).

Table 18

ANOVA Results of Grade Level Differences in Subscales of WebLEI

	F	*p*	*df*
WebLEI Access	7.24	.007	2,14
WebLEI Interaction	3.48	.059	2,14
Web LEI Response	3.58	.056	2,14
WebLEI Results	3.43	.061	2,14

Grade level differences in the subscales of the WebLEI--Interaction, Response, and Results--approached significance.

Differences by Years of Teaching Experience

Years of teaching experience categories were also examined with respect to computer self-efficacy and satisfaction with online learning. Years of teaching were grouped as: 0-5, 6-10, 11-15, 16-20, and 21-25. No significant differences were found in pre and post computer self efficacy or satisfaction with online learning (see Table 19).

Table 19

Years of Teaching Experience Differences in Pre/Post Computer Self-Efficacy and WebLEI

	F	*P*	*df*
Pre-CUSE	.14	.967	4,25
Post-CUSE	.33	.852	4,21
WebLEI Access	.66	.634	4,15
WebLEI Response	1.31	.326	4,15
WebLEI total	2.01	.162	4,15

Significant differences for number of years teaching experience in the Interaction section of the WebLEI were found; F (4,15) = 4.73, $p < .05$ (see Table 20). Participants with 20-25 years teaching experience had the highest mean score of M=4.69, all of the scores from 6 years experience and higher were all above a M=4.0, compared to participants with 0-5 years teaching experience having a mean score of only M=3.63, which was not only the lowest score but the only group that scored below 4.

Table 20

Years of Teaching Experience and Interaction Scale of WebLEI

	M	*SD*	*N*	*F*	*p*	*df*
0-5	3.63	.28	5	4.73	.018	4,15
6-10	4.67	.07	3			
11-15	4.16	.63	4			
16-20	4.25	.35	2			
20-25	4.69	.08	2			
Total	4.17	.54	16			

Significant differences exist for years of teaching experience in the Results scale of the WebLEI; $F\ (4,15) = 4.89,\ p < .05$. Teachers with less experience had lower mean scores on the Interactions section of the WebLEI, but in contrast teachers with 16-20 years experience had a lower mean score on the Results section of the survey (see Table 21).

Table 21

Years of Teaching Experience and Results Scale of WebLEI

	M	*SD*	*N*	*F*	*p*	*df*
0-5	4.03	.33	5	4.89	.016	4,15
6-10	4.54	.08	3			
11-15	4.38	.27	4			
16-20	3.88	.19	2			
21-25	4.69	.08	2			
Total	4.28	.36	16			

This researcher hypothesized a difference between new teachers (defined to be a teacher in their first 5 years) and established teachers. A significant difference between new and established teachers does not exist on the pre-CUSE and post-CUSE nor does a significant difference exist on the Access or Response sections of the WebLEI. However, the Results scale and Total WebLEI scores are approaching significance as seen in Table 22.

Table 22

Years of Teaching Experience (New vs. Established) and Pre/Post Computer Self-Efficacy and WebLEI

	F	*p*	*df*
PreCUSE	.01	.934	1,25
PostCUSE	.70	.412	1,21
WebLEI Access	.07	.800	1,15
WebLEI Response	.89	.360	1,15
WebLEI Results	4.24	.059	1,15
WebLEI Total	3.92	.068	1,15

The two categories of teaching experience, new and established, resulted in more of a significant difference on the Interactions section of the WebLEI (Table 23).

Table 23

Years of Teaching Experience (New vs. Established) and Interaction Scale of WebLEI

	M	*SD*	*N*	*F*	*p*	*df*
New teachers	3.63	.28	5	12.99	.003	1,15
Established Teachers	4.41	.44	11			

Differences by Gender

Gender differences in computer self-efficacy and satisfaction with online learning were also examined. Females had higher mean Pre-CUSE (M=136.14) and Post-CUSE (M=141.25) scores. Female mean CUSE scores increased slightly from the Pre to the Post test, and Male

CUSE scores decreased slightly. Results from T-test of Individual Samples show no significant differences between male and female scores on the subscales or total WebLEI score. However, gender differences on the post-CUSE were approaching significance (see Table 24).

Table 24

Gender and Pre/Post Computer Self-Efficacy and WebLEI

	Female			*Male*			*t*	*p*	*df*
	M	*SD*	*N*	*M*	*SD*	*N*			
Pre	136.14	20.29	21	119.40	33.58	5	1.46	.157	24
Post	141.25	21.72	20	116.33	18.15	3	1.88	.074	21
WebLEI Access	4.52	.51	14	4.42	.38	3	.32	.75	15
WebLEI Interaction	4.10	.55	14	4.25	.66	3	-.42	.682	15
WebLEI Response	3.44	.65	14	3.42	.56	3	.051	.96	15
WebLEI Results	4.21	.51	14	4.17	.069	3	.12	.905	15
WebLEI Total	4.07	.44	14	4.06	.38	3	.02	.985	15

Previous Computer Classes

ANOVA was conducted to examine if completing a previous computer class effects computer self-efficacy and satisfaction with online learning (see Table 25). Sixty-eight per cent of the participants reported attending a computer-training course. No significant group differences existed in scores on the Pre-CUSE, Post-CUSE, and WebLEI. A slight increase in mean scores, as shown in Table 22, from pre-CUSE (M=131.94) to post-CUSE (M=136.67) for previous and pre-CUSE (M=134.78) to post-CUSE (M=140.5) for no previous computer classes.

The increase from pre-CUSE to post-CUSE was slightly higher for the participants reporting no previous computer classes.

Table 25

Previous Computer Classes and Pre/Post Computer Self-Efficacy and WebLEI

	Previous Computer Classes			*No Previous Computer Classes*			*t*	*p*	*df*
	M	*SD*	*N*	*M*	*SD*	*N*			
Pre-CUSE	131.94	24.80	17	134.78	22.33	9	-.287	.777	24
Post-CUSE	136.67	23.92	15	140.50	21.23	8	-.380	.708	21
WebLEI Access	4.61	.33	12	4.25	.72	5	1.1414	.178	15
WebLEI Interaction	4.16	.53	12	4.05	.64	5	.351	.730	15
WebLEI Response	3.49	.52	12	3.30	.87	5	.571	.577	15
WebLEI Results	4.22	.47	12	4.15	.50	5	.270	.791	15
WebLEI Total	4.12	.34	12	3.95	.59	5	.766	.456	15

Research Question 2

Does computer self-efficacy increase from the beginning to the end of an online course?

A t-test of related means was used to compare the participants' pre and post computer self-efficacy scores. The t-test results indicated a significant increase from pre to post survey results: t (20) = -2.042, p = .027 (Table 26).

Table 26

Pre and Post Computer Self-Efficacy

	M	*SD*	*N*	*df*
Pre-CUSE	132.90	24.04	21	20
Post-CUSE	139.71	20.60	21	

Research Question 3

Is computer self-efficacy significantly related to satisfaction with online professional development?

Pearson Correlation revealed no significant relationship between computer self-efficacy (pre or post) and satisfaction with online learning. A significant relationship existed only between post-CUSE and the Results scale of the WebLEI.

Table 27

Correlations Between Pre/Post Computer Self-Efficacy and WebLEI

	PRE			*POST*		
	R	*p*	*N*	*r*	*p*	*N*
WebLEI Access	-.05	.873	15	.10	.717	16
WebLEI Interaction	-.12	.675	15	.14	.596	16
WebLEI Response	.07	.794	15	.23	.395	16
WebLEI Results	.09	.748	15	.56	.024	16
WebLEI Total	-.01	.987	15	.32	.234	16

Summary

The overall purpose of this study was to examine learning style differences in relation to computer self-efficacy and satisfaction with online learning. Results conveyed that participants in an online course do not differ significantly by learning style, with respect to pre and post self-efficacy (CUSE) and online course satisfaction (WebLEI access, interaction, response, results and overall). A significant difference does exist across learning styles in the Access scale of the WebLEI, which indicates participants were satisfied with the opportunity to access the course learning activities at a time and place convenient for them and complete the work when and how they decided.

Computer experience categories significantly differed in pre- and post self-efficacy scores. Computer experience groups did not significantly differ in satisfaction of an online course as measured by the WebLEI, however, satisfaction of an online course was significantly different by grade level taught. Significant differences existed between years of teaching for the Interaction and Results scales of the WebLEI.

Females had higher mean computer self-efficacy score than males. In addition, mean scores for the female group increased from pre to post, whereas, mean scores for the male group decreased slightly from pre to post CUSE. Gender differences were not significant in overall satisfaction with online learning, and no significance existed on the subscales of the WebLEI.

Results of the t-test of related samples indicated a significant increase from pre to post computer self-efficacy results. Pearson Correlation revealed no significant relationship between computer self-efficacy and satisfaction with online learning, however, a significant relationship existed on the post-CUSE and the Results scale of the WebLEI.

A detailed discussion of the implications of the results described in Chapter IV will be presented in Chapter V.

CHAPTER V. CONCLUSIONS AND DISCUSSION

Chapter 5 presents an overview of the study and interpretations, conclusions, and limitations regarding the findings from statistical results in Chapter 4. Recommendations for educators and professional development providers as well as suggestions for further study are discussed.

Overview of the Study

The No Child Left Behind Act (2001) has outlined requirements for all K-12 teachers in public schools to participate in High-Quality Professional development each school year. With ever increasing demands on teachers' time, various deliveries of professional development are necessary to meet the needs of the teachers, administrators, and school districts. Online professional development is one delivery system that allows teachers to access the professional development courses when time allows, and complete the work required for the course in the comfort of their own home. However, not all teachers are comfortable with online learning and some do not have the technological skills or a comfort level with computers to complete an online course.

This study examined the relationship among learning styles, computer self-efficacy and satisfaction with online learning. Participants for the study were 30 teachers from throughout Ohio enrolled in an online course, Lesson Lab's BreakThrough Mathematics. The participants were asked to complete an online learning style inventory (Kolb's Learning Style Inventory) and a pre-computer self-efficacy survey (pre-CUSE) prior to starting the course. After the completion of the course, participants were asked to complete a post-computer self-efficacy survey (post-CUSE) and a satisfaction with online learning survey (WebLEI).

Limitations of this study included the small number of participants (n=30) due to the unexpected low enrollment in the courses. Additionally, only participants enrolled in the online course were surveyed. The small number of participants limits the generalizability of the results to a larger population. Furthermore, the results of this research may have been different if more teachers were surveyed, and teachers from both online and face-to-face deliveries were represented. Finally, two different instructors facilitated the course, which may also have affected the results of the measure of satisfaction with the online course. However, even with the limitations of the study, adequate data were provided to begin exploring learning styles, computer self-efficacy, and satisfaction with online learning.

Summary and Discussion of Results

Teachers taking online courses have few with respect to learning style and satisfaction with online learning, however, a significant difference existed when examining computer self-efficacy, which significantly increased from the beginning of the course to the end of the course. Detailed discussion about each of the questions researched in this study provide a closer examination at who is taking online courses and how the characteristics of the online participants relate to computer self-efficacy and satisfaction with online professional development.

Research Question 1

Do computer self-efficacy and satisfaction with online professional development differ by learning style preference, previous computer experience, grade level, teaching experience, gender, previous computer courses and age among K – 12 teachers?

The results of Kolb's Learning Style Inventory divulged that there was one learning style that was much higher for the participants enrolled in the Lesson Lab online course than the others. The percentage of participants with the Assimilator learning style (43%) was much

higher than the other three—Accommodator (17%), Diverger (27%), Converger (10%). Barnes, Preziosi, and Gooden (2004) reported similar results, however, the Diverger (64%) learning style had the largest percentage of participants and participants with Assimilator (32%) learning style had the second largest percent. Representation of all four learning styles indicated that individuals with any learning style were willing to participate in an online course. Schaller and Allison-Brunell (2003) indicated findings similar to the current study, indicating that participants with the Assimilator learning style are more likely to prefer an online course due to the nature of the learner preferring the online environment which requires reading and reflective analysis. In contrast, Buerck, et al. (2003) found that participants with the Assimilator learning style--the highest number of participants in this study--were more likely to sign up for a face-to-face class, and the participants with Converger learning style--the smallest number enrolled in this study--were most likely to sign up for an online course.

Oh, Lin, and French (2004) found that learning styles were not correlated with instructional delivery mode, but instead, students who were comfortable with computer technology were more likely to have a positive attitude toward online learning. Computer self-efficacy scores did not differ significantly by learning style, but participants with the Accommodator learning style had a higher mean score on the pre-CUSE and the post-CUSE than participants with the other three learning styles. Individuals with an Assimilator learning style excel in inductive reasoning and are more concerned with abstract concepts rather than people (Kolb, 2000; Barnes, Preziosi, & Gooden, 2004), which could explain the high pre-CUSE and post-CUSE scores. Participants with Accommodator learning style scored the highest on all scales of the WebLEI, which indicated they were most satisfied with the online course.

Computer self-efficacy and satisfaction with online professional development also differed little by gender. Self-efficacy scores increased significantly for females while the scores from pre to post self-efficacy actually decreased slightly for males. In the current study no significant differences between males and females were noted on the CUSE. Interestingly, this study revealed that females had a higher mean score on both the pre-CUSE and post-CUSE and an increased score from the pre-CUSE to the post-CUSE, whereas, the mean post CUSE decreased for male participants from the pre-CUSE. Mean female scores were also slightly higher on all sections of the WebLEI, with the exception of the Interaction scale, in which the mean score for males was slightly higher, which could be attributed to the fact that 80% of the males in this study preferred the Assimilator learning style. Individuals with Assimilator learning style are generally reflective and prefer time to think things through and the Access section of the WebLEI assesses not only active participation, but also reflective interaction. Hsu, Wang, and Hong (2003) found similar results in their study comparing the effects of gender and learning motivation for E-learning students. Several researchers contend that gender differences in computer and Internet usage are diminishing (Davidson-Shrivers, et al, 2003; Hartsell, 2004). Research conducted by Hartsell (2004), reported that on an average women produced more postings than men, however, an independent-samples t-test revealed no significant differences.

Satisfaction with online professional development differed significantly by teaching experience only on the Interaction and Results scales of the WebLEI. Teachers with more than five years experience had higher mean scores, all above 4, on the Interaction scale of the WebLEI. Teachers with more experience have had more opportunities to interact with colleagues and have most likely taken more classes.

Computer experience stood out as significantly related to computer self-efficacy in both the pre-CUSE and post-CUSE, however, the number of individuals with very limited previous experience (n=1) skewed that data. Interestingly, participants with some experience had a higher mean score for both the pre-CUSE and post-CUSE than the participants with quite a lot of experience and the difference between pre and post was greater for the participants with some experience. Overall, computer self-efficacy was high for the participants in this online course, however, if participants in the face-to-face courses would have been given the CUSE, this researcher predicts the participants in the face-to-face courses would have had much lower computer self-efficacy scores than the participants enrolled in the online course.

Unlike the assertion set forth by Oh, Lin, and French (2004) that students who are comfortable using technology also have positive attitudes toward online learning, this researcher found very few significant relationships between computer self-efficacy and satisfaction with online learning. However, other factors relating to satisfaction with online learning were revealed. Overall satisfaction with online learning was highest among teachers of grades 4-9. The individual scales of the WebLEI showed that grade level was one of the common traits that showed significance or close to significance on all four scales. The higher WebLEI scores among teachers in grades 4-9 may be in part due to the ease of access to computers the participants have at school. K-3 and high school teachers may not have the ease of access at school because many of the elementary schools have computer labs instead of individual computers in the classroom and very little time during the school day is available for K-3 teachers to work on courses. High school teachers do not always have computers in their classrooms and have to use a common computer, possibly located in the teachers lounge, making it difficult to spend the amount of time needed to complete course assignments at school.

No significance was shown when comparing years of teaching experience for Pre and Post CUSE and the WebLEI Access section, WebLEI Response section and the total WebLEI. A significant difference was found to exist between years of teaching experience for the Interaction section of the WebLEI. Teachers with the least teaching experience (0-5 years) had a lower mean score (3.63) on the Interactions section than any of the other groups, and the only mean score of any of the groups below 4.0. The results of this section are understandable when realizing the number of tasks a beginning teacher has to learn in the first five years of teaching, and interacting with other teachers is one of those tasks. These results were even more dramatic when comparing new teachers to established teachers (over 5 years experience) as seen in Table 20. The Results section of WebLEI and years of teaching experience also resulted in significant differences; teachers with 16-20 years experience had the lowest mean score (3.88) and the only mean score below 4.0. A higher mean score on this section would indicate that the participants felt the goals and outcomes of the course were met. Possibly the group of teachers that had 16-20 years experience had different expectations for the course and those expectations were not met to the same degree of satisfaction as the other groups. However, when comparing new to established teachers, no significance was shown on the Results section of the WebLEI.

Research Question 2

Does computer self-efficacy increase from the beginning to the end of an online course?

Computer self-efficacy was relatively high prior to the online course and increased significantly at the end. Bandura (1977) theorizes that an individual's perceived self-efficacy will influence the choice of settings. Participants with high computer self-efficacy would be more likely to enroll in an online course than participants with low computer self-efficacy. Self-efficacy increases when an individual feels he can be successful (Bandura, 1977, 1999). Lee and

Witta (2001) found that computer self-efficacy increased significantly in an online course as early as three weeks into the twelve-week course and continued to increase throughout the course. Increased success leads to increased computer self-efficacy, accounting for the significant increase between the pre-CUSE and post-CUSE.

Research Question 3

Is computer self-efficacy significantly related to satisfaction with online professional development?

Several variables relate to computer self-efficacy and the satisfaction with online learning to some extent, but few of these characteristics are significantly related to computer self-efficacy and satisfaction with online learning, which would indicate further research is necessary to provide more information to determine if online learning is for everyone.

As previously stated, computer self-efficacy increased from the beginning to the end of the online course, as measured by the CUSE. However, no significant relationship was revealed between computer self-efficacy and satisfaction with online learning. The only scale of the WebLEI that was significantly related to the post CUSE was the Results scale, which would indicate that participants with higher computer self-efficacy were more satisfied that the goals of the course were met. Success with online technology increases computer self-efficacy, however; lack of success or perceived success as indicated in the Results section of the WebLEI, would lead to lower computer self-efficacy since participants learn better online when they have a positive attitude toward online learning (Kurbacak & Baptiste, 2002).

Conclusions

This study sought to determine if teachers with certain learning styles and characteristics had higher computer self-efficacy and were more satisfied with online professional development.

The results of this study point out several characteristics of online learners that are significant with regard to computer self-efficacy and satisfaction with online learning.

All types of learners can be successful in an online learning environment given the presumption that the activities are varied to accommodate different learning styles. Facilitators must use a variety of teaching strategies to meet the variety of learning styles.

Online learning is becoming a necessity in this society as demands increase for continuous professional development. Teachers have competing demands on their time and online learning can provide the professional development in a delivery mode that allows the teacher to complete the work at a time and place convenient for that individual. Technology has become a part of professional development, allowing teachers to accumulate knowledge about teaching and learning in a different delivery mode than the traditional face-to-face workshop (Stigler & Hiebert, 1999).

This study found that learning style does not significantly affect satisfaction with online learning or computer self-efficacy. However, participation in online courses increases technology skills, which in turn increases computer self-efficacy. These findings are reflective of previous research by Lee and Witta (2001), Kurubacak and Baptiste (2002), and others.

Course satisfaction was not significantly related to computer self-efficacy. Computer self-efficacy increases with positive computer experience, whereas, it decreases with negative computer experience (Cassidy & Eachus, 2002). Participants in this research study reported satisfaction with the online learning course. This positive experience with computers, while not statistically significant, would, theoretically, increase computer self-efficacy. Gender was not a significant factor in computer self-efficacy or satisfaction with online learning. Other research findings are similar; no significant differences have been noted for gender, on lower level skills

such as word processing and spreadsheets (Cassidy & Eachus, 2002). However, on more advanced computer skills, males generally had higher computer self-efficacy.

Participants, regardless of learning style, can be successful in an online learning environment. All four learning styles were represented in this study and no significant differences existed for computer self-efficacy or satisfaction with online learning. Although participants in each group reported satisfaction with the course, the Diverger learning style group scored lower on all scales of the WebLEI, denoting less satisfaction overall with the course. Learners with Diverger learning style generally: prefer learning in groups, are interested in people, perceive the instructor as a motivator, and expect personalized feedback (Kolb, 1999). These expectations may not be addressed in an online course as well as in a face-to-face course, which could explain the lower mean scores on the WebLEI. Comments by participants on the open-ended responses on the WebLEI reinforced the conjecture that more interaction and feedback were desired from the online course in statements such as; “more interaction and feedback with the instructor” and “perhaps have a live chat room for certain parts of the course”.

This researcher has attempted to examine the relationship among learning styles, computer self-efficacy, and satisfaction with online learning. While not generalizable to the entire population of teachers enrolled in online professional development, understanding these relationships may provide teachers, administrators and professional development providers information that will enhance their ability to make informed decisions to include or not include online professional development as a delivery style option for professional development.

Recommendations and Suggestions for Further Research

A number of recommendations for teachers and professional development providers have come from this research and literature review. In addition to recommendations, suggestions for further research about online learning became apparent throughout the study.

Recommendations for Teachers

1. Teachers considering online delivery of professional development should consider several factors: time requirements, self-directed learning, and technology. The perception of online classes is that not as much time is required as in a face-to-face class. However, as much time should be allotted to an online class and time should be scheduled just as a teacher would schedule time for a face-to-face class (Boyd, 2004). Self-direction and self-motivation are also factors that are necessary to complete an online course. Unlike face-to-face courses, online courses require the participant to take total responsibility for accessing and completing course work without the constant support of the instructor. Finally, the technology a teacher is using for an online course must support the necessary tools required in the course (i.e. QuickTime, Microsoft Word, Internet server) and the teacher must possess the necessary skills, (i.e. e-mail, word processing, discussion board posting), to be an active participant in the course (Boyd, 2004).

2. A benefit of online professional development is it allows participants to spend less time away from home and family (Buerck, et al., 2003; DeWert, et al., 2003; Hsu, Wang, & Hong, 2003; Huang, 2002). The main reason participants in this study cited on the open-ended questions of the WebLEI for taking online courses was the ability to work at home because of child care needs, flexibility in scheduling, travel time and expenses, and ability to work at one's own pace. Although working at home can be a benefit, working at home could also interfere with the

completion of course work because of outside distractions, such as family obligations, as the participants in this study noted on the open-ended questions. Participants in an online course need to be motivated and self-disciplined. Time and space should be set aside for online course work to ensure successful completion of the course (Boyd, 2004).

3. Although participants with each of the learning styles from Kolb's Learning Style Inventory participated in this study of online learning, teachers should consider what type of learning style best describes oneself and then decide if an online course meets the needs of that learning style. Teachers enroll in online courses because they have other commitments that keep them from taking face-to-face courses, but if human interaction is being sought in a course, possibly online learning is not the best delivery of professional development for that person. In this study, participants with the Diverger learning style were the least satisfied with the online course. Possibly, these participants would be more satisfied with a face-to-face course. In addition, participants enrolled in an online course must be self, disciplined, self-motivated, and computer literate (Boyd, 2004; Resta, Wang & Hao, 2003) if they are to be successful. The participants in this study all had high computer self-efficacy scores and the scores increased from pre to post, indicating that they were successful in the online course which in turn increased their computer self-efficacy.

Recommendations for Professional Development Providers

1. Professional development providers should continue to provide different delivery styles: online, blended, and face-to-face. Professional development standards apply to all delivery styles. Learning styles of participants should be addressed when planning and implementing online professional development (Diaz & Cartnel, 1999; Palloff & Pratt, 2003), because online and face-to-face courses are comprised of individuals with different learning styles. Since all

learning styles were represented in this study, it was even more important for the instructors to be aware of and meet the needs of a variety of learning styles and provide a variety of learning activities to meet these learning style needs. BreakThrough Mathematics courses provide a variety of learning experiences, and by doing so participants of all learning styles were satisfied with the course.

2. Online professional development courses should be held to the same goals and evaluation standards as face-to-face classes. Outcomes for professional development are the same no matter which delivery system---online, blended, or face-to-face--- is offered. Professional development providers should be aware of the advantages and disadvantages of each delivery system (Kapp & McKeague, 2002). Some of the disadvantages participants described in an online course were: a) lack of face-to-face interaction, b) unsure of clarity of questions asked by e-mail, and c) lack of interaction and feedback from instructors. Issues such as these should be addressed when designing an online course to make sure the same standards for professional development are being met.

3. A shortage of math and science teachers across the country creates the need for more online programs for licensure. Many individuals with degrees other than math and science education are returning to school to obtain teaching licensure through programs like Teach for America and Teach Ohio. These individuals often hold full-time jobs and/or have families and other commitments that make it difficult for them to attend classes at a specific time or place. Online courses provide these individuals with the opportunity to meet the teacher licensure requirements at a time and place convenient for them. Offering online courses is one way to attract teacher candidates for math and science.

4. One final recommendation for professional development providers is to explore the possibilities online learning presents for collaboration among universities to provide a licensure program for individuals wishing to pursue a career in education but who currently possess other degrees. Online courses could be taken anywhere at anytime; therefore, each university could specialize in a certain field (i.e. algebra) and all of the participants seeking licensure would take the series of courses pertaining to that specialty from that university and then take additional courses from other universities throughout the state to achieve the necessary requirements for licensure. University faculty could focus on one or two courses rather than all of the courses needed for licensure. This type of delivery would make teacher licensure in mathematics and science available to more individuals while providing courses of high quality. Licensure would then be received from the state and not from a specific university.

Suggestions for Further Research

This researcher observed several gaps in the literature with regard to online learning. Some topics for future research to begin to fill these gaps are as follows:

1. *Is there a difference in student learning outcomes between online and blended delivery styles of professional development*? *Is there a difference in the quality of material presented in an online class versus a face-to-face class?* The courses offered online in this study had the same learning outcomes as the face-to-face courses; however, the face-to-face classes often included other activities in addition to the activities set forth in the curriculum. Discussions often went in other directions in the face-to-face classes to accommodate the needs of the participants--this was not generally the case in the online courses. These differences in delivery, even with the same curriculum, would be difficult to measure when comparing online and face-to-face delivery. More importantly, student learning outcomes should be the focus of the comparison of

online and face-to-face (Diaz, 2000; O'Lawrence, 2006), focusing on how students learn in an online environment (Richardson & Newby, 2006). Another factor to consider when comparing student outcomes for different delivery systems is the effect of the instructor. Even with the same online course, different instructors respond to the participants and provide feedback differently.

2. *Is the drop-out rate higher in an online course than either a blended or a face-to-face course?* The participants that completed the surveys for this study all completed the course; however, many online as well as face-to-face participants drop out before the course is over. Dropout rates may be due to the fact that participants are not self-directed learners (Rossett & Schafer, 2003) or lack time, or encounter distractions (Frankola, 2001). Courses that are not interactive and meaningful may cause students to become bored which may then result in increased dropout rates (Steinbronn & Merideth, 2003). More research is needed to determine why participants drop out of online and face-to-face courses and then compare the dropout rate of each and determine if a relationship exists between delivery system and dropout rate.

3. *Who is the successful online learner? What characteristics are most common in a successful online learner? Are these characteristics different from the face-to-face learner?* Research to determine what characteristics make up the successful online learner would be beneficial to prospective online students. A successful learner would be an individual who is satisfied with the course and completed assignments to the desired degree set forth by the facilitator. Many online courses provide a survey for participants to complete before signing up for an online course; items focus on how the participant learns best. Information about the characteristics of an online learner would also benefit instructors of online courses. Several researchers describe the online learner as self-directed, self-motivated, a critical thinker, and a reflective thinker

(Boyd, 2004; Palloff & Pratt, 2003; Resta, Wan, & Hao, 2003), but these are possibly the same characteristics face-to-face learners possess. Additionally, computer self-efficacy is a determinant of expected outcomes in an online course (Papasratorn & Wangpipatwong, 2006), suggesting that high computer self-efficacy is one characteristic an online learner should possess to be successful in an online course.

More research is needed to understand the online student's learning strategies, motivation and prior experience (Richardson & Newby, 2006). Further research is also needed to examine the relationship of instructional design and the online environment (Papasratorn & Wangpipatwong, 2006).

REFERENCES

An, Y. & Frick, T. (2006). Student perceptions of asynchronous computer-mediated communication in face-to-face courses. *Journal of Computer-Mediated Communication,* 11(2), article 5.

Bandura, A. (1994). Self-efficacy. In V.S. Ramachaudran (Ed.) *Encylopedia of human behavior* (4) 71-81. New York: Academic Press. (Reprinted in H. Friedman [Ed.], *Encyclopedia of mental health.* San Diego: Academic Press, 1998).

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control.* Freeman: New York.

Bandura, A. (1999). A social cognitive theory of personality. In L. Pervin & O. John (Ed.), *Handbook of Personality* (2nd ed., pp. 154-196). New York: Guilford Publications.

Barnes, F., Prezioisi, R., & Gooden, D. (2004) An examination of the learning styles of online MBA students and their preferred course delivery methods. *New Horizons in Adult Education,* 18 (2), 19-30.

Boulton-Lewis, G., Wilss, L., & Mutch, S. (1996). Teachers as adult learners: Their knowledge of their own learning and implications for teaching. *Higher Education, 32, 89-106.*

Boverie, P., Nagel, M., MeGee, M., & Garcia, S. (1998). Predicotrs of satisfaction for distance learners: A study of variable conditions. *SIGCUE Outlook,* 26(2), 2-7.

Boyd, D. (2004). The characteristics of successful online students. *New Horizons in Adult Education,* 18 (2), 31-39.

Buerck, J., Malmstrom, T., and Peppers, E. (2003). Learning environments and learning styles: Non-traditional student enrollment and success in an internet-based versus a lecture-based computer science course. [Electronic version] *Learning Environments Research:* (6) 137-155.

Butler, J. (1992). Staff Development. *School Improvement Research Series.* Accessed 10/16/06 at http://www.nwrel.org/scpd/sirs/6/cu12.html.

Carr-Chellman, A. (2000). Burrowing through the network wires: Does distance detract from collaborative authentic learning? *Journal of Distance Learning,* 15(1), 39-62.

Cassidy, S. & Eachus, P. (2002). Developing the Computer User Self-Efficacy (CUSE) Scale: Investigating the relationship between computer self-efficacy, gender and experience with computers. *Journal of Educational Computing Research. 26(2). 133-153.*

Chang, V., & Fisher, D. (2003). The validation and application of a new learning environment instrument for online learning in higher education. In M. S. Khine & D. Fisher (Eds.), *Technology-rich learning environments: A future perspective* (pp. 1-18). Singapore: World Scientific.

Coates, D., Humphreys, B., Kane, J. & Vachris, M. (2004). No "significant distance" between face-to-face and online instruction: evidence from principles of economics. *Economics of Education Review,* 23, 533-546.

Connor, M. (2004). *Learn More Now*. Hoboken, NJ: John Wiley & Sons.

Corcoran, T. (1995). *Helping teachers teach well: Transforming professional development.* Consortium for Policy Research in Education.

Davidson-Shivers, G., Morris, S., & Srewongkol, T. (2003) Gender differences: Are they diminished in online discussions? *International Journal on E-Learning*, 2 (1), 29-36.

DeWert, M., Babinski, L., & Jones, B. (2003). Safe passages: Providing online support to beginning teachers. [Electronic version] *Journal of Teacher Education*, 54 (4), B311-320.

Diaz, D. (2000). Carving a new path for distance education research. *The Technology Source Archives*, March/April.

Diaz, D. & Cartnal, R. (1999). Students' learning styles in two classes: Online distance learning and equivalent on-campus. *College Teaching,* 47(4), 130-135.

Dille, B. & Mezack, M. (1991). Identifying predictors of high risk among community college telecourses students. *The American Journal of Distance Education,* 5(1), 24-35.

Ellis, H. (2002). Andragogy in a web technologies course, *ACM SIGCSE Bulletin* – Proceedings of the 33rd SIGCSE technical symposium on computer science education, 34(1).

Evans, J. & Haase, I., (2001). Online business education in the twenty-first century: An analysis of potential target markets. *Internet Research,* 11(3), 246-260.

Forsyth, R. (2002). Making professional development flexible: a case study. *Open Learning, 17(3).*

Fraenkel, J. & Wallen, N. (2003). *How to design and evaluate research in education.* (5th ed.). Boston: McGraw-Hill.

Frankola, K. (2001). Why online learners drop out. *Workforce.* Retrieved October 31, 2004, from http://www.findarticles.com/p/articles/mi_m0FXS/is_10_80/ai_79352432

Graham, R. (2004). Online or face-to-face: How to deliver professional development. *Society for Information Technology and Teacher Education International Conference 2004*(1), 1576-1580. [Online]. Available: http://dl.aace.org/14540

Guskey, T. (2000). *Evaluating professional development*. Thousand Oaks, CA: Corwin Press, Inc.

Guskey, T. (2002). Does it make a difference? Evaluating professional development. *Educational Leadership,* 59, 45-51.

Guskey, T. & Sparks, D. (2002, April). *Linking professional development to improvements in student learning.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Hartsell, T. (2004). Look Who's Talking: A Descriptive Analysis of Gender and Online Communication.. *World Conference on E-Learning in Corp., Govt., Health., & Higher Ed. 2004*(1), 1921-1926. [Online]. Available: http://dl.aace.org/16709

Hew, K., Knapczyk, D., & Frey, Y. (2005). *Electronically training teachers at a distance: An analysis of six online pedagogical activities.* Paper presented at SITE annual meeting.

Hirsh, S. & Sparks, D. (1999). Staff development resolutions for the next millennium. *The High School Magazine,* 7, 20-24.

Howland, J. & Moore, J. (2002). Student perceptions as distance learners in Internet-based courses. *Distance Education*, 23 (2), 183-195.

Hsu, T., Wang, H., & Hong, M. (2003). Effects of Gender, GPA, Computer Self-Efficacy, and Learning Motivation on the Collaborative E-Learning Participation. *World Conference on E-Learning in Corp., Govt., Health., & Higher Ed. 2003*(1), 241-248. [Online]. Available: http://dl.aace.org/13650

Huang, H. (2002). Toward constructivism for adult learners in online learning environments. [Electronic version] *British Journal of Educational Technology*, 33(1), 27-37.

Hudson, B. (2002). The jungle syndrome: Some perils and pleasures of learning without walls. In K. E. Rudestam & J. Schoenholtz-Read (Eds.), Handbook of online learning: Innovations in higher education and corporate training (pp. 3-28). Thousand Oaks, CA: Sage.

Ingvarson, L. (1998). Professional development as the pursuit of professional standards: The standards-based professional development system. *Teaching and Teacher Education,* 14, 127-140.

James, J. & Bailey, G. (2002). *Online professional development: A customized approach for technology leaders.* Eugene, OR: International Society for Technology in Education.

Kapp, K. & McKeague, C. (2002). Blended learning for compliance training success. *EduNeering.* Accessed online. 10/17/06. http://www.astd.org/NR/rdonlyres/456DB5F7D0FE-49B8-AE38-78167D308C7B/0/blendedlearning.pdf

King, K. (2002). Identifying success in online teacher education and professional development. *Inernet and Higher Education. (5), 231-246.*

King, K. (2002a). Educational technology professional development as transformative learning opportunities. [Electronic version] *Computers and Education*, 39, 283-297.

Knowles, M. (1978). *The adult learner: A neglected species*. Houston: Gulf Publishing.

Kolb, D. (2000). *Facilitator's guide to learning.* Boston: Hay/McBer.

Kolb, D. (1999). *The Kolb Learning Style Inventory*. Boston: Hay Resources Direct.

Kurubacak, G. & Baptiste, H.P. (2002). Creating a virtual community with PT3: College of Education students' beliefs, expectations and attitudes toward online learning. Paper presented at the *ED-MEDIA 2002 World Conference on Educational Multimedia, Hypermedia & Telecommunicaiton.* Denver, CO.

Lawler, P. (1991). The keys to adult learning: Theory and practical strategies. Philadelphia. Research for Better Schools.

Lawler, P. (2003). *Teachers as adult learners: A new perspective.* New Directions for Adult and Continuing Education, 98, 13-22.

Lawler, P. and King, K. (2000). *Planning for effective faculty development: Using adult learning strategies.* Malabar, Florida. Krieger.

Lee, Y. (2004). *How To Consider Individual Differences In Online Learning Environments. Society for Information Technology and Teacher Education International Conference 2004*(1), 545-550. [Online]. Available: http://dl.aace.org/14337

Lee, C. & Witta, E. (2001, November). *Online students' perceived self-efficacy: Does it change?* Paper presented at the National Convention of the Association for Educational Communications and Technology, Atlanta, GA.

Lieb, S. (1991). Principles of adult learning. *Vision.* Retrieved September 8, 2003 at http://www.hcc.hawaii.edu/intranet/committees/FacDevCom/guidebk/teachtip/adults2htm

Loucks-Horsley, S. (1997). *Ideas that work: Mathematics professional development.* Columbus,OH: Eisnehower National Clearinghouse.

McCartney, B. & Shannon, R. (1999). *Web based teaching: Do learning styles matter?* World Conference on the WWW and Internet 1999 (1), 1346-1347. [Online] Available: http://dl.aace.org/5539

McKinzie, L., & McCallie, T. (1999). Teaching Online: A Professional Development Model. In *Proceedings of Society for Information Technology and Teacher Education International Conference 1999* (pp. 564-570). Norfolk, VA: AACE.

Merriam, S. (2001). Andragogy and self-directed learning: Pillars of adult learning theory. *New Directions for Adult and Continuing Education*, 89, 3-13.

Mertler, C. & Vannatta, R. (2002). *Advanced and multivariate statistical methods*. (2nd ed.). Los Angeles:Pyrczak.

Meyer, K. (2003). Face-to-face versus threaded discussions: The role of time and higher order thinking. *Journal of Asynchronous Learning Network,* 7(3), 55-65.

Mezirow, J. (1997). Transformative learning: Theory to practice. *New Directions for Adult and Continuing Education* (74).

Muir, D. (2001). Adapting online education to different learning styles. In *Building on the Future.* National Educational Computing Conference, Chicago, 22, 1-14.

National Staff Development Council (2001). *E-Learning for educators.* Oxford, OH.

No Significant Difference Phenomenon Website. http://nosignificantdifference.wcet.info/index.asp

Nunnally, J. (1067). *Psychometric Theory*. New York: McGraw-Hill.

Oh, E., Lim, D., & French, R. (2004). Field-related learning styles and online education. *Society for Information Technology and Teacher Education International Conference 2004 (1), 2981-2988.* [Online]. Available: http:..dl.aace.org/14838.

Ohio Department of Education (2001). *Quality professional development: A guide for Ohio's Educators.*

O'Lawrence, H. (2006). The influence of distance learning on adult learners. *Techniques,* 81(5), 47-49.

Papasratorn, B. & Wangpipatwong, T. (2006). The effects of self-efficacy and attitude on E-learning outcomes. In T. Reeves & S. Yamashita (Eds.), *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education,* Chesapeake, VA: AACE.

Poftak, A. (2003). Are your teachers "Highly Qualified"? *Technology and Learning, 23*(11), 24-27.

Palloff, R. & Pratt, K. (2003). The virtual student: A profile and guide to working with online learners. San Francisco: Jossey-Bass.

Raschick, D., Maypole, E., & Day, P. (1998). Improving field education through Kolb Learning Theory. *Journal of Social Work Education*, (34)1.

Resta, P., Wang, J., & Cen, H. (2003). Who benefits more from online learning? The relationship between online learning styles and outcomes. In *Proceedings of Society for Information Technology and Teacher Education International Conference 2003* (282-284). Norfolk, VA: AACE.

Richardson, J. & Newby, (2006). The role of student cognitive engagement in online learning. *The American Journal of Online Learning,* 20(1), 23-37.

Ross, J. A., Hogaboam-Gray, A., & Hannay, L. (2001). Effects of teacher efficacy on computer skills and computer cognitions of K-3 students. *Elementary School Journal, 102*(2), 141-156.

Rossett, A. & Schafer, L. (2003). What can we do about e-dropouts? Retrieved July 14, 2005, from http://edweb.sdsu.edu/courses/edtec644/Rossett_Schafer_ElrnrDropou.pdf

Schaller, D. & Allison-Brunnell, S. (2003). Practicing what we teach: How learning theory can guide development of online educational activities. Paper from an International Conference, Charlotte, NC.

Senge, P. (1990). *The fifth discipline: The art & practice of the learning organization.* New York, NY: Doubleday

Simpson, C. & Du, Y. (2004). Effects of learning styles and class participation on students' enjoyment level in distributed learning environments. *Journal of Educational Library Information Science,* 45(2), 123-136.

Singh, H. (2003). Building effective learning programs. *Educational Technology,* 43, 51-54.

Smith, M. (2001) David A. Kolb on experiential learning: The encyclopedia of informal education. Online http://www.infed.org/biblio/b-explrn.htm. Accessed 11/9/04.

Sparks, D. (1996). A new form of staff development is essential to high school reform. *The Educational Forum,* 60, 260-266.

Sparks, D., & Hirsh, S. (1997*). A new vision for staff development*. Alexandria,VA: Association for Supervision and Curriculum Development.

Sparks, D. & Hirsh, S. (2004). *A national plan for improving professional development.* Oxford, OH: National Staff Development Council.

Spicer, J. (2002). Eisenhower National Clearinghouse. *Even better than face-to-face*. Retrieved November 12, 2006, from http://0my.goenc.com.maurice.bgsu.edu:80/classroom/documents/?doc_type=doc&doc_d=259 &file_name=index.asp

Steinbronn, P. & Merideth, E. (2003). An outward design support system to increase self efficacy in online teaching and learning. *Campus-Wide Information Systems,* 20(1), 17-24.

Stigler, J., & Hiebert, J. (1999). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom*. New York, NY: The Free Press.

Tennet, M. (1997). As cited in Smith, M. (2001). David A. Kolb on experiential learning. *The encyclopedia of informatal education.* http://www.infed.org/b-explrn.htm

Tucker, S. (2001). Distance education: Better, worse, or as good as traditional education? *Online Journal of Distance Learning Administration,* 4(4). Retrieved November 27, 2006, from http://www.westga.edu/%7Edistance/ojdla/winter44/tucker44.html

Tyre, T. (2002). The art of online learning. *District Administration.* Retrieved September 13, 2003 at www.DistrictAdministrator.com.

U.S. Department of Education, Office of the Secretary, *No Child Left Behind,* 2001.

Warrick, W. (2005). The learner and the expert mentor, learners and a facilitator, peer facilitated learning: A comparison of three online learning designs. In C. Crawford et al. (Eds.), *Proceedings of Society for Information Technology and Teacher Education International Conference 2005* (pp. 659-665). Chesapeake, VA: AACE.

Wang, A. & Newlin, M. (2002). Predictors of web-student performance: The role of self efficacy and reasons for taking an online class. *Computers in Human Behavior,* 18, 151-163.

Wenglinsky, H. (2000). How Teaching Matters. Educational Testing Service, Princeton.

Willis, S. (2002). Creating a knowledge base for teaching: A conversation with James Stigler. *Educational Leadership,* 59, 6-11.

Yang, S. & Liu, S. (2004). Case study of online workshop for the professional development of teachers. *Computers in Human Behavior,* 20, 733-761.

APPENDIX A

Kolb's Learning Style Inventory

Part I: Concrete Experience vs. Abstract Conceptualization

1. I prefer
A. hands-on learning experiences.
B. learning through thinking and reasoning.

2. I tend to
A. rely on feelings when making decisions.
B. rely on logical reasoning when making decisions.

3. I learn more effectively from
A my peers.
B. my teachers.

4. I like learning through
A. simulations.
B. lectures.

5. I learn well by
A. practical experience.
B. applying theories to hypothetical situations.

6. I am best at learning
A. facts.
B. concepts.

Total of As _____ Concrete Experience (CE) score

Total of Bs _____ Abstract Conceptualization (AC) score

Part II: Active Experimentation vs. Reflective Observation

1. I learn best through
C. active involvement in projects.
D. observation.

2. I would rather
C. do volunteer work with disadvantaged youth.
D. read about disadvantaged youth.

3. I prefer assignments that
C. require me to work examples.
D. require me to think about situations.

4. I learn well through
C. participating in a discussion
D. listening to what others have to say.

5. I tend to
C. jump right in and do something new.
D. think about possible outcomes before trying something new.

6. I learn best
C. by doing.
D. watching and then reflecting.

Total of Cs _____ Active Experimentation (AE) score

Total of Ds _____ Reflective Observation (RO) score

Interpretation:

A responses = Concrete Experience (CE)
B responses = Abstract Conceptualization (AC)
C responses = Active Experimentation (AE)
D responses = Reflective Observation (RO)

APPENDIX B

Computer User Self-Efficacy Scale

Computer User Self-Efficacy Scale

The purpose of this questionnaire is to examine attitudes toward the use of computers. The questionnaire is divided into two parts. In Part 1 you are asked to provide some basic background information about yourself and your experience of computers, if any. Part 2 aims to elicit more detailed information by asking you to indicate the extent to which you, personally, agree or disagree with the statements provided.

Part 1:

Your Name: _____

Your Age: _____

Your sex: ☐M ☐F

Experience with computers:

- ❑ none
- ❑ very limited
- ❑ some experience
- ❑ quite a lot
- ❑ extensive

Please indicate (tick) the computer packages (software) you have used

- ❑ Wordprocessing packages
- ❑ Spreadsheets
- ❑ Databases
- ❑ Presentation packages (e.g., Harvard Graphics, Coreldraw)
- ❑ Statistics packages
- ❑ Desktop Publishing
- ❑ Multimedia

Other (specify) _____

Do you own a computer?

☐Yes ☐No

Have you ever attended a computer-training course?

☐Yes ☐No

Part 2:

Below you will find a number of statements concerning how you might feel about computers. Please indicate the strength of your agreement/disagreement with the statements using the 6-point scale shown below. Tick the box (i.e., between 1 and 6) that most closely represents how much you agree or disagree with the statement. There are no *correct* responses, it is your own view that are important.

1. Most difficulties I encounter when using computers, I can usually deal with.
   strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

2. I find working with computers very easy.
   strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

3. I am very unsure of my abilities to use computers.
   strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

4. I seem to have difficulties with most of the packages I have tried to use.
   strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

5. Computers frighten me.
   strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

6. I enjoy working with computers.
   strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

7. I find that computers get in the way of learning.
   strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

8. DOS-based computer packages don't cause many problems for me.
   strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

9. Computers make me much more productive.
   strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

10. I often have difficulties when trying to learn how to use a new computer package.
    strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

11. Most of the computer packages I have experience with, have been easy to use.
    strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

12. I am very confident in my abilities to make use of computers.
    strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

13. I find it difficult to get computers to do what I want them to.
    strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

14. At times I find working with computers very confusing.
strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

15. I would rather that we did not have to learn how to use computers.
strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

16. I usually find it easy to learn how to use a new software package.
strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

17. I seem to waste a lot of time struggling with computers.
strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

18. Using computers make learning more interesting.
strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

19. I always seem to have problems when trying to use computers.
strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

20. Some computer packages definitely make learning easier.
strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

21. Computer jargon baffles me.
strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

22. Computers are far too complicated for me.
strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

23. Using computers is something I rarely enjoy.
strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

24. Computers are good aids to learning.
strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

25. Sometimes, when using a computer, things seem to happen and I don’t know why.
strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

26. As far as computers go, I don’t consider myself to be very competent.
strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

27. Computers help me to save a lot of time.
strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

28. I find working with computers very frustrating.
strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

29. I consider myself to be a skilled computer user.
    strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

30. When using computers I worry that I might press the wrong button and damage it.
    strongly disagree ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 strongly agree

APPENDIX C

Web-Based Learning Environment Instrument

Directions for Respondents

This questionnaire contains statements related to your learning in a web-based learning environment. You will be asked how often each practice takes place.

There are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Think about how well each statement describes what the web-based learning environment class is like for you.

Draw a circle around

1	if the practice takes place	Never
2	if the practice takes place	Seldom
3	if the practice takes place	Sometimes
4	if the practice takes place	Often
5	if the practice takes place	Always

Be sure to give an answer for all questions. If you change your mind about an answer, just cross it out and circle another.

Some statements in this questionnaire are fairly similar to other statements. Don't worry about this. Simply give your opinion about all statements.

WEB-BASED LEARNING ENVIRONMENT

For each statement, please **circle** the number that best represents your answer.

ACCESS

		Always	Often	Sometimes	Seldom	Never
1.	I can access the learning activities at times convenient to me.	5	4	3	2	1
2.	The on-line material is available at locations suitable for me.	5	4	3	2	1
3.	I can use time saved in traveling and on campus class attendance for study and other commitments.	5	4	3	2	1
4.	I am allowed to work at my own pace to achieve learning objectives.	5	4	3	2	1
5.	I decide how much I want to learn in a given period.	5	4	3	2	1
6.	I decide when I want to learn.	5	4	3	2	1
7.	The flexibility allows me to meet my learning goals.	5	4	3	2	1
8.	The flexibility allows me to explore my own areas of interest.	5	4	3	2	1

INTERACTION

		Always	Often	Sometimes	Seldom	Never
9.	I communicate with other students in this subject electronically (email, bulletin boards, chat line.)	5	4	3	2	1
10.	In this learning environment, I have to be self-disciplined in order to learn	5	4	3	2	1
11.	I have the autonomy to ask my tutor what I do not understand.	5	4	3	2	1
12.	I have the autonomy to ask other students what I do not understand.	5	4	3	2	1
13.	Other students respond promptly to my queries.	5	4	3	2	1
14.	I regularly participate in self-evaluations.	5	4	3	2	1
15.	I regularly participate in peer-evaluations.	5	4	3	2	1
16.	I was supported by positive attitude from my peers.	5	4	3	2	1

WEB-BASED LEARNING ENVIRONMENT (CONT.)

RESPONSE

		Always	Often	Sometimes	Seldom	Never
17.	This mode of learning enables me to interact with other students and the tutor asynchronously.	5	4	3	2	1
18.	I felt a sense of satisfaction and achievement about this learning environment.	5	4	3	2	1
19.	I enjoy learning in this environment.	5	4	3	2	1
20.	I could learn more in this environment.	5	4	3	2	1
21.	It is easy to organize a group for a project.	5	4	3	2	1
22.	It is easy to work collaboratively with other students involved in a group project.	5	4	3	2	1
23.	The web-based learning environment held my interest throughout my course of study.	5	4	3	2	1
24.	I felt a sense of boredom towards the end of my course of study.	5	4	3	2	1

RESULTS

		Always	Often	Sometimes	Seldom	Never
25.	The scope or learning objectives are clearly stated in each lesson.	5	4	3	2	1
26.	The organization of each lesson is easy to follow.	5	4	3	2	1
27.	The structure keeps me focused on what is to be learned.	5	4	3	2	1
28.	Expectations of assignments are clearly stated in my unit.	5	4	3	2	1
29.	Activities are planned carefully.	5	4	3	2	1
30.	The subject content is appropriate for delivery on the Web.	5	4	3	2	1
31.	The presentation of the subject content is clear.	5	4	3	2	1
32.	The quiz in the web-based materials enhances my learning process.	5	4	3	2	1

Open-Ended Comments

Please write your responses in the space provided below. Your comments could provide an explanation of previous responses and/or additional information you may wish to provide.

1. Why are you studying in an on-line mode?

2. What are the advantages of studying in an on-line mode?

3. What are the disadvantages of studying in an on-line mode?

4. Are there any suggestions to improve the delivery of the unit in an on-line mode?

APPENDIX D

Initial E-mail

Dear Colleague,

You are invited to be part of a research study on *Learning Styles, Self-Efficacy, and Satisfaction with Online Learning: Is Online Learning for Everyone?* As part of my work on my doctoral dissertation in the Department of Leadership Studies at Bowling Green State University, I am conducting a research study of teachers enrolled in an online course of BreakThrough Mathematics.

Please read the attached letter which provides information about the study.

After reading the attached letter, please reply to this message and let me know whether or not you agree to participate.

Thank you for your time.

Debra Shelt

Attachment

APPENDIX E

Participant Consent Letter

December 15, 2005

Dear Colleague:

You are invited to be part of a research study on *Learning Styles, Self-Efficacy, and Satisfaction with Online Learning: Is Online Learning for Everyone?* As part of my work on my doctoral dissertation in the Department of Leadership Studies at Bowling Green State University, I am conducting a research study of teachers enrolled in an online course of BreakThrough Mathematics. The results of this study could provide insight into whether a relationship exists between learning styles and attitudes toward online professional development. Such information would be benefit educators when planning for professional development, especially when considering online delivery.

The purpose of this study is to examine the relationships between learning styles of the online learner and attitudes toward/satisfaction with online professional development. This study will request you to complete an online Learning Styles Inventory, a pre- and post- computer self-efficacy survey, and a Web Learning Environment Instrument. All of the instruments will be completed online. The Learning Style Inventory and the pre-self-efficacy survey will be completed prior to start of the course. The post-self-efficacy survey and the Web Learning Environment Instrument will be completed at the completion of the online course. I estimate that the two instruments completed prior to the course will take approximately a half hour and the two instruments at the conclusion of the course will take approximately 40 minutes to complete.

I understand that your time is very valuable, but I would very much appreciate your participation in this study. Your participation is completely voluntary, and you are free to stop your participation at any time without penalty or explanation. Information you provide will remain confidential and your identity will not be revealed. Only the research team will have access to the data you provide. Confidentiality of you as a respondent and your responses will be protected throughout the study and publication of the study results. The risks of participating in this study are no greater than those encountered in normal daily life.

Please reply to this e-mail indicating your consent to participate in this study. Please note that e-mail is not 100% secure, so it is possible that someone intercepting your e-mail will gain knowledge of your interest in this study. Please remember to clear our browser's cache and page history after you submit the survey in order to protect your privacy. Some employers use tracking software to monitor and record keystrokes, mouse clicks, and web sites visited. This could impact the confidentiality of your responses and you may wish to complete the surveys on your home computer.

If you have any questions or comments about this study, you can contact me at 419-372-9188 or dshelt@bgsu.edu or Dr. Vannatta, my dissertation advisor, at rvanna@bgsu.edu. If you have questions about the conduct of this study or your rights as a research participant, you may contact the Chair of Bowling Green State University's Human Subjects Review Board at (419) 372-7716 (hsrb@bgnet.bgsu.edu).

Sincerely,
Debra Shelt

APPENDIX F

E-mail for First Two Surveys

Dear ,

Thank you for participating in *Learning Styles, Self-Efficacy, and Satisfaction with Online Learning: Is Online Learning for Everyone?*
The following two items will need to be completed before you begin your online course: Kolb's Learning Style Inventory and the pre- Computer Self-Efficacy survey.

To access the Kolb's Learning Style Inventory please use the following information:

Learning Style Inventory Access Information

From your Internet browser (Netscape Navigator or Internet Explorer versions 4.0 or higher) go to
HTTP://www.hayresourcesdirect.haygroup.com/lsi/default-new.asp?oz=559.
This will bring you to the survey login page. If you cannot access the URL by clicking, you can cut and paste it in your browser.

At the login page, enter the organizational password 111405.

You will then need to do the following:
Enter a username - we recommend first name underscore last name e.g. Joe_Sample
Enter a password - this is a personal password of your choice (6-20 characters)
Enter the organizational password: 111405

You will not be able to access the results since this is for research purposes only.

If you have any questions please call the Hay Group at 1 800-729-8074.

To access the Computer Self-Efficacy Survey please use the following information:
Click on the URL http://edhd.bgsu.edu/shelt/precuse.php and complete the demographic information and the survey. If you cannot access the URL by clicking, you can cut and paste it in your browser.

Click on the *Click Here to Submit Your Responses* button.

If you have any questions or need more information please contact me at dshelt@bgsu.edu or by phone at 419-372-9188.

Again, thank you very much for participating.
Sincerely,
Debra Shelt
Bowling Green State University

APPENDIX G

E-mail for Last Two surveys

Dear Participant:

Thank you for participating in *Learning Styles, Self-Efficacy, and Satisfaction with Online Learning: Is Online Learning for Everyone?*
Prior to taking the course, you completed the Kolb's Learning Style Inventory and the Pre Computer Self-Efficacy survey.
Now that you have completed your online course, would you please complete the following two surveys:
Post- Computer Self-Efficacy survey
WebLEI.

To access the Computer Self-Efficacy Survey please use the following information:
Click on the URL http://edhd.bgsu.edu/shelt/postcuse.php and complete the demographic information and the survey. If you cannot access the URL by clicking, you can cut and paste it in your browser.

Click on the *Click Here to Submit Your Responses* button.

To access the WebLei, please use the following information:

Click on the URL http://edhd.bgsu.edu/shelt/weblei.php and complete the survey. If you cannot access the URL by clicking, you can cut and paste it in your browser.

Click on the *Click Here to Submit Your Responses* button.

If you have any questions or need more information please contact me at dshelt@bgsu.edu or by phone at 419-372-9188.

Sincerely,

Debra Shelt
Bowling Green State University

APPENDIX H

Syllabus for Lesson Lab's BreakThrough Mathematics Course

MATH 586
Solving Equations
BreakThrough Mathematics

Instructors:

Dr. Barbara Moses, 419-372-7464, E-MAIL: bmoses@bgsu.edu
Ms. Debra Gallagher, 419-372-9188, E-MAIL: dgallag@bgsu.edu

Online office hours:
Sundays, 7 pm – 9 pm
Tuesdays, 8 pm – 9 pm
Wednesdays, 8 pm – 9 pm
You can email at other hours, but the instructors may not respond immediately.

Course Description:

This course is designed to provide teachers with a deep knowledge of the concept of solving equations. Participants will have the opportunity to observe, analyze, and then develop effective strategies to teach these concepts to students. In this course, teachers will explore content, analyze lessons, and work to improve their own teaching practices.

Expected Outcomes:

By the completion of this course, participants will:

- deepen their knowledge of critical concepts in mathematics,
- recognize how students understand and learn about these concepts, and
- develop improved methods for teaching these concepts.

Teachers finish the course by developing their own lesson plan thereby demonstrating a firm assessment of how students understand mathematical concepts. In addition, after submitting their own lesson plan, teachers will critique online five lessons plans written by other teachers in the class. This is the beginnings of lesson study.

Course Requirements:

Participants are required to participate in all of the online discussions, problem sets, and lesson planning activities. Two hours of graduate credit are awarded to participants who complete the course and all the tasks and forums. The letter grade given will be based on the appropriateness of responses to the tasks and forums and to the final project including lesson plan interpretations and suggested next steps.

Course Outline:
The course is organized into two phases: Content Exploration and Lesson Analysis.

I. Content Exploration

In this phase participants will deepen content knowledge:

- through an analysis of concepts and problems, and
- by studying a video of a mathematics educator discussing the concepts with a group of teachers.

Participants will also:

- explore prerequisite skills and knowledge,
- learn about areas that present student learning challenges,
- develop appropriate solution strategies, and
- assess their students' knowledge in the particular area of study previous to their teacher's involvement in the course (pre-assessment).

II. Lesson Analysis

In this phase, participants will:

- analyze a teacher's lesson plan and lesson video,
- examine examples of student thinking and learning,
- explore effective instructional strategies, and
- generate teaching alternatives and provide a rationale for those choices.

In addition, participants will:

- revise the video teacher's lesson plan and provide suggestions,
- develop their own lesson plan,
- plan and test some of their ideas with their own classes,
- share lesson plan implementation results, and
- assess their students' knowledge in the area.

Timeline:

Week 1	Introduction to Visibility Software, Defining Equations
Week 2	Writing and Interpreting Algebraic Expressions and associated teaching/learning issues
Week 3	Techniques for Solving Equations
Week 4	Links to Practice, Discussion of math standards
Week 5	Analyzing the Main Problem, Discussion of Rich Problems, Analyzing the lesson plan of the video teacher

Week 6 Watching the video, Analyzing student work, Analyzing Instruction, Create lesson plan

Week 7 Submit lesson plan, Respond to other lesson plans

Week 8 Submitting final lesson plan

Assessment:

- Respond to all Tasks and Forums by deadlines
- Share personal view of mathematics with respect to the readings
- Complete all assigned mathematics problems
- Complete lesson plan to be used in classroom
- Respond to five other lesson plans
- Revise and submit lesson plan

Required Readings:

All required reading is provided within the content of the course itself. This includes:

LessonLab's Approach to Teacher Learning
LessonLab's BreakThrough Mathematics Series
Defining Equations
Teaching and Learning Issues in Defining Equations
Equivalent Equations
Teaching and Learning Issues in Equivalent Equations
Techniques for Solving Linear Equations
Solving Equations Core Concepts

Recommended Readings:

Hiebert, James & Stigler, J.W. (1999). *The Teaching Gap: best ideas from the world's teachers for improving education in the classroom.* New York, NY: The Free Press.

Stevenson, H.W. & Stigler, J.W. (1992). *The Learning Gap: why our schools are failing and what we can learn from Japanese and Chinese education.* New York, NY: Touchstone.