University of Nevada, Reno

Preservice Mathematics Teachers' Perceptions of Using a Web 2.0 Technology as a Supportive Teaching-Learning Tool in a College Euclidean Geometry Course

A dissertation submitted in partial fulfillment of the requirements
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Curriculum, Teaching, and Learning
with an emphasis on
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by

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THE GRADUATE SCHOOL

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ABSTRACT

Preservice Mathematics Teachers' Perceptions of Using a Web 2.0 Technology as a Supportive Teaching-Learning Tool in a College Euclidean Geometry Course

This mixed methods study examined preservice secondary mathematics teachers' perceptions of a blogging activity used as a supportive teaching-learning tool in a college Euclidean Geometry course. The effect of a 12-week blogging activity that was a standard component of a college Euclidean Geometry course offered for preservice secondary mathematics teachers, during the fall semester of 2011 in a university in the western United States, was investigated in this study. The blog can be visited at: http://edsc353fall2011.wordpress.com/

Participants' perceptions were measured by two dependent variables: (1) participants' attitudes toward the blogging activity in the college Euclidean Geometry course – measured by calculating the median response to the 16 Likert-type scale items measured on a six-point scale; and (2) participants' perceived effectiveness of the blog for the learning of Euclidean Geometry – measured by calculating the median response of another 18 Likert-type scale items measured on a six-point scale. Participants' cumulative quiz scores attained on eight in-class quizzes was used as a dependent variable to see whether or not there were relationships between the quiz total and either of the other dependent variables. There were two independent variables: (1) participants' gender – a categorical variable with two categories: male and female; and (2) participants' self-reported total time spent on the Internet per week – these values were divided into two categories using a median split.

Quantitative data was collected using an instrument developed by the researcher. Validity and reliability of the instrument were measured through appropriate procedures and were found to be authentic and consistent. Qualitative data was collected using two open-ended questions on the survey as well as from the students' postings to the online discussion board on the blog. The quantitative and qualitative data were analyzed separately using SPSS-PASW for Windows and MAXQDA, respectively.

Participants' overall attitude scores toward the blogging activity showed a mean, median, and mode of 4.18, 4.0, and 4.0 respectively with a standard deviation of 0.95, suggesting that participants' typical response indicated that they had slightly more than positive agreement that they held a positive attitude toward the blogging activity in the College Euclidean Geometry course. Similarly for perceived effectiveness, the mean, median, mode of 4.13, 4.0, and 4.0, respectively indicated that the typical response of participants corresponds to slightly more than agreement that the blogging activity was an effective means of teaching and learning Euclidean Geometry.

Due to the ordinal nature of the first two dependent variables that measure participants' attitudes toward and perceived effectiveness of the blogging activity, respectively, the non-parametric Wilcoxon-Mann-Whitney U test was carried out on median attitudes and median perceived effectiveness scores, separately, to determine if differences exist on these data across participants' gender and self-reported time on the Internet.

The study did not indicate any significant difference in the participants' median attitude scores ($N = 28$, $U = 68.0$, $p > 0.05$) toward the blogging activity in a college Euclidean Geometry course based on their gender. Also, no significant difference was indicated in the participants' median perceived effectiveness scores ($N = 28$, $U = 94.50$, $p > 0.05$) of the blogging activity for the learning of Euclidean Geometry in terms of their gender.

Similarly, the study did not indicate any significant difference in the participants' median attitude scores ($N = 28$, $U = 61.50$, $p > 0.05$) toward the blogging activity in a college Euclidean Geometry course with regard to their self-reported total time spent on the Internet per week. However, a significant difference was indicated in the participants' median perceived effectiveness scores ($N = 28$, $U = 53.00$, $p < 0.05$) of the blogging activity for the learning of Euclidean Geometry with regard to their self-reported total time spent on the Internet per week.

Moreover, the study did not indicate a significant correlation ($N = 28$, $r_s = -0.145$, $p > .05$) between the participants cumulative quiz scores and their median attitude scores

toward the blogging activity. Similarly, the study did not indicate a significant correlation ($N = 28$, $r_s = -0.232$, $p > .05$) between the participants cumulative quiz scores and their median perceived effectiveness scores toward the blogging activity.

Furthermore, qualitative analyses of the survey data revealed that the preservice mathematics teachers reported numerous advantages of the blogging activity as a supportive tool in the college Euclidean Geometry course, despite the limitations of the free blog service being used. No mentionable disadvantage of using the blogging activity as a supportive tool in the college Euclidean Geometry course were found, although some minor problems of using the free blog were reported by participants.

Additionally, this study analyzed the major trends that emerged in an unguided online discussion board on the blog. This component of the study revealed approximately twenty major themes raised by preservice secondary mathematics teachers. Although, the participants' discussion did not focus in any specific direction, interestingly, most of the topics were related to the improvement of learning styles and professional development, topics that are often not discussed in the classroom.

The study revealed that participants considered the blog to be an open and public forum where they can discuss issues and discussion topics of interest to them and present their personal views and experiences without hesitation. Blogs have the potential to allow mathematics students and teachers to build and participate in many virtual platforms where they can share their voices and perspectives in a public forum.

The findings of this study suggest that blogs and other Web 2.0 technologies could provide an important avenue for fostering the teaching and learning of mathematics in today's technologically advanced society. Thus, educators need to capitalize on the proliferation of information technology and the fascination of students with the interactive features of emerging Web 2.0 applications that can be used wirelessly.

Finally, based on the findings of the study the researcher provided some implications for practice; and recommendations for further research regarding the use of blogs and other Web 2.0 applications in the teaching and learning of mathematics.

Dedication

I dedicate this work to my late
father, *Mokaddes Ali*,
and my mother, *Moriam Begum*.

There is no doubt that
their unconditional love,
sacrifice, support, and prayers
brought me to where I am today.

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Mokter Hossain
May, 2012
Reno, Nevada, USA

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CHAPTER ONE: INTRODUCTION

Technology has been included as an important principle in the National Council of Teachers of Mathematics' (NCTM) Principles and Standards for School Mathematics (NCTM, 2000) in the United States. Highlighting the importance of technology in teaching-learning mathematics, *Principles and Standards* encourages teachers and students to use technology to broaden and deepen their mathematics understanding. The technology principle states that technology is a tool that can enhance teaching-learning mathematics. NCTM (2000) notes, "When technological tools are available, students can focus on decision making, reflection, reasoning, and problem solving" (p. 24). They recommend, "In mathematics-instruction programs, technology should be used widely and responsibly, with the goal of enriching students' learning of mathematics" (p. 25). According to *Principles and Standards*, with appropriate use of technology students can better understand the underlying meaning of mathematics and learn mathematics more easily. Technology can enrich students' range and quality of mathematical investigations by providing a means for viewing mathematical ideas from multiple perspectives (NCTM, 2000).

The NCTM (2000) *Principles and Standards* recommends that students use technology as an aid to help solve mathematical problems and enhance learning skills. They do not suggest, however, that technology should replace the role of the mathematics teacher. Instead, they envision that students in a mathematics classroom should have access to technology to facilitate their mathematics learning under the guidance of a skillful teacher who will decide when and how technology will be used. Further, they

expect that teachers will play multiple roles in a technology-rich classroom to facilitate students' learning in appropriate ways (pp. 25-26). NCTM (2000) acknowledges that the effective use of technology in the mathematics classroom depends heavily on the corresponding effort and experience of the teacher. According to the NCTM (2000) Principles and Standards:

> Decisions to incorporate new technology also require that teachers be prepared and supported in using it to serve instructional goals. Teachers must themselves experience how technology can enhance the learning of significant mathematics and explore models for incorporating it in their classroom practice. (p. 373)

Information Technology should play an increasingly important role in teaching-learning mathematics at all levels. Currently, most mathematics classrooms in the United States have advanced technological tools including high-speed Internet connected computers, projectors, smart-boards, graphing calculators, and various standalone mathematical software packages such as: Geometer's Sketchpad, Math Arena Advanced, and Data Explorer, as well as TI-84 Graphing Calculators and Explorer Calculators. (Engelbrecht & Harding, 2004; Garofalo, Drier, Harper, Timmerman, & Shockey, 2000). These technological tools have the capability of assisting teachers and students in the collection, recording, organization, and analysis of data in the teaching and learning of mathematics (Kimmins, 1995). These tools also provide convenient, accurate, and dynamic graphing, drawing, and enhanced computational power and mathematical skills.

Unfortunately, however, information technology has not reached its full potential in the mathematics education programs across the U.S. (Gunter, 2001; Kurz &

Middleton, 2006). Many prospective mathematics teachers' view on the role of technology in mathematics education is not satisfactory (Habre & Grunmeier, 2007). In many mathematics classrooms technology is used improperly in ways that focus more on the technology than on mathematical understanding or calculation (Habre & Grunmeier, 2007). The use of computers for instructional purposes still lags behind the integration of technology in the corporate world and is not used as frequently or effectively as is needed in the mathematics classroom (Powers & Blubaugh, 2005). Many newly graduated preservice mathematics teachers do not have sufficient experience in the use of computers in the teaching-learning process (Kurz & Middleton, 2006). Most preservice mathematics teachers identified technology as important in education; however, many of them felt that after graduation they might not be well prepared to teach with technology (Carlson & Gooden, 1999; Kurz & Middleton, 2006; Terri, 2011).

Mathematics is a subject that requires much interaction with teachers when a student faces difficulty learning mathematics strategies; however, most mathematics learning software does not provide an opportunity for students to ask questions when they face difficulty (Frank, 2008). Moreover, most mathematics teaching-learning software and traditional web-based programs are very costly and require frequent updates of purchased licenses. Some require a yearly license fee and a high-speed Internet and computer system to run; thus, they are beyond the accessibility of students and teachers in many rural school districts (Sledge & Morehead, 2006). As a result, a large portion of students, teachers, and classrooms across the world cannot afford and use purchased mathematics software and web-based applications.

Fortunately, Web 2.0 technology, which is a new development of the Internet services available on the World Wide Web that allows Internet users to collaborate and share web information actively (O'Reilly, 2005), has great potential to create new opportunities and challenges, especially for mathematics students, teachers, and educators seeking to develop new models that will be available and affordable to almost all students, teachers, and mathematics classrooms in the world. The continuing spread of Web 2.0-based free applications could provide an alternative means of supporting a large population of mathematics students, teachers, and classrooms who cannot afford to purchase licensed mathematics software or flexible online teaching-learning systems. This may be an especially effective avenue for fostering mathematics learning in today's technologically advanced young students, who tend to use the Internet through wireless means.

This study was intended to examine the feasibility of using Web 2.0 technologies in the teaching and learning of mathematics – by measuring preservice mathematics teachers' perceptions regarding a blogging activity that was a standard component of a Euclidean Geometry course offered in a university in the western United States. Participants' attitudes toward and perceived effectiveness of the blogging activity were measured using an instrument developed by the researcher (Appendix A).

Background of the Study

Technology has been a powerful tool in the United States' mathematics classrooms for several decades. Technology is one of the six principles stated in the NCTM (2000) Principles and Standards of School Mathematics. The NCTM (2000)

Principles and Standards admits that "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning" (p. 24). It also advocates for the appropriate and integrated use of technology in every aspect of mathematics education from what is taught in mathematics; how mathematics is taught and learned; and how mathematics is assessed (Powers & Blubaugh, 2005).

However, the current progress in science, technology, and mathematics education in the U.S. is not satisfactory as evaluated by educators and legislators (Hossain & Robinson, 2011; Leshner, 2009). Although many U.S. students excel in mathematics, as a whole, U.S. performance on international mathematics tests consistently remains between the second and third quartile (Leshner, 2009). There are wide disparities in mathematics achievement among various ethnic groups. Too many U.S. students and parents think that mathematics is a difficult and uninteresting subject. The result is that mathematics education in the U.S. is failing to instill students with sufficient skills and knowledge necessary to meet the century's challenging economy and leadership (Leshner, 2009).

Moreover, information technology use is not satisfactory in the mathematics education programs nationwide in the U.S. (Gunter, 2001; Kurz & Middleton, 2006). Studies show that many teacher education programs in the U.S. have not integrated technology appropriately (Mistretta, 2005; Watts-Taffe, Gwinn, Johnson, & Horn, 2003). The preparation of preservice teachers to use technology is one of the critical challenges teacher education programs face (Powers & Blubaugh, 2005). Another study to measure preservice teachers' technology beliefs, skills, and barriers to the use of technology

reports that many teacher education programs prepare preservice teachers with low level or outdated technology skills that do not provide preservice teachers with adequate knowledge to provide sufficient technology-based instruction in their classrooms (Brush, Glazewski, & Hew, 2008). Many teacher education programs use the computer as a teacher-centered tool rather than as a student-centered tool (Wang, 2002). Without adequate knowledge, these teachers get little opportunity to integrate technology into their actual classrooms (Brush et al., 2008).

On the other hand, the advancement of Web 2.0 technologies and their access through laptop, netbook, iPad, iPhone, and handheld cellular devices has made a radical change in the lifestyles of young students in the U.S. and worldwide (Baker, Wentz, & Woods, 2010; Hodson, 2008). Research shows that young students spend more time with computer, Internet, and mobile phone use than any other age group, with most of that time spent on social network sites (Clark, Logan, Luckin, Mee, & Oliver, 2009; Lenhart & Madden, 2009; Selouani & Hamam, 2007). Text messaging, blogging, online discussion groups, social networking sites, and other Web 2.0 tools have become integral parts of their lives (Baker et al., 2010). These young students are arriving in high schools, colleges, and universities having multitasking operation skills in blogging, podcasting, tweeting, and other Web 2.0 applications. Due to their inclination to Web 2.0 technologies, mathematics instruction in the traditional static mode might not be sufficient to meet their needs (Hossain & Wiest, 2011a, 2011b).

Meanwhile, the emergence of Web 2.0 technologies is receiving intense and growing interest across many sectors of the education industry for addressing the needs

of today's diverse students (Alexander, 2006; Allen, 2008; Lee & Ge, 2010; McLoughlin & Lee, 2008). In the fields of law, business, communication, and politics users have been grappling with advanced features of Web 2.0 tools for at least several years (Lemley & Burnham, 2009). As Web 2.0 tools allow users to create Web content from text based web pages and online journals to visual format, Web 2.0 could provide appropriate technologies to create multiuser virtual teaching-learning systems.

Thus, the possibility exists for using the interactive features of Web 2.0 technologies to motivate today's technologically advanced students to create and participate in many virtual platforms where they can enrich their mathematical knowledge and understanding by posting mathematical problems and quizzes; providing solutions to problems posted by others; and sharing their thinking in solving and creating mathematics problems. Such activities may change the lackluster attitudes toward learning mathematics held by many U. S. students who are more willing to spend their time on social networking sites than practicing mathematics. This may improve their performance in national and international mathematics assessments. More importantly, it might provide a way of learning and understanding mathematics for those teachers and students who cannot afford costly mathematical software.

Statement of the Problem

Due to the high cost of purchased licenses and annual subscription fees of mathematics learning software and traditional web-based programs, many such programs are beyond the accessibility of students and teachers in underdeveloped countries as well as in many rural school districts in some developed countries (Sledge & Morehead,

2006). As a result, a large portion of students, teachers, and classrooms across the world, as well as in the U.S. cannot use mathematics software and web applications for teaching and learning purposes.

Fortunately, the rapid growth of Web 2.0 technologies and their free access through computers and handheld mobile devices has provided a new possible alternative means of improving the teaching and learning of mathematics. It is expected that the open, free, and easy accessibility of Web 2.0 technologies can meet the increasing demand of new generation students and teachers. The interactive features of Web 2.0 technologies can be utilized by mathematics students, teachers, and educators to develop many online platforms in which students can participate and contribute to developing and extending web-based mathematical repositories.

A blog is a standard example of Web 2.0 technologies (Maddux, Liu, & Johnson, 2008). It is one of the easiest applications of Web 2.0 technologies and can offer unlimited possibilities for building collaborative teaching-learning environments in mathematics education. Creating a blog is one of the fastest growing Web 2.0 applications among mobile Internet users (Kairer, 2009). Blogs promote reflective practice as well as collaboration and social interaction among users (Ray & Hocutt, 2006). As a collaboration and communication tool, educators can use blogs to post announcements for students and parents; students can build their portfolios and digital diaries; and students can share their reflections with others and plan for new projects (Ray, 2006). This may benefit students by allowing them to become "engaged as subject matter experts, motivated as owners of their own learning, involved in a community of

practice, and exposed to diverse perspectives" (Norton & Hathaway, 2008, p. 167). Blogs can be used as the means of obtaining or outsourcing solutions of quizzes, fallacies, and various mathematical problems students need to know to be prepared for competitive tests.

The review of literature served as impetus for this study. Research revealed that blogs, podcasts, YouTube, wikis, Facebook, and similar interactive Web 2.0 tools are already being adopted in the fields of information technology, engineering, business, language, journalism, and the medical sciences (Lemley & Burnham, 2009; Malhiwsky, 2010; McLoughlin & Lee, 2008; Thomas & Li, 2008). However, no empirical studies were found that evaluated the effectiveness of blog and other standard Web 2.0 technologies in teaching-learning mathematics. Thus, this study was conducted with the intention to create an avenue in this arena.

Purpose of the Study

This study was intended to investigate the effectiveness of using a Web 2.0 technology as a supportive tool in teaching-learning mathematics. The study examined preservice secondary mathematics teachers' perceptions of a blogging activity used as a supportive teaching-learning tool in a college Euclidean Geometry course offered in a university in the western United States. Participating preservice teachers' self-reported attitudes toward the blogging activity in a college Euclidean Geometry course and their perceived effectiveness of the blog for the learning of Euclidean Geometry were measured using an instrument developed by the researcher (Appendix A). Participants' attitude and perceived effectiveness scores were compared across their gender and self-

reported time on the Internet to determine if differences exist across these categories. Quantitative methods were used to answer these questions.

Secondly, this study sought to determine if a relationship exists between participants' attitudes toward the blogging activity or perceived effectiveness of the blog to their total quiz scores, measured by eight in-class quizzes. Thirdly, this study qualitatively analyzed the advantages and disadvantages/problems of the blogging activity as reported by the students using data gathered by two separate open-ended questions on the instrument. Fourthly, this study qualitatively determined what trends emerge in students' contributions to an unguided discussion section of the blog.

Based on the findings of this study, appropriate recommendations are made to students, teachers, and teacher educators regarding the potential use of Web 2.0 activities such as blogging. Additionally, the results of this study may provide important information for policy-makers or those responsible for instructional design. Finally, avenues for potential further research in this area are presented.

Significance of the Study

The high costs for purchasing and updating mathematics teaching-learning software, and the problems and challenges associated with traditional and Web-based online courses call for the use of Web 2.0 technologies in the teaching and learning of mathematics. With the rapid growth of social network services, Internet, and mobile web usage, it is expected that Web 2.0 tools will be a popular alternative to traditional teaching-learning software and Web-based online courses.

Moreover, due to the free accessibility of online resources, traditional and authoritative printed material may no longer serve as the standard means of resource sharing (Thomas & Li, 2008). These online resources may better meet the demand of a new generation of students. Hossain and Wiest (2011a, 2011b) support this prediction with an additional concern that due to the inclination of the young generation, both students and teachers, to use Web 2.0 technologies in their personal lives, mathematics instruction in the traditional static mode might not be sufficient to meet the needs of today's students.

As a standard example of Web 2.0 applications, a blog that is free and relatively easy, fast, and requires only basic computing knowledge (Solomon & Schrum, 2007) was considered as an appropriate tool to examine possible usage of other Web 2.0 applications. Researchers expect that over the next few years blogs will be one of the fastest growing Web 2.0 applications (Kairer, 2009). Thus, a blog was considered as an appropriate tool to evaluate the possible usage of other Web 2.0 technologies. Moreover, since the students in the course in which the study was conducted were preservice or in-service teachers, measuring their perceptions regarding a blogging activity was expected to provide evidence of the effectiveness of using Web 2.0 technologies in learning, teaching, and professional perspectives.

The findings of this study could provide important information for mathematics students, teachers, and educators regarding the use of blogs and other Web 2.0 applications as a supportive tool for teaching and learning Geometry as well as other mathematics subjects. Replication of the type of blogging activity discussed in this study

might be a way to improve students' performance in learning mathematics in alternative, collaborative, and interactive ways. Possibly, the use of smart phones and similar handheld cellular devices may motivate some students to learn mathematics from inside and outside the classroom even while riding in a school bus or private car, eating in a restaurant, or walking in a shopping mall. This has the potential to improve mathematics education in the U.S. as well as many developed and developing countries where young students spend many hours on social networking sites.

Most importantly, the results of this study may encourage changes in the way mathematics is taught which could in turn change young students' lackluster attitudes toward learning mathematics. Increased use of Web 2.0 applications on mobile devices may occur. Ideally, students and teachers may create and join in virtual platforms where they can enrich their mathematical knowledge and understanding by posting mathematical problems and quizzes; proposing solutions to problems posted by others; and sharing their thinking in solving and creating mathematics problems. Finally, the results of this study might provide an effective means of learning and understanding mathematics for those teachers and students who cannot afford costly mathematical software or Web-based applications.

Theoretical Framework

Collaboration, constructivism, and motivation are the fundamental features of Web 2.0 technologies (Anderson, 2007; Cash, 2010; Kamel Boulos & Wheeler, 2007). Collaborative activities lead to improved knowledge acquisition compared to instruction delivered through non-collaborative activities (Bonk & Wisher, 2000). In an online

classroom, collaborative learning can take the form of discussion among the whole class or within smaller groups (Brindley, Blaschke, & Walti, 2009). Collaborative learning can help young learners advance their Zone of Proximal Development (ZPD), the area between a learner's independent problem-solving ability and his or her potential for solving problems under the guidance of an expert or in collaboration with more capable peers (Vygotsky, 1978). Vygotsky (1978) holds that knowledge does not preexist in the world but is constructed first socially and then absorbed by young learners individually. Accordingly, collaborative work with Web 2.0 technologies can help young learners advance their knowledge and skills.

Constructivist learning theory is based on the premise that students build their knowledge through interactions between their previous experiences and ideas (Piaget, 1965). Constructivism offers promising new approaches to teaching (Bruner, 1990). Constructivism and *socioculturalism* (Vygotsky, 1978) are the elements of the two most dominant cognition theories that have been applied to mathematics teaching (Crowe & Zand, 2000). In Web 2.0-based teaching-learning activities constructivist theory is applied explicitly in the sense that students play an active role in creating their own study materials, solving realistic and meaningful problems, and collaborating with other participants (Ullrich et al., 2008). Thus, learning takes place in context and in collaboration while the control over the learning process shifts from the teacher to the students. In such an activity, the teacher acts as a supervisor who initiates, advises, and provides support when assistance is needed.

Studies have revealed that motivation is a key component that affects student performance and learning, particularly in online learning (Cole, Field, & Harris, 2004; Papastergiou, 2009; Ryan, 2001; Tuzun, Yilmaz-Soylu, Karakus, Inal, & Kizilkaya, 2009). According to Butler and Butler (2008), "One method of motivation is to use technology to engage students inside and outside of the classroom" (p. 1). In Web 2.0-based collaborative environments students and teachers become self-motivated to engage themselves inside and outside the classroom. Interactive features of Web 2.0 tools motivate participants to spend more time online, and share their creativity to a broader audience than might be possible in a regular classroom (Malhiwsky, 2010).

Given emphasis on these features, many educational commentators argue that Web 2.0 technologies can offer great potential for supporting students' learning in online mathematics education (Alexander, 2006; McLoughlin & Lee, 2008; Waycott et al., 2010). Thus, it has become a recent quest to understand what young learners do with the emerging features of Web 2.0 technologies, and how information technology use and Web 2.0 activities can be incorporated into classroom instruction for the teaching and learning of mathematics.

This study was intended to examine the effectiveness of a standard Web 2.0 technology as a supportive teaching-learning tool in a secondary mathematics course. The effect of a 12-week blogging activity that was a standard component of a particular college Euclidean Geometry course offered for preservice secondary mathematics teachers was investigated in this study. At the end of the activity, attending preservice mathematics teachers' attitudes toward blogging activity and self-reported effectiveness

of the blog were measured using an instrument developed by the researcher (Appendix A).

The two independent variables in this study were: (1) participants' gender, and (2) participants' self-reported total time spent on the Internet per week. The three dependent variables were: (1) participants' attitudes toward the blogging activity in a college Euclidean Geometry course, (2) participant's perceived effectiveness of the blog for the learning of Euclidean Geometry, and (3) participant's total quiz scores attained on eight in-class quizzes.

It was the intent of the researcher to record participants' gender; and to compare male and female participants' perceptions of the blogging activity. This comparison had an intrinsic importance in the sense that studies have shown that gender differences play an unexpectedly significant role in interaction on the Internet in contrast to socioeconomic factors, such as education, income, or age (Bimber, 2000; Carstensen, 2009; Winker, 2005). Men and women use the Internet very differently (Fallows, 2005; Grove, 2010). For instance, women send and receive emails in a richer and more engaging way; women appear to have overtaken men in online shopping; more men than women perform online financial transactions; men pursue and consume information online more aggressively than women (Fallows, 2005). Thus, it could be that men and women might have different perceptions of using a blog as a supportive tool in a college Euclidean Geometry course.

The researcher also recorded and compared perceptions of the participants who spend more time on the Internet with those who spend less time on the Internet. This

comparison has an explicit importance in the sense that studies have found that Americans spend approximately one third of their online time (36%) communicating and networking across social networks, blogs, personal email, and instant messaging (The Nielson Company, 2010). This predicts that there is a strong positive correlation between time spent on the Internet and time spent on social network sites; and therefore, it is possible that there might be a different perception among participants who spend more time on the Internet and social network activities than participants who spend less time on these activities with regard to participating in a blogging activity in a college Euclidean Geometry course.

Additionally, the researcher sought to determine if a correlation exists between students' total quiz score and either their attitudes toward the blogging activity or their self-reported perceptions of the effectiveness of using the blog. This was done with the thought that students who are good in mathematics might have different perceptions of using a new teaching-learning tool.

Furthermore, the researcher qualitatively analyzed the advantages and disadvantages of using a blog in a college Euclidean Geometry course as reported by the participants; and analyzed contributions to an online discussion on the blog for emergent themes. Data for these research questions was collected through two separate open-ended items of the survey instrument and through participants' self-contributed postings to the online discussion board, respectively.

A mixed methods study, with both quantitative and qualitative approaches, was employed to do a cross check among the fixed pattern options of the quantitative data and the open-ended qualitative data with the intention of making the study more authentic.

Research Questions

In order to examine preservice secondary mathematics teachers' perceptions of a blogging activity used as a supportive teaching-learning tool in a Euclidean Geometry course; assess the advantages and disadvantages of the blogging activity; and determine trends that emerge in the student contributions to the unguided online discussion board on the blog, the study addressed the following quantitative and qualitative research questions:

Quantitative Research Questions

Research question 1a: Are there significant differences by gender with regard to preservice mathematics teachers' attitudes toward the blogging activity in a college Euclidean Geometry course?

Research question 1b: Are there significant differences by gender with regard to preservice mathematics teachers' perceived effectiveness of the blog for the learning of Euclidean Geometry?

Research question 2a: Do preservice teachers who report spending more time on the Internet differ significantly from those who report spending less time on the Internet with regard to their attitudes toward the blogging activity in a college Euclidean Geometry course?

Research question 2b: Do preservice teachers who report spending more time on the Internet differ significantly from those who report spending less time on the Internet with regard to their perceived effectiveness of the blog for the learning of Euclidean Geometry?

Research question 3a: Is there a relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry course and their attitudes toward the blogging activity in a college Euclidean Geometry course?

Research question 3b: Is there a relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry course and their perceptions of the effectiveness of the blog for the learning of Euclidean Geometry?

Qualitative Research Questions

Research question 4: What do preservice secondary mathematics teachers perceive as the advantages and disadvantages of using a blog as a supportive tool in a Euclidean Geometry course?

Research question 5: What trends emerge in the analysis of preservice secondary mathematics teachers' contributions to an online discussion board on a blog used in a college Euclidean Geometry course?

Definition of Terms

In this study, the following terms were used frequently as defined below.

Blog. A blog is an individually customizable web page that allows users to create and publish web pages with personal and anecdotal information. Blogs typically contain text, images, and links to other web pages, blogs, and related topics.

Discussion Board. Discussion Board refers to a blog page that allows participants to present their personal views on various topics in a public and open forum.

***Social Networking Sites*.** Social networking sites are Web 2.0 applications that allow users to share personal information with each other in convenient ways. Facebook, MySpace, Twitter, and YouTube are popular applications of social networking services.

Web 1.0. Web 1.0 refers to the first stage of the World Wide Web that allows users to view content in static mode.

Web 2.0. Web 2.0 refers to the second generation of Internet services available on the World Wide Web that allows Internet users to collaborate, share, and control web information interactively and simultaneously.

Organization of the Study

This dissertation contains five chapters. Chapter one offers an overview of the study and its purpose, a description of the background and discussion of its significance, statement of the problem, theoretical framework of the study and the research questions that evolved, a definition of terms, and discussion of the organization of the study.

Chapter two presents a review of the related literature and provides an in-depth study on Web 2.0 technologies. The chapter starts with the concepts and limitations of

Web 1.0-based virtual learning systems and transitions to the emergence of Web 2.0 technologies. Discussion covers the interactive features of Web 2.0 technologies and the potential of using Web 2.0 technologies in promoting mathematics education. The chapter closes with a brief summary.

Chapter three describes the selected research methodologies for this study along with the methodological steps, instrumentation and its validity and reliability checking processes, sample selection, and data collection procedures.

Chapter four provides an analysis and interpretation of the data with regard to the research questions posed. Analyses of quantitative and qualitative research data are presented in different sections; tables and figures are presented wherever required.

Finally, chapter five presents discussion, implications, and conclusions of this study. Responses to the research questions presented in chapter four led to the discussion in that chapter with a brief description of connections between the quantitative and qualitative findings. The chapter, also, includes limitations and delimitations, implications for practice, and recommendations for further research. It closes with the researcher's final thoughts on the study.

CHAPTER TWO: REVIEW OF LITERATURE

Introduction

This chapter contains a review of literature related to this study. As stated in chapter one, the purpose of this study was to examine the feasibility of using blog and other Web 2.0 technologies in the teaching and learning of mathematics – by measuring preservice mathematics teachers' perceptions regarding a blogging activity in a college Euclidean Geometry course. With an intention to gather information from existing research papers, studies, websites, and other sources related for this study, this chapter focuses on Web 2.0 technologies and their potential use in teaching-learning mathematics. The chapter starts with the concepts and limitations of Web 1.0-based virtual learning systems and transitions to the emergence of Web 2.0 technologies. The discussion covers the interactive features of Web 2.0 technologies; rapid growth of Internet and mobile web usage; young students' trends on Web 2.0 technologies; use and impact of Web 2.0 technologies for teaching-learning purposes; the current state of mathematics education in the U.S.; and, the potential use of Web 2.0 technologies in promoting mathematics education. The chapter closes with a brief summary.

Web 1.0-Based Virtual Learning Systems

Web 1.0 technology refers to the first stage of the World Wide Web that allows users to view online content in static mode. Using full functionalities of Web 1.0 technology, Virtual Learning Systems (VLSs) such as Angel, Blackboard, eCollege, and WebCT are some well-known programs that have been developed to provide online

mathematics courses (Engelbrecht & Harding, 2004). These and many others web-based VLSs have recently gained popularity and have been used widely worldwide. Over the past few years, many mathematicians, mathematics educators, and researchers have been developing and delivering web-based and/or web-assisted mathematics and mathematics education courses using the VLSs (Thomas & Li, 2008).

Web 1.0-based VLS allows instructors and designers to manage and control online courses easier than traditional static online teaching-learning systems (Thomas & Li, 2008). Although, the VLS discussion forum provides the means to decrease many of the limitations of traditional online systems and increase students' critical thinking for such discourse, students still lack the intellectual maturity and experience necessary for true collaboration (Thomas & Li, 2008). For instance, in WebCT discussion many students become awkward and feel uneasy when asked to correspond and collaborate via threaded online discussion with other students taking the same course. Similarly, many of them struggle when asked to respond constructively but critically to other students' postings (Thomas & Li, 2008; Wuensch, Aziz, Ozan, Kishore, & Tabrizi, 2006).

Other limitations of WebCT courses are that such courses are provided only through the use of supportive tools and technologies that require additional cost, installation, and support in both school and home computers that may have different configurations, operating systems, and security setups (Thomas & Li, 2008).

Moreover, students' and instructors' access to a WebCT course is limited to the semester or course offering time only. Once the course or semester is over students do not have access to the WebCT system. Thus, they cannot go back to the discussions, emails,

or any course content unless they previously saved them. Most importantly, WebCT programs need information technology savvy instructors that are sometimes unavailable or unaffordable by the schools in rural districts or in developing or underdeveloped countries.

The problems and challenges of traditional and WebCT-based online courses, associated with the limitations of the first generation of the World Wide Web, Web 1.0 technology that allows users to view content in static mode, call for the use of Web 2.0 technologies in the teaching and learning of mathematics. According to Baker, Wentz, and Woods (2010), one technology that has the potential to engage students in online interaction is the use of virtual worlds or multiuser virtual environments. As Web 2.0 facilitates a relatively quick communicative exchange between individuals who are geographically or temporally distant (Hodson, 2008) it could provide various new dimensions to enhance mathematics education.

Understanding Web 2.0 Technologies

What are Web 2.0 Technologies?

According to Musser (2006), "Web 2.0 is a set of social, economic, and technology trends that collectively form the basis for the next generation of Internet – a more mature, distinct medium characterized by user participation, openness, and network effect" (p. 4). The current widespread popularity and use of Blogs is a good example of Web 2.0 (Maddux et al., 2008). Web 2.0 refers to the second generation of Web development and design that is more tailored to providing Web applications to next-generation Internet users. It transforms static Hypertext Markup Language (HTML) Web

pages into more dynamic and interactive Web pages (O'Reilly, 2005). Unlike traditional Web 1.0 technology, which allows web users to accept information passively, Web 2.0 allows web users to accept and modify web information, interactively and simultaneously.

Web 2.0 refers to the second generation of Internet services available on the World Wide Web that lets Internet users collaborate and share information online (O'Reilly, 2005). In contrast to the first generation Web 1.0 technology that refers to the early stage of the World Wide Web (WWW) and supports documents in HTML format, Web 2.0 provides users with an interactive and dynamic experience. Web 2.0 represents a transition from static HTML web pages to user manipulated dynamic networks. O'Reilly (2005) further states that Web 2.0 is more than tools and technology on the Internet. It is also a way for individuals to connect, communicate, and collaborate in ways that were limited with Web 1.0 technology.

Web 2.0 includes additional Web-based features beyond traditional Web 1.0 tools that are available to users anytime from anywhere when they are connected to the Internet through personal computers or handheld mobile devices. It allows users to access and customize information. Web 2.0 technologies make the Web design codes available for users to customize freely (Solomon & Schrum, 2007). Blogs, Flickr, Wikis, and social networking sites, including Facebook, Google+, Hi5, LinkedIn, MySpace, Twitter, YouTube, Wikipedia, and so forth, are the successful implementation of new-generation Web 2.0 technology. Almost all of these emphasize no-cost online social collaboration and resource sharing among users (O'Reilly, 2009).

Web 2.0 resources are now hosted on the World Wide Web; and are accessible on any computer or handheld cellular device that has an Internet connection. For instance, the Google Docs word processing application has all of the functions of a traditional Word Processor installed in a desktop or laptop computer. In contrast with the traditional MS Word, Google Docs is a Web-based open source application that does not require any payment or license to use (O'Reilly, 2009).

Some Web 2.0-Based Applications

Numerous applications are included under the label of Web 2.0 Technologies. These include Blogs, Wikis, Audio-Video and Photo Sharing Sites, Social Networking Sites, and online document management applications. These social broadcasting tools have been in use in their current form and at their current capacity for less than a decade, and, for some tools, less than five years. Currently, many websites offer one or more of these applications. Each of which has a unique purpose that may or may not benefit the user. Many Web 2.0 applications are created for educators to use in their classroom, while others allow for easy access and communication between the user and the outside world. Here are brief descriptions of some of the most commonly used Web 2.0 applications.

Blog. Blog, a short form of Weblog, is an individually customizable web page with a minimum technique threshold. Although the traditional *Threaded Blog* started in the early 1990s, what is often referred to as *Semantic Blog* has become more popular recently with the evolution of low cost but powerful tools of Web 2.0 technologies (Yuan, 2008). Blogs allow users to create and publish web pages that share personal and

anecdotal information with other users worldwide (Richardson, 2006). Blogs typically contain text, images, and links to other web pages, blogs, and content related to the topic. They usually provide news or comments on a particular subject or a person's opinion in text, picture, audio and video formats. As publishers, bloggers can place their comments and views on the blog. The reverse chronological order of the comments on the blog ensures that the most recent information or the most current position of the Blogger is given top priority (Norton & Hathaway, 2008). Blogs can be visited by local and global communities. Creating and editing most blogs is free and relatively easy and fast, requiring only basic computing knowledge rather than programming knowledge (Solomon & Schrum, 2007). More than 75,000 new blogs are created every day; and as of August 9, 2011, there were over 167 million public blogs in existence (BlogPulse, 2011). The International Data Corporation (IDC) expects that over the next few years creating blogs will be one of the fastest growing applications for mobile Internet users (Kairer, 2009).

Podcast. A podcast is a series of digital media files in audio or video format. It allows users to publish their audio and video recordings on the web episodically and to download them through multiple devices including cell phone, iPad, net book, laptop, desktop and similar handheld devices (Richardson, 2006). Publishing audio and video recordings of lecture materials and class discussion on a podcast is a popular way of information sharing among the new generation of students, teachers, and social workers.

Wikis. A wiki is a collaborative web page that allows users to create and easily edit any number of interlinked web pages using a traditional web browser (Richardson,

2006). A wiki can be developed through the WYSIWYG (*What You See Is What You Get*) format that allows users to view its content in a format that is very similar to the end result while it is created. Wikis allow users to have different levels of access to edit or delete content. Creating or editing a wiki requires only basic computing knowledge – no programming knowledge at all (Cronin, 2009). Wikipedia, the online encyclopedia, is a great example of a Wiki that is created and constantly developed and edited by its users.

Social Networking Sites. Social networking sites are Web 2.0 based applications that allow users to share personal information with each other in convenient ways. Social networking sites focus on building and reflecting upon social relations and interactions among people who possess the same interests. Social network sites essentially represent individuals' profiles, social links, and a variety of additional services. They enable users to share ideas, opinions, activities events, and interests within their individual networks over the Internet through e-mailing and instant messaging. Facebook, Hi5, LinkedIn, MySpace, Twitter, and YouTube are popular applications of social networking services. They emphasize online social collaboration and resource sharing among users free of charge. Although social networking sites are mainly used for social collaboration, they have a huge potential to be used for teaching-learning purposes.

Facebook. Facebook is one of the most popular social networking services, launched in February 2004, and operated and privately owned by Facebook, Inc., USA (Eldon, 2008). On Facebook, users can create personal profiles, add other users as friends, and exchange instant messages including audio, video, image, and links. A Facebook user can search other Facebook users through their names, schools, colleges,

work places, or similar attributes; and invite them to be his/her Facebook friend. When a first user makes a Facebook friend with a second user, friends of the second user are automatically recognized by the first user; and very often get invitations to be friends of the first user. Thus, within a short period of time a Facebook user gets connected with many other Facebook users in multiple groups. Additionally, users can create groups with other Facebook users who share common interests and exchange their views through automatic and instance messages. Creating a Facebook account is free but requires an active email address. The users must be at least 13 years old. On August 26, 2008 there were about 100 million active Facebook users; by July 6, 2011 that number surpassed 750 million users worldwide, with a 2.54% monthly growth rate (Olivarez-Giles & Guynn, 2011)

Google Plus. Google Plus, abbreviated as Google+ is a social networking service operated by Google Inc., launched on June 28, 2011 (Kaste, 2011). Google+ integrates social services such as Google Profiles and Google Buzz, and introduces new services called Circles, Hangouts, Sparks, and Huddles. Existing Social network services such as Facebook have some limitations in downloading their data, Google+ has the potential to reduce these limitations (McCullagh, 2011). After 4 weeks in operation, Google+ had reached 25 million users. Due to this rapid growth, sources such as *The New York Times* predict that Google+ might surpass Facebook among social network users.

Interactive Features of Web 2.0 Technologies

Web 2.0 is a collaborative Web development platform (O'Reilly & Battelle, 2004). It allows users to develop user-centered, participatory Web applications to add, control, and share information interactively, simultaneously, and interoperably, accessible entirely through a browser from anywhere with an Internet connection (O'Reilly, 2005). Web 2.0 enables users to create, share, consume, revise, and extend data from multiple sources and exercise control over that data (O'Reilly, 2006a). Accordingly, Web 2.0 includes additional Web-based features beyond traditional Web 1.0 tools, allowing users to customize information to suit their needs. Web 2.0 applications are those that make the most of the intrinsic advantages of the Web 2.0 platform. Building Web 2.0 applications improves as more people work together to use them (O'Reilly, 2006a).

Compared with traditional Web 1.0 development tools, Web 2.0 includes some additional features that are accessible to users entirely through a browser located anywhere – connected to the Internet via personal computer or handheld mobile devices (O'Reilly, 2009). Web 2.0 applications provide web hosting, audio-video sharing, social collaboration, and many more web-based applications and services. They permit free online collaboration, social connections, and resource sharing among users. Web 2.0 tools allow users to add their own content with few or no restrictions on it. Users can not only retrieve information but also enhance applications as they use them (Downes, 2005).

Web 2.0 not only has additional features not possessed by its predecessor, Web 1.0, but it is qualitatively different from Web 1.0 in many ways. Web 2.0 enables users to interact with other users actively as well as to view information passively. The dynamic

features of Web 2.0 allow users to interact with each other and to change website content jointly over time. A Web 2.0 site allows its users to interact with other users or to simultaneously change website content from any location at any time (Downes, 2005).

Other improved functionality of Web 2.0 includes open source applications, open sharing of information, open control, and open communication with an emphasis on Web-based communities of users free of charge (O'Reilly, 2005, 2006b). In the Web 2.0 platform everyone may be both a consumer and producer of information that appears on the Web. The interactive features of Web 2.0 technologies enable users to actively participate and contribute to developing and extending web page content. Web 2.0 users are also able to develop, share, and enhance their knowledge and thinking through interactions with other users. Most of the Web 2.0 sites hosted by individuals, non-profit, or even commercial organizations are dedicated for free use; and customizable to the desire of the users (Solomon & Schrum, 2007).

The advanced features of Web 2.0 technologies are similar to applications that are used on desktop computers and are available to users from any computer or handheld mobile devices connected to the Internet at any time. In order to ensure this, Web 2.0 sites are being developed with open source technology that makes the Web design codes available for all to use and modify freely (Solomon & Schrum, 2007). Solomon and Schrum (2007) stated, “It enables the Web to shift from being a medium in which information is transmitted and consumed into being a platform in which content is created, shared, remixed, repurposed, and passed along” (p. 46). Since Web 2.0 tools are

available on the Internet for the user to customize, users are able to interact with the information to create, fix, and use as they like (Solomon & Schrum, 2007).

Web 2.0 tools allow Internet users to create text based web pages, online journals, and resources to text, audio, video, music, and manifestos (Hodson, 2008). Web 2.0's improved functionality in features such as openness, customization, and freedom of control over data has led to significant advances compared with the traditional Web development approach. Web 2.0 tools allow users to add their own content with few or no restrictions, encouraging them to contribute material in addition to retrieving it (Coppola & Neelley, 2004). Web 2.0 technologies create a diversity of information and a virtual platform for online discussion; and offer access to information that empowers users to contribute directly to the development of online resources (Hodson, 2008). Web 2.0 tools allow Internet users to create Web content from text based web pages and online journals to visual format; and social networks allow for distribution of these cultural products far and wide (Hodson, 2008).

Rapid Growth of Internet and Mobile Web Usage

As information technology becomes more prevalent, more and more advancements are being created to help nations work interactively under a global network. If we think back to the information technology of only a few years ago, we notice several things that were not previously available that are available now. The number of worldwide Internet users surpassed 2.1 billion on March 2011; up from 1.2 billion in 2006; 430 million in 2000 and only 45 million in 1995 (Internet World Stats, 2011). The number of worldwide Internet users in 2011 represented about one-third of

world population (30.2%) up from 16.6%, about half-of this percentage in 2006. By the end of 2010, the number of worldwide mobile phone users exceeded 5 billion, 4 billion in 2008; and 2.5 billion in 2006 – that number was predicted to reach six billion by the middle of 2012 (BBCNEWS, 2010). In 2010, mobile web usage grew 110% in the United States and 148% worldwide compared to the previous year (Schonfeld, 2010). In 2009, there were more than 450 million mobile Internet users worldwide. This number is expected to more than double by the end of 2013; and the number of mobile devices accessing the Internet is expected to surpass the one billion mark worldwide (Kairer, 2009). Thus, it is most likely that within a few years more than two-thirds of the world population will have a mobile device with high speed Internet connection; and soon, the number of mobile Internet users will overtake fixed Internet users (Ingram, 2010).

The proliferation of iPhone and smart phones has resulted in rapid growth of Internet users. As information and communication technology continues to develop, the cost of using the Internet through cellular devices is decreasing, and the number of Internet users is expected to increase very quickly. Even in developing and newly industrialized countries where the number of mobile phone users is growing fast, Internet access through cellular devices is becoming cheap, easy, and popular. According to International Data Corporation's (IDC) Digital Marketplace Model and Forecast, in 2008 roughly 40% of all Internet users worldwide had mobile Internet access which was more than 1.5 billion; by the end of 2012, the number of worldwide mobile devices accessing the Internet will double to more than 3 billion, including PCs, mobile phones, and online videogame consoles, half of which will be mobile devices (IDC CEMA

Telecommunications Newsletter, 2008). By the end of 2010, wireless broadband subscriptions in the Organization for Economic Co-operation and Development (OECD) countries exceeded half a billion (TelecomPaper, 2011). According to another prediction by Juniper Research, the number of subscribers using mobile Internet services will rise to 1.7 billion worldwide by 2013; Internet access by mobile phones will represent around 50% of the total Internet usage (ICT Statistics Newslog, 2008).

It is very likely that, within a couple of years, the number of mobile Internet users will overtake fixed Internet users (Ingram, 2010). This prediction is supported by a statewide survey in California in 2011 that revealed that Californians are twice as likely to use their cell phones to access the Internet than they were just three years ago (Public Policy Institute of California (PPIC), 2011). The report says that 55-56% of California residents are more likely to go online from their desktop or laptop computers, whereas 40% connect to the Internet from their cell phones – that number was 19% in 2008 and 26% in 2009. In early 2008, 71% of American teens, ages 12 to 17, had a cell phone with Internet connection (Lenhart & Madden, 2009). This supports S. Keshav's prediction that cell phones will dominate the future Internet (Keshav, 2005).

The most popular online activities of mobile Internet users are similar to those of other Internet users, such as: using search engines, sending/receiving email and instant messages, reading news and sports information, downloading music and videos (Kairer, 2009). Thus, it is most likely that cell phones will be more popular to the new generation of people for accessing the Internet than the use of desktop and laptop computers. According to John Gantz, chief research officer at IDC, "With an explosion in

applications for mobile devices underway, the next several years will witness another sea change in the way users interact with the internet and further blur the lines between personal and professional" (Yadagiri & Vidya Sagar Thalluri, 2012, p. 67).

Young Students' Trends on Web 2.0 Technologies

Due to advancement of Web 2.0 technologies young students have changed their lifestyles radically. They are growing up with new technologies and spending their time surrounded by and using computers, laptops, videogames, digital music players, webcams, cell phones, and many other toys and tools of the digital age (Roberts, 2005). Prenksy (2001) calls them *digital natives* and Roberts (2005) calls them *net generation* students. However, *web generation* sounds more appropriate as Web 2.0 applications are integral parts of their lives. Use of Web 2.0 technologies has pushed them one step ahead (Prenksy, 2001).

These web generation students are most likely arriving in high schools, colleges, and universities having firsthand experience with multitasking operations in blog, podcast, tweeting, and other Web 2.0 applications, which are one step ahead of traditional voice and text messaging, and emailing. Web 2.0 tools provide today's students with new outlets for global interaction. These tools allow web generation students to post their own views on public forums that are accessible from anywhere, anytime, with a computer or hand held cellular device with Internet connection. These technologically advanced students are ready for Web 2.0-based learning to be delivered on a flexible learning schedule that is not tied to the classroom setting in a certain time and location. Thus, there is a concern regarding whether web generation students can be fully satisfied with

the traditional education system designed to teach them before Web 2.0 technologies emerged.

According to a 2009 Pew Internet & American Life Project survey, 56% of adult Americans had Internet access by wireless means, such as using a laptop, mobile device, game console, or MP3 player; and about one-third of Americans (32%) had used a cell phone or smart phone to access the Internet for emailing, instant messaging, or information-seeking. Thirty seven percent of Internet users age 18-24 use Twitter or another service, up from 19% in December 2008 (Pew Internet, 2009). The Public Policy Institute of California (2011) survey found that by the first half of 2011, 52% of Californians used social networking sites –that number was 26% in 2008. Older, less-educated, and lower-income Californians, along with Latinos, are less likely than others to participate in most of these activities. According to Mark Baldassare, president and CEO of PPIC, "The growing use of cell phones for accessing the Internet is changing the way Californians relate to work, and this trend also has promise for reducing the digital divide" (Baldassare, Bonner, Petek, & Shrestha, 2011, p. 3).

Research shows that young students spend more time with computer, Internet, and mobile phone use than any other age group, and most of that time is spent in social network sites (Lenhart, 2009). A 2007 nationwide survey conducted by the U.S. National School Boards Association finds that young students from ages 9 to 17 reported spending at least nine hours per week online on social networking and other websites, a time almost equal to the ten hours per week spent watching television (National School Boards Association, 2007). The study found that young students actively contribute to their own

content in the social networking sites. Ninety-six percent of students surveyed said that they were familiar with using Web 2.0 or open source resources. Seventy-one percent of students reported using these resources almost every day; and 50% of them said they used Web 2.0 applications to get help in completing their homework (National School Boards Association, 2007). The study also found that 76% of parents believe that social networking helps to strengthen their children's reading, writing, and social skills.

Another 2008 British study found that 94% of British teenagers had Internet access at home and school; 92% owned or had access to a mobile phone, 88% a computer with 29% using an additional laptop, 69% an iPod/mp3 player, 73% a game console device, 40% a standalone digital camera, and 10% a video camera (Clark et al., 2009). Another research report commissioned by the British Educational Communications and Technology Agency (BECTA) finds that teens had higher levels of access to the Internet and many technologies that support Web 2.0: 98.4% had access to a computer; 96.6% had access to the Internet; 74% had at least one social network site account; and over 50% had shared pictures, video, or music in the last week of the survey (Luckin et al., 2008). By that time more than 71% of American teens had mobile phones with an Internet connection; and about 85% of them said that they visited Facebook, MySpace, or Twitter regularly (Lenhart, 2009).

According to a statistical study of Online Schools (2011), reported by DigitalBuzzBlog (2011), as of 2011, there were over 500 million Facebook users worldwide; over 50% of them logged on to Facebook every day; and every Facebook user had about 130 friends on average. The report said that 48% of 18-34 year olds check

Facebook when they wake up, with 28% doing so before even getting out of bed. Almost 72% of all American Internet users use Facebook, while 70% of Facebook users are outside of the United States. According to the report, over 700 billion minutes a month are spent on Facebook, 20 million applications are installed per day and over 250 million people interact with Facebook from outside the official website on a monthly basis, across 2 million websites. Over 200 million people accessed Facebook via their mobile phone; 48% of young people receive their news through Facebook. Meanwhile, in just 20 minutes on Facebook over 1 million links are shared, 2 million friend requests are accepted, and almost 3 million messages are sent (DigitalBuzzBlog, 2011).

Teens spend more time on the Internet for gaming, instant-messaging, file and photo sharing, and social communicating than on studying or information searching (Clark et al., 2009; Selouani & Hamam, 2007). They participate in Web 2.0-based activities as authors and consumers of content from file sharing to online gaming and writing on blogs (Boyd, 2007; Lenhart & Madden, 2009; Richardson, 2006). One survey showed that about 35% of all teens do blogging, 54% post photos online, 19% post videos, 39% share their own artistic creations online, 26% remix content, 27% maintain personal web pages, 28% have their own blogs (Ivanova, Ivanova, & Smrikarov, 2009). Clark et al. (2009) finds that young students surf about 30 social networking sites. Most use these sites in and out of school for social communication; only a few, however, use them for academic purposes. This might be because schools or students are unaware of the educational advantages of using social-networking sites and social-networking tools.

Young students enjoy the benefits of getting multiple resources from the Web (Douma, Ligierko, & Romano, 2009).

Text messaging, playing online games, downloading music, audio, video, and accessing news, sports, financial or credit information have already become the most common activities among mobile Internet users worldwide (IDC CEMA Telecommunications Newsletter, 2008). Participation in social networking is becoming very popular among teen Internet users through personal computer or cellular devices (Internet World Stats, 2011). A growing number of kids are using social networking sites. According to two surveys released in 2009 by Pew Internet Research, 38% of respondents ages 12 to 14 claimed to have an online profile; while 61% of those from ages 12 to 17 claimed to use social networks; 42% of them daily (CNN Tech, 2009). Once on the Internet, teen users are most likely to spend their time on newly emerging Web 2.0 activities, such as watching user-generated videos, reading and posting blogs, and participating in social networks rather than the traditional *Web 1.0* activities like searching, chatting, playing online games, and sending and receiving emails (IDC CEMA Telecommunications Newsletter, 2008). The IDC expects that, over the next few years, making online purchases, participating in online communities, and creating blogs will be the fastest growing applications among teen Internet users (Kairer, 2009).

Use and Impact of Web 2.0 Technologies for Teaching-Learning Purposes

The emergence of Web 2.0 technologies has led to exploring their potential use in the teaching and learning process. Increased access to and use of electronic classrooms, Web 2.0-based interactive applications, and contemporary web-based conferencing tools

are changing the ways students learn and teachers teach (Greenhow, Robelia, & Hughes, 2009; Lee, 2005; Tammets, Tammets, & Laanpere, 2009). Students, teachers, and educators now seek to have any time, any place, any path, and any pace learning opportunities (Lamb & Callison, 2005). Participants in Web 2.0-based asynchronous learning environments get more time for reading, writing, and posting in discussion forums. This allows them to participate in online discussions by providing reflections after thinking about how they should reply (Saade & Huang, 2009).

According to Conrad and Donaldson (2004), collaborative attainment of knowledge is one key component of creating a successful online learning environment. Activities that require interactive collaboration among the participants, and encourage sharing of ideas promote a deeper level of thought and a lifelong understanding environment (Conrad & Donaldson, 2004). Interactive learning tools that engage and stimulate students more than a face-to-face classroom can compensate for the absence of direct interaction between teachers and students in online education (Dong, Xu, & Lu, 2009). Web 2.0 technologies provide such interactive tools and technology that ease the development of active collaboration among participants in the United States and abroad.

The openness, collaborative, and interoperability features of Web 2.0 technologies can enable teachers to engage students in working together inside and beyond the classrooms (Solomon & Schrum, 2007). Using these features Web 2.0 users can easily publish and share their work, connect with a community of like-minded people, and comment on other users' contributions (Waycott et al., 2010). Given emphasis on these features, many educational commentators argue that Web 2.0 technologies offer great

potential for supporting students' learning in online education (Alexander, 2006; McLoughlin & Lee, 2008; Waycott et al., 2010).

Web 2.0 technologies allow novice and expert users alike to have a voice (LaMonica, 2006; Scoble & Israel, 2006). When a Web 2.0 user wishes to go public with his/her thoughts and opinions, whether in text, image, audio, or video format, he/she can do that immediately without asking permission, waiting for approval from someone, or spending money. With the Internet connection in hand, global publication is only a few seconds away. In many cases the thoughts of youth on a particular issue are as profound as those of an experienced person (Allen, 2008). Allen (2008) found that Web 2.0 tools connect participants to a global audience; allow them to engage in more authentic student work; shift them from the classroom's center to the outside world; improve student performance; increase student engagement; and bypass local student performance stigmas. Allen (2008) suggests that U.S. federal education policies for teachers and students, district-sanctioned opportunities for teacher learning, teacher education programs, and learning experiences for school leaders should include Web 2.0 tools; and district technology support structures and policies should foster teaching and learning with Web 2.0 technologies.

Studies have found that Web 2.0 tools are more convenient than traditional classroom learning because of the availability of materials, and anytime and anywhere accessibility to learners (Malhiwsky, 2010; Shihab, 2009; Solomon & Schrum, 2007). Using Web 2.0 technologies an instructor can provide a student-centered syllabus containing objectives stated in terms of student performance; meaningful activities

designed to consider learners' interests, needs and learning styles; step-by-step lesson plans; and a clear evaluation system. With all of the information at hand, students have the autonomy to complete their activities at their own pace (Gonzalez & Louis, 2008). These flexibilities help students utilize their metacognitive strategies in order to set their own objectives, distribute their time, and evaluate their own performance in completing the assigned tasks. In this way, students become responsible for their own learning (Gonzalez & Louis, 2008). Joseph Cash (2010) found that there was a significant positive relationship between the degree of Web 2.0 composite usage and extracurricular participation in arts, literature, science, and mathematics among high school students. G. Allen (2008) advocates that Web 2.0 tools can promote a significant change in perceptions of K-12 public school teachers' roles in and out of the classroom.

Web 2.0 technology can be used as a multi-functioning resource by participants in the learning process (Malhiwsky, 2010). Web 2.0 tools have impacted e-learning by creating a modern learning process which involves "collaborative aspects and active contributions to learning content" (Safran, Helic, & Gütl, 2007, p. 1). Gayle Allen (2008) urges that as technologies become more interactive, personally adaptable, and specific to the needs of students, teachers, and educators, it may turn out that technology integration occurs more readily and more naturally and that it feels more aligned with teachers' and educators' pedagogical goals. Web 2.0 technologies have enhanced participants' experience of communication within the classroom, while the portability of Web 2.0 technology has made the learning process convenient; anytime accessibility of Web 2.0 tools allows participants to take advantage of multiple learning materials; and the

anywhere accessibility of Web 2.0 tools enables participants convenient accessibility from home and/or school computers (Malhiwsky, 2010).

Web 2.0 tools allow students, teachers, and researchers to use web tools to engage in distributed dialogue with one another. Web 2.0 users do not need to rely on book stores, school libraries, or Internet search engines to find the information they need to study, teach, or do research (Hodson, 2008). With Web 2.0 tools teachers can become armchair experts for each other and use the advice of their peers to find the information they need (Hodson, 2008). In the Web 2.0 environment, participants work online with peers from around the world. They get the opportunity to learn and understand local and global issues and become enriched by perspectives, traditions, and values of others across the world. Consequently, their personal, social, political, and professional identities can be shaped by the shared goals, interests, and concerns of both local and global communities (Thomas & Li, 2008). In Web 2.0 enhanced courses, self-monitoring of progress is an important achievement that often is not seen among students using traditional technologies (Malhiwsky, 2010).

The use of Web 2.0 tools has been found to increase student achievement in the English learning classroom (Shihab, 2009). Furthermore, Shihab (2009) found that Web 2.0 tools improve teaching and collaboration in high school language classes by making high school teachers more confident in teaching language learners in efficient and convenient ways. Web 2.0 tools also improve students' collaboration and communication with the teacher and other students in the course. Shihab (2009) reports that teachers and students who experience using Web 2.0 for the first time, recommended use of Web 2.0

in other subjects. Free and open accessibility to Web 2.0 interfaces provides improved and enhanced teaching and learning experiences (Kwan, 2009). Blogs, Podcasts, Wikis, and Social networking applications such as Facebook, Google+, LinkedIn, MySpace, and Twitter can be the basis of information and resource sharing as well as a means of collaboration and sustained learning.

Malhiwsky (2010) reports that Web 2.0 enhanced courses that utilize multiple technology tools improved student achievement significantly in an online Spanish teaching course. Malhiwsky (2010) found a higher level of connectedness in Web 2.0-based courses than in non-Web 2.0-based courses. Reimer and Moyer (2005) found that by using Web 2.0 pedagogy students' achievement scores improved significantly. Janossy (2007) found that university students who made use of podcasting and took advantage of Web 2.0 resources felt that they understood and retained course information better. McGee and Diaz (2007) found that Web 2.0 technologies provided learners with educational benefits that were similar to learner-centered and pedagogically driven instruction. Moreover, Web 2.0 technologies enable developing new tools and methods of online teaching (Kwan, 2009). Kwan (2009) also reported that these tools can allow educators to explore beyond traditional teaching pedagogies and student participation roles.

WordPress is an open source blog-publishing service that has been available for a couple of years. WordPress allows anyone to create a blog without paying a registration or annual license fee. WordPress has a web template system that allows considerable customization. In WordPress, users can re-arrange widgets without writing or editing

program codes. They can use built-in themes or edit themes for more advanced customization. WordPress provides integrated link management features –a search engine-friendly, clean permalink structure, and the ability to assign nested and multiple categories for articles. It includes an automatic filter option for spam; provides standardized formatting and styling of text in articles; supports the tagging of posts and articles; and provides trackback and pingback standards for displaying links to other sites that are linked to a post or article (Pardamean & Susanto, 2012). WordPress has become a popular self-hosted blogging tool, used on millions of sites and seen by tens of millions of people every day (WordPress.com, 2011). WordPress is widely used for developing personal and commercial blogs; however, it has started to get the attention of students, teachers, educators, and researchers to be used for teaching-learning purposes.

Edmodo is another free and secure social learning network that is compatible for teaching-learning purposes. It is best described as a micro-blogging platform for students, teachers, and schools. Edmodo's user interface is very similar to Facebook; moreover it has built-in security features that give teachers privacy controls over their virtual classrooms (Carta, 2011). Edmodo promotes anytime, anyplace learning both inside and outside the classroom. Using Edmodo, teachers can post messages, discuss classroom topics, assign, and grade homework for students. Students can then submit the homework and view their grade (Waters, 2011). A teacher can divide the class into several groups and assign a common or individual assignment to each group member. After a course period is completed the teacher can close out the network and log on to another course (Waters, 2011). Similarly, after completing a semester or an academic year the teacher

can close out the network and start up new sessions. Launched in late 2008, as of February 2011, there were over 1.5 million Edmodo users worldwide. A number of school districts in the United States are now promoting Edmodo for use in their classrooms (Edmodo.com, 2011).

Unlike WordPress, Edmodo was launched with the aim of targeting mainly teaching and learning purposes. However, each of these networks has some advantages and disadvantages/problems with regard to educational uses. Edmodo's interface is very similar to that of Facebook (Carta, 2011). It provides teachers and students with a safe and easy way to connect and collaborate, and to exchange content, materials, and ideas with their peers (Johnson, 2011). On the other hand, WordPress is known for its open accessibility and use in developing multipurpose blogs. Most WordPress blogs are public and visible to anyone; however, only the participating teachers and students have access to Edmodo blogs. Non-participating teachers and students cannot view an Edmodo blog. Thus, teachers have a limited chance of following other teachers and students who are using blogs in Edmodo.

Current State of Mathematics Education in the United States

According to the report of the National Assessment of Educational Progress in 2007, 70% of U.S. eighth-grade students performed at or above the basic level in mathematics, and 31% performed at or above the proficient level (National Center for Educational Statistics, 2008). Even the eighth graders in the best-performing states such as Massachusetts rank significantly lower than the average eighth graders in the highest-achieving countries such as South Korea, Singapore, and Taiwan (Kuenzi, 2008).

Compared to other industrialized nations, mathematics achievement of U.S. students appears inconsistent with a nation considered to be the world leader in scientific innovation (Hossain & Robinson, 2011).

According to the results of the Trends in International Mathematics and Science Study (TIMSS), U.S. students' progress and performance in mathematics is not satisfactory. The TIMSS report showed that in 1995, U.S. fourth-grade and eighth-grade students achieved an average score of 518 and 492 points respectively (TIMSS, 1995a, 1995b). In 1999, only eighth graders were tested, the average mathematics scores of U.S. eighth-graders was 502 (TIMSS, 1999); in 2003, the average mathematics scores of U.S. fourth-graders and eighth-graders were 518 and 504 respectively (TIMSS, 2003); and in 2007, these scores were 529 and 508 points respectively (TIMSS, 2007). In each year for each grade level those scores were compared with an international average that was normed at 500 points with a standard deviation of 100 points. A closer look at the results of past TIMSS studies is shown in Table 1.

Table 1
U.S. Students' Mathematics Performance Recorded in TIMSS 1995 – 2007

Assessment Year	Participating Countries	U.S. Fourth-graders Score	Average Score		U.S. Eighth-graders Score
			M	SD	
1995	41	518	500	100	492
1999*	38	-	500	100	502
2003	46	518	500	100	504
2007	48	529	500	100	508

*In TIMSS 1999 only eighth graders were tested.

A superficial look at this table might mislead the reader into believing that the U.S. is doing well in mathematics. However, this would be a mistake as the improvement

from 1995 to 2007 was not measureable. Although, both U.S. fourth- and eighth-graders improved in mathematics in 2007 compared to 1995, no measurable change was found in the percentage of either U.S. fourth- or eighth-graders performing at or above the advanced international benchmark in mathematics between 1995 and 2007 (grade four: 9 vs. 10 percent; grade eight: 4 vs. 6 percent) (TIMSS, 2007). Compared with the average score of 500 points in each grade with a standard deviation of 100 points, the U.S. fourth-graders' average mathematics achievement on these tests was slightly higher; however, eighth-graders' average achievement was close to the average level.

In 2007, compared to the mathematics achievement of fourth-graders among the 36 participating countries, the average mathematics score of U.S. fourth-graders was higher than 23 out of the 35 other countries, lower than in eight countries, and not measurably different from the average scores of students in the remaining four countries; the average mathematics score of U.S. eighth-graders was higher than 37 of the 47 other countries, lower than in five countries, and not measurably different from the average scores of students in the remaining five countries (TIMSS, 2007).

Moreover, according to the Program for International Student Assessment (PISA), which is a system of international assessments that focuses on 15-year-old students' scholastic performance on mathematics, science, and reading among the 35 Organisation for Economic Co-operation and Development (OECD) member nations and some other non-member nations, in 2003, 2006, and 2009, U.S. 15-year-old students' combined mathematics scores were below the overall average score of 500 with a standard

deviation of 100 in each of the assessments. A closer look at U.S. 15-year-old students' mathematics performance in the past PISA studies is shown in Table 2.

Table 2
U.S. 15-year-old Students' Mathematics Performance in PISA 2003 – 2009

Assessment Year	U.S. Score	Average Score		Participating Countries	U.S. Position
		M	SD		
2003	483	500	100	41	24th
2006	474	500	100	57	32nd
2009	496	500	100	67	24th

In PISA 2003, 15-year-old U.S. students' average mathematics score was 483 compared to the overall average score of 500 with a standard deviation of 100. The U.S. 15-year-old students ranked 24th in average mathematics score among the 41 participating countries (Lemke et al., 2004). In PISA 2006, 15-year-old U.S. students' average mathematics score was 474 compared to the OECD average mathematics score of 498 and that was in 32nd position among 57 participating countries (Baldi et al., 2007). In PISA 2009, U.S. 15-year-old students' average mathematics score was 487 compared to the OECD average score of 496 and that was in 24th position among 67 participating countries (Fleischman, Hopstock, Pelczar, & Shelley, 2010).

Although U.S. 15-year-old students' average mathematics score in 2009 was higher than their average mathematics score in 2006, it was not measurably different from its average mathematics score in 2003. U.S. 15-year-old students' average mathematics scores were lower than the OECD average scores in each of the assessment years from 2003 to 2009. Only 27% of U.S. 15-year-old students scored at or above proficiency level four in mathematics – that was lower than the 32% of 15-year-old

students in the OECD countries on average that scored at or above level four (Fleischman et al., 2010).

According to Hiebert, Stigler, and Jacobs (2005), some of the reasons for these less than impressive results in mathematical skills are the stigma associated with excelling in mathematics, and a lack of demonstrating the value of mathematics education to our students and how it can prepare them for success in the future. According to Susan H. Fuhrman, the dean of the University of Pennsylvania's graduate school of education, the U.S. middle school curriculum includes considerable repetition and little new content, but seeks to cover a great deal of ground; whereas other countries focus on a few content areas, but deal with them in greater depth (Hoff, 2000). According to the U.S. Education Secretary Arne Duncan the *No Child Left Behind Act* has resulted in dumbing down the curriculum in the United States. The secretary does agree that the U.S. curriculum is wide enough but not adequately deep, especially in the middle school grades (Touhey, 2011). However, studies show that middle school grades are the most critical periods for young students regarding their achievement in high school and college; and are gateways to higher studies in STEM fields (Catsambis, 1994; Midgley, Feldlaufer, & Eccles, 1989; Singh, Granville, & Dika, 2002; Wentzel, 1997).

The Glenn Commission Report (2000) characterized the basic teaching styles in too many U.S. mathematics courses as several decades old. The report considers mathematics as a primary source of lifelong learning and a progress indicator of American civilization. However, due to lackluster performance in mathematics, U.S. students are also behind in most of the sciences, engineering, architecture, medical

science, economics, most of the trades, and many areas of the arts. Experts warn that the U.S. lackluster performance in mathematics can complicate the troubles of the nation's already ailing economic situation. Economists estimate that the U.S. economy will grow by 4.5% per year over the next 20 years if the U.S. can catch up in mathematics achievement; however, they fear that mathematics progress in the U.S. is not happening fast enough, especially at the high school level, to achieve this goal (Ramirez, 2008).

Moreover, information technology has not reached its full potential in mathematics education programs across the United States (Gunter, 2001; Kurz & Middleton, 2006). Many prospective mathematics teachers' views on the role of information technology in mathematics education are not satisfactory (Habre & Grunmeier, 2007). Habre and Grunmeier (2007) found that prospective mathematics teachers believe that they should use information technology to help teach students mathematics; and that mathematics and not information technology should remain the focus of instruction in mathematics classrooms. However, many of these preservice teachers believe that in many mathematics classrooms information technology is used improperly in ways that focus more on the technology than on mathematical understanding or calculation (Habre & Grunmeier, 2007). For instance, in an experiment, if students are shown tessellations of a plane using a web-based Java applet many participants may skip the mathematical knowledge behind the tessellation, since a Java applet may not show the mathematical calculation behind it (Habre & Grunmeier, 2007).

Studies also show that information technology is integrated inappropriately in many teacher education programs (Mistretta, 2005; Watts-Taffe et al., 2003). The

preparation of preservice teachers to use information and communication technology is one of the critical challenges teacher education programs face (Powers & Blubaugh, 2005). Another study found that many teacher education programs use the computer as a teacher-centered tool rather than as a student-centered tool (Wang, 2002). Many information technology courses that are part of teacher preparation programs emphasize preservice teachers' learning with technology rather than the integration of technology into their classroom teaching (Lederman & Neiss, 2000). Another study to measure preservice teachers' technology beliefs, skills, and barriers to the use of information technology reports that many teacher education programs prepare preservice teachers with lower or outdated information and communication technology skills that do not provide preservice teachers adequate knowledge to provide sufficient information technology-based instruction in their classrooms (Brush et al., 2008). Without adequate knowledge, these teachers get little opportunity to integrate information technology into their actual classrooms (Brush et al., 2008).

Potential Use of Web 2.0 Technologies in Promoting Math Education

Collaboration is a fundamental feature of Web 2.0 technologies (Anderson, 2007; Cash, 2010; Kamel Boulos & Wheeler, 2007). It is an important component for success in Web-based environments (Kamel Boulos & Wheeler, 2007). According to Kamel Boulos and Wheeler (2007), "collaborative learning is an activity where learners who are brought together through the Internet focus on working together as a learning community in which they share resources, knowledge, experiences, and responsibilities" (p. 3).

Kear (2004) asserts that students participate collaboratively mainly to obtain help and guidance from their peers. Studies also find that the implementation of specific Web 2.0 technologies enhances student learning and collaboration (Cormode & Krishnamurthy, 2008; McGee & Diaz, 2007; Purushotma, 2006; Safran et al., 2007; Thomas & Li, 2008; Ullrich et al., 2008). Web 2.0 technologies improve students' learning, writing abilities, and satisfaction with the course; as well as their interaction with faculty and other peers (Ajjan & Hartshorne, 2008). The concepts of active participation and collaborative learning continually emerge as major pedagogical attributes of Web 2.0 technologies. Web 2.0-based learning environments foster collaboration among students and faculty; and allow the student to create and share new knowledge with their peers (Ajjan & Hartshorne, 2008).

Collaborative attainment of knowledge is one key to creating a successful online learning environment (Conrad & Donaldson, 2004). Activities that require interactive collaboration among the participants, and encourage sharing of ideas promote a deeper level of thought and lifelong understanding. Interactive learning tools that engage and stimulate students more than a face-to-face classroom can compensate for the absence of direct interaction between teachers and students in online education (Dong et al., 2009). Web 2.0 technologies provide interactive tools that ease the development of active collaboration among the participants from anywhere in the world. The openness, collaborative nature, and interoperability features of Web 2.0 technologies enable teachers to engage students in working together inside and beyond the classrooms (Solomon & Schrum, 2007). Using these features Web 2.0 users can easily publish and

share their work, connect with a community of like-minded people, and comment on other users' contributions (Waycott et al., 2010).

As Web 2.0 emphasizes a collaborative learning environment it can generate and promote the development of new ways of thinking, learning, and sharing in online education where participants can play the central role in creating, using, and redesigning resources. In such an environment participants can share their resources and merit through self-publishing media such as Blogs, Facebook, Podcasts, Wikis, and similar social networking media. Such an online syndication of learning materials may become a repository of online resources in collaboration with millions of participants with anywhere and anytime accessibility. Using Web 2.0-based mathematics resources mathematics students and teachers should be able to show their true talents and interests in mathematics and prepare themselves for competitive tests and future careers.

Constructivism is another explicit mechanism in Web 2.0-based teaching-learning activities. Cherry Ward (2001) urges that use of constructivist methods in the areas of instructional methodology, classroom communication and questioning techniques "furnishes a more experiential learning environment in which the student can develop critical-thinking skills and improve transfer and retention of knowledge" (p. 96). Engelbrecht and Harding (2005) suggest that these should also be applicable in the mode of online mathematics teaching.

Collaboration in a constructivist classroom results in personal meaning-making on the part of the individual student and creates a container wherein social construction of knowledge and meaning can occur (Palloff & Pratt, 1999). McLoughlin and Lee (2007,

2008) urge that effective learning is conversational in nature and necessitates a social dimension, including communication, dialogue, and shared activity. An effective learning environment allows students and teachers to create and share new knowledge; support the connection of different pieces of information; as well as fosters collaboration among students and faculty (Ajjan & Hartshorne, 2008). Collaboration with other participants in the Web 2.0 environment can enhance critical thinking that leads to higher achievement and more satisfaction in online learning (Zhang & Kenny, 2010). The pedagogical shift from behaviorist to constructivist learning enables students to become active creators of knowledge and move beyond passive class participation (Heafner & Friedman, 2008).

People who love and practice mathematics can join in such platforms to enrich their mathematical knowledge and understanding by posting mathematical problems and quizzes; providing solutions to problems posted by others; and sharing their thinking in solving and creating mathematics problems. This kind of mathematical virtual network can strengthen weak ties between students and teachers and can also increase participation in practicing mathematics. More importantly, this might be a way of learning and understanding mathematics for students who are too poor to afford high cost mathematics software or web-based programs, especially in developing countries.

Blogs, podcasts, wikis, Facebook, and similar interactive Web 2.0 tools are already being adopted in the fields of information technology, engineering, business, language, journalism, and the medical sciences (Lemley & Burnham, 2009). As many sectors in education settings increasingly use Web 2.0 tools, the time has come to think about providing preservice K-12 mathematics teachers with ways in which these tools

might support classroom teaching and learning. There is a potential for Web 2.0 tools to be implemented alone or in conjunction with one another to create collaborative teaching-learning in middle and high school mathematics courses. The interactive and emerging features of Web 2.0 technologies can enable middle and high school students and mathematics teachers to build collaborative learning environments inside and outside of the classroom. Web 2.0 tools are free access to educators, they are easily mastered by teachers and K-12 students; and school districts' technology resources are sufficient to develop Web 2.0 applications (Norton & Hathaway, 2008).

Creating and editing most Web 2.0 applications is relatively easy and fast, requiring only basic computing knowledge rather than programming knowledge (Solomon & Schrum, 2007). To initiate a new blog or wiki on a topic, teachers first need to form small groups of students to work together on specific topics. For instance, a middle or high school Geometry teacher might form several study groups for discussing important or sophisticated topics that he or she wants to explore more extensively so that students can clarify and deepen their understanding. Hossain and Aydin (2011) referred to these groups as *iGroups,* to reflect the interactive and dynamic nature of working together using Web 2.0 technologies such as blogs, podcasts, and wikis. An iGroup may continue studying a topic for a long time even after the topic or semester is finished. Students may be more motivated to join and participate in such an iGroup if they are using a blog or other new technology instead of simply writing on paper (Solomon & Schrum, 2007). If someone outside the course requests to be a member of an iGroup, teachers can add or reject the request based on the nature of the activity.

The Standards for Mathematical Practice of the Common Core State Standards Initiative (CCSSI) stress the importance of helping students persevere in the problem solving process (Common Core State Standards Initiative, 2010). The use of Web 2.0-based forums on the Internet can enable mathematics students and teachers to discuss mathematical problems and to work collaboratively (Kimmins & Bouldin, 2009). In this way, the interest generated by online interaction could provide the motivation necessary to increase the level of perseverance of students engaged in the problem solving process. Additionally, the CCSSI emphasize the importance of constructing arguments and critiquing arguments developed by others (Common Core State Standards Initiative, 2010). Certainly, online interaction among students on blogging sites can provide a forum for these types of activities. Thus, in a variety of ways, Web 2.0-based activities may play an important role as educators across the country attempt to implement the Common Core State Standards.

Notably, Web 2.0 technologies and tools can be used in the mathematics classrooms to make the teaching-learning processes more interesting, faster, and longer lasting. In the context of static to dynamic, in an interactive mathematics program, Web 2.0 technology can increase students' ability to achieve a variety of higher-order learning outcomes, such as reasoning, reflection, problem posing, problem solving, and decision making. Web 2.0 Technology based tools for presentation, construction, computation, and visual representation can enable mathematics teachers to present critical content and contexts in easier ways that would otherwise be too complex for them to explore on the whiteboard. These tools also enable students to practice and capture difficult

mathematical problems in easier and faster ways that would otherwise be too hard for them to draw and understand in paper-pencil format.

Chapter Summary

The review of literature identified that a number of educators and researchers have started to examine the feasibilities of using Web 2.0 technologies for teaching and learning purposes and found a potential impact. However, the use of Web 2.0 technologies in mathematics classrooms at the K-12, college, and preservice teacher education levels is still in its infancy. No significant research was found in these critical areas. Similarly, no publications were identified that evaluated various Web 2.0 tools and their relationships with student achievement in mathematics at the high school or preservice teacher levels. This review began with a general discussion on the current trends and uses of Web 2.0 technologies and went on to consider effective ways Web 2.0 technologies can be used in the teaching and learning of mathematics.

CHAPTER THREE: METHODOLOGY

Introduction

The main purpose of this mixed methods study was to examine preservice secondary mathematics teachers' perceptions of a blogging activity used as a supportive teaching-learning tool in a college Euclidean Geometry course. As stated earlier, no empirical studies were found that evaluated the effectiveness of blog and other standard Web 2.0 technologies in teaching-learning mathematics. Thus, the researcher developed and used a new instrument (Appendix A) that was determined to be valid and reliable to meet the requirement of this study.

This chapter presents the methods, procedures, and tasks employed to conduct and complete this study. More specifically the chapter includes: research questions; research design employed; the blogging activity and selection of participants; the significance of choosing the college Euclidean Geometry course; instrumentation; validity and reliability measuring procedures; data collection and data analysis procedures; reasons for using median scores instead of mean scores; and specific tests/procedures carried out for analyzing each of the research questions addressed in this study. It closes with a brief summary.

Research Questions

In order to (a) examine preservice secondary mathematics teachers' perceptions of a blogging activity, used as a supportive teaching-learning tool in a Euclidean Geometry course; (b) assess the advantages and disadvantages of the blogging activity; and, (c) identify trends that emerge in student contributions to the unguided online discussion

board on the blog, this study addressed the following quantitative and qualitative research questions:

Quantitative Research Questions

Research question 1a: Are there significant differences by gender with regard to preservice mathematics teachers' attitudes toward the blogging activity in a college Euclidean Geometry course?

Research question 1b: Are there significant differences by gender with regard to preservice mathematics teachers' perceived effectiveness of the blog for the learning of Euclidean Geometry?

Research question 2a: Do preservice teachers who report spending more time on the Internet differ significantly from those who report spending less time on the Internet with regard to their attitudes toward the blogging activity in a college Euclidean Geometry course?

Research question 2b: Do preservice teachers who report spending more time on the Internet differ significantly from those who report spending less time on the Internet with regard to their perceived effectiveness of the blog for the learning of Euclidean Geometry?

Research question 3a: Is there a relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry course and their attitudes toward the blogging activity in a college Euclidean Geometry course?

Research question 3b: Is there a relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry course and their perceptions of the effectiveness of the blog for the learning of Euclidean Geometry?

Qualitative Research Questions

Research question 4: What do preservice secondary mathematics teachers perceive as the advantages and disadvantages of using a blog as a supportive tool in a Euclidean Geometry course?

Research question 5: What trends emerge in the analysis of preservice secondary mathematics teachers' contributions to an online discussion board on a blog used in a college Euclidean Geometry course?

Research Design

To address these research questions, the study collected and examined both quantitative and qualitative data. Accordingly, a mixed-methods research design was utilized in this study. According to Creswell and Plano Clark (2007), mixed methods research is a research design that includes philosophical assumptions as well as methods of inquiry. The central premise of a mixed methods research design is that the combined use of quantitative and qualitative approaches provides a better understanding of research problems than either approach alone (Creswell & Plano Clark, 2007). Tashakkori and Creswell (2007) have defined mixed methods as a research approach in which the

researcher collects and analyzes data, integrates the findings, and draws inferences using both quantitative and qualitative approaches in a single study or program of inquiry.

Moreover, Creswell and Plano Clark (2011) posit that in a mixed methods approach, the researcher collects and analyzes persuasively and rigorously both quantitative and qualitative data (based on research questions); mixes (or integrates or links) the two forms of data concurrently by combining (or merging) them one with another; gives priority to one or both forms of data (in terms of what the research emphasizes); and uses these procedures in a single study. Creswell and Plano Clark (2007) mentioned that as a methodology, mixed-methods research involves philosophical assumptions that guide the direction of the collection and analysis of data and the mixture of qualitative and quantitative approaches in many phases in the research process; and as a method, it focuses on collecting, analyzing, and mixing both quantitative and qualitative data in a single study or series of studies.

In this study, both quantitative and qualitative data were collected. Quantitative data were gathered from the first part of a survey instrument using a number of Likert-type scale questions and from the cumulative quiz scores students attained on the in-class quizzes. Qualitative data included student contributions to the unguided discussion board as well as student responses to open-ended questions on the survey instrument. Quantitative data were analyzed using SPSS-PASW for Windows; and MAXQDA, a qualitative data analyzing software was used to analyze qualitative data. Then, possible connections between the quantitative and qualitative results were sought to determine

whether or not the quantitative and qualitative data support one another. Thus, the researcher considered all possible aspects of a mixed methods research design.

In this study, a concurrent triangulation strategy was used to dictate the research design. In this design, the quantitative and qualitative data were collected concurrently in a single phase of the research study. Equal priority was given to both qualitative and quantitative methods in order to ensure that the strategy integrated the results of the two methods during the interpretation stage. Additionally, analysis of qualitative data in quantitative form using the MAXQDA software yielded better phenomena to determine the trends that emerge in the students' contributions to the discussion board. Therefore, it was expected that this study would yield a better understanding of preservice mathematics teachers' perceptions in terms of attitude toward and perceived effectiveness of the blogging activity, than if only quantitative or qualitative methods alone were used.

The Blogging Activity and Selection of Participants

The study was conducted during the fall semester of 2011 in a college Euclidean Geometry course taught in the college of education of a university in the western United States. All of the students enrolled in this course and a preservice teacher auditing the course as part of an independent study were asked to participate. Most of the students in this course were secondary mathematics education majors; however, a few were majoring in other areas. There were 29 students in the course. The students were given a choice to join or not to join in the blogging activity; with an alternate assignment provided by the instructor to those students who did not wish to participate in the blogging activity (Appendix C).

Initially, all 29 of the students agreed to participate in the blogging activity. One student, who attended only two class sessions and did not continue the course, did not participate in this study. Finally, all 28 remaining students continued in the blogging activity and participated in the study. There were more than 6,500 visits to the blog during the twelve weeks of the activity. The blog can be visited at http://edsc353fall2011.wordpress.com/.

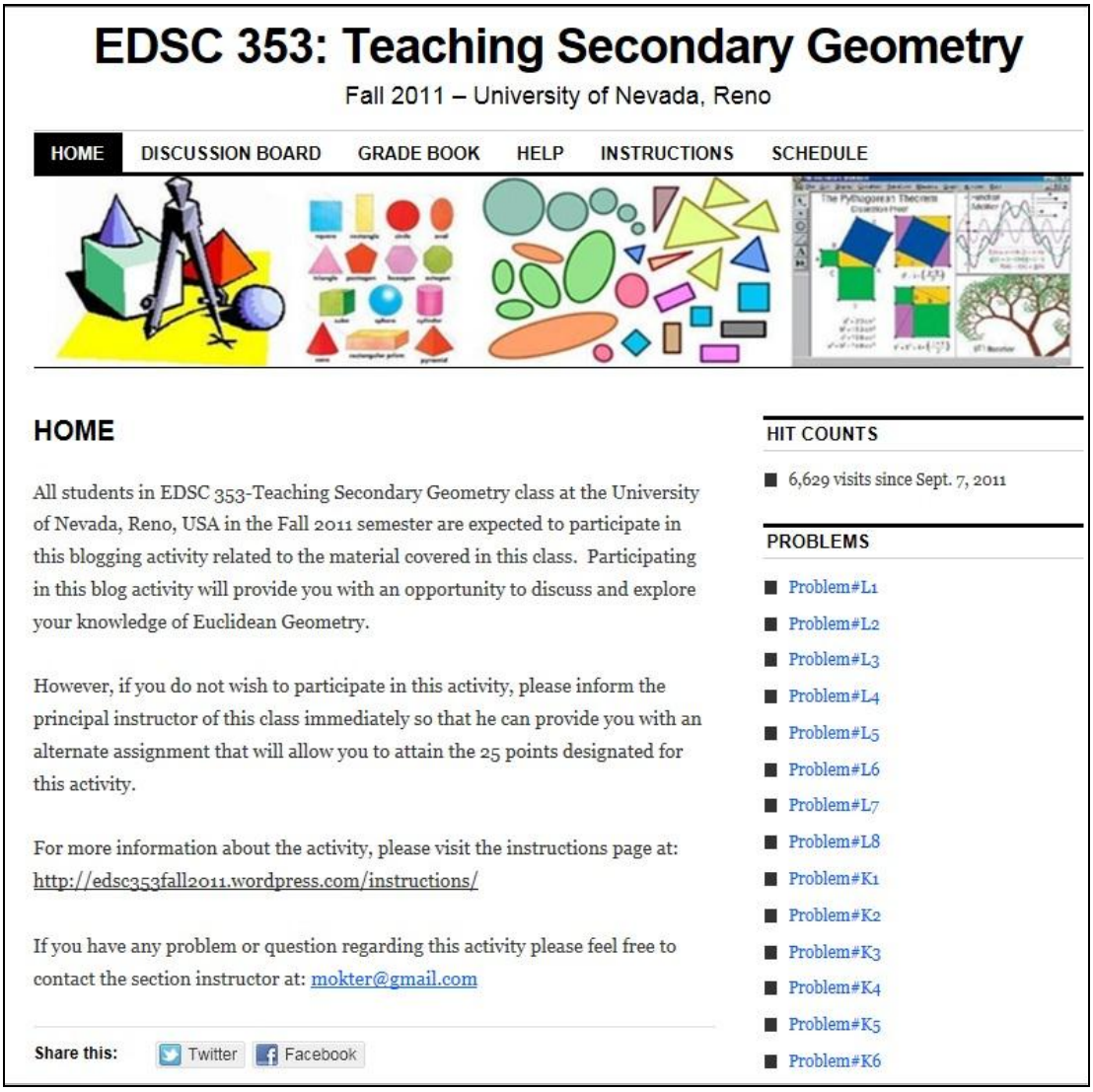

Figure 1. A Screenshot of the Homepage of the Blog used for this Study

The blogging activity was designed to run for twelve weeks and was a regular component of this course. The students were divided into six groups with five students in five of the groups and three in the remaining group. Each week the researcher uploaded a new problem set. The six groups were randomly assigned to a pair of weeks, 1st and 7th, 2nd and 8th, 3rd and 9th, 4th and 10th, 5th and 11th, or 6th and 12th. During the weeks to which they were assigned, group members were responsible for solving problems and leading the discussion board activity on the blog. The schedule was purposely set so that each group was assigned one week during the first half of the activity and another week in the second half. Each student created a pseudonym to maintain confidentiality throughout the activity (Appendix D).

Each group member was responsible for submitting a complete solution, to one of the eight problems posted during the weeks assigned to their group. Additionally, during the assigned week, at least one group member was responsible for initiating a new discussion thread and the other group members were expected to contribute to the thread. Additionally, throughout the semester each class member was required to post at least five substantive comments to solutions posted by other students; and to actively participate in the online discussion. Substantive comments included verifying a solution posted by someone else, fixing an incorrect or partially incorrect solution, or providing an alternative solution. In the online discussion board, a student could raise a discussion topic such as a contemporary issue related to the topics taught in the class or comment on threads that had been started by other class members.

The course syllabus indicated 25 points for the blogging activity, out of 180 total points for the course. In the blogging activity every student was required to complete the following tasks: (a) post a complete solution to one problem during each of the two weeks assigned to their group (8 points); (b) post at least five substantive comments to solutions posted by other students (10 points); (c) participate in the online discussion at least five times (5 points); and complete a survey regarding this activity (2 points). In order to be awarded the maximum number of points in each category: (i) solutions needed to be complete and correct; (ii) substantive comments needed to make a clear point regarding one of the problems or posted solutions; (iii) participation in the online discussion needed to be active; and (iv) the survey needed to be submitted to the instructors.

The blogging activity was designed to provide participants with an opportunity to explore and share their knowledge of various geometric problems and their applications in real life situations. Every weekend the researcher posted eight problems on the blog and sent an email to all of the participants with a reminder that the problems were uploaded on the blog and were ready to be solved. It is noted that there were a maximum of five participants in a group; however, eight problems were posted each week. Thus, extra problems were posted each week so that even the last participant in a group had some options to choose from when selecting and solving a problem. The researcher periodically updated the grade sheet related to the blogging activity; posted it on the blog using pseudonyms; and sent a reminder to participants who were behind in their assigned tasks. All participants completed their assigned tasks for this activity in a timely manner

and achieved the full number of points allocated for this activity. After the 12 week activity had concluded each class member completed a survey that gathered information regarding his/her attitudes toward the blog and his/her perceptions of its effectiveness.

Nature of the Euclidean Geometry Course

The EDSC 353 - Teaching Secondary Geometry course in which the blogging activity was conducted was an undergraduate level course. The purpose of the course was to prepare secondary mathematics education majors for the teaching of Euclidean Geometry. It was intended to help prepare students to become high school mathematics teachers. No effort was made to determine how far along individual students were with regard to this goal, however, almost all students had already decided that they want to be high school mathematics teachers, while a couple might have taken this course to help them decide if they want to pursue the goal of becoming a high school mathematics teacher.

Other specific objectives of the course were to: (1) solve problems appropriate to a Euclidean Geometry course using multiple strategies; (2) rigorously prove theorems typically included in Euclidean Geometry; (3) explain the nature of proof and consider its role in a Euclidean Geometry course; (4) explain the role of technology in the teaching of Euclidean Geometry; (5) describe the different experiences that must occur to facilitate the learning of High School Geometry; (6) explain instructional strategies appropriate for teaching Euclidean Geometry; (7) communicate geometric concepts effectively, both orally and in writing; and (8) define and discuss the teacher's role in the Geometry

classroom, including responsibility to the diversity of students and their various learning styles.

Discovering Geometry: An investigative approach by Michael Serra (2008) served as the textbook for the course. The text contained 14 chapters on various Euclidean Geometry topics including: Geometric Art, Introducing Geometry, Reasoning in Geometry, Using Tools of Geometry, Discovering and Proving Triangle Properties, Discovering and Proving Polygon Properties, Discovering and Proving Circle Properties, Transformation and Tessellation, Area, The Pythagorean Theorem, Volume, Similarity, Trigonometry, and Geometry as a Mathematical System.

All chapters in the textbook were covered during the semester, with their content providing potential fodder for the quizzes as well as for the blog. After teaching each couple of chapters an in-class quiz was administered by the instructor. There were eight 10-point quizzes administered throughout the semester. The cumulative quiz scores were considered as quantitative data for the study.

Significance of Choosing the College Euclidean Geometry Course

As stated earlier, the main purpose of this study was to examine preservice secondary mathematics teachers' perceptions of using blogs, one of the most common Web 2.0 technologies, as a supportive teaching-learning tool in a college Euclidean Geometry course. Moreover, as a new technology, many mathematics teachers and students do not have practical experience in using Web 2.0-based applications in their classroom setting. Thus, the researcher aimed to conduct the study for an entire semester.

This plan was designed to help the researcher to implement and see the effectiveness of this model in an actual classroom setting.

Moreover, at the time of conducting this research, Web 2.0 technologies had not been widely incorporated in the secondary school curricula (Fahser-Herro, 2010; Fahser-Herro & Steinkuehler, 2009–10). Thus, it was difficult for the researcher to find an actual secondary mathematics course in which the study could be conducted for an entire academic semester. Fortunately, the course described above was very similar to a secondary mathematics course. This course was taken by many secondary mathematics education majors and minors. The course prepared participants for teaching Euclidean Geometry using multiple strategies that were appropriate for a secondary mathematics classroom setting. The researcher served as a teaching assistant to the main instructor of the course, and helped develop and implement course materials throughout the semester.

Instrumentation

The main instrument of data collection in this study was a researcher-developed survey (Appendix A). According to Sapsford (2006), one of the major benefits of using a survey is that it is flexible to conduct and can deal with different types of data. Thomas (2003) states that "surveys are useful in revealing the current status of a target variable within a particular entity" (p. 44). As an emerging technology, Web 2.0 is still in its initial phases for teaching and learning purposes. Most Web 2.0 tools have only recently been developed. There was no research study publicly available that used a survey instrument compatible with the purpose of this study. Thus, following some relevant studies such as Cash (2010) and Reilly (2007), the researcher developed a survey, as the

primary instrument for this study that specifically met the purposes of this study's research questions. The survey included five major sections:

- Demographic Information
- Experience in using Web 2.0 Applications
- Attitudes Toward the Blogging Activity
- Effectiveness of the Blogging Activity; and
- Open-ended Questions

The first section was designed to collect participants' demographic information in terms of gender and age. The second section consisted of five items related to participants' experience in using the Internet and Web 2.0 applications. The third section was intended to measure participants' attitudes toward the blogging activity. This section consists of 16 Likert-type items (item numbers 8 to 23 of the instrument, in Appendix A) with a 6-point scale: Very Strongly Agree (VSA), Strongly Agree (SA), Agree (A), Disagree (D), Strongly Disagree (SD), or Very Strongly Disagree (VSD). The fourth section was intended to measure participants' perceived effectiveness of the blogging activity using 18 Likert-type items (item numbers 24 to 41 of the instrument, in Appendix A) with a 6-point scale: Very Strongly Agree (VSA), Strongly Agree (SA), Agree (A), Disagree (D), Strongly Disagree (SD) or Very Strongly Disagree (VSD). Finally, the fifth section was intended to collect participants' written comments regarding the advantages and disadvantages of the blogging activity through two open-ended questions.

Both positively and negatively worded Likert-type items were included in the instrument. The same response options were given for all items; however, point values for negatively worded items were reversed for data analysis purposes.

A similar instrument had been developed and used to evaluate the effectiveness of a similar blogging activity conducted in the same course during the fall 2010 semester. The results of this survey were used to improve the original instrument. The fall 2010 bogging activity was conducted over 13 weeks and can be found at http://webactivities.wordpress.com/. There were 22 students in that course and all of them participated in the activity and the post-activity survey. Based on participants' feedback and findings, the items of the survey instrument were carefully reexamined and modified, wherever needed, to meet the objectives of the current study.

Validity and Reliability of the Instrument

Validity

Validity is the most important characteristic a measuring instrument can possess (Reilly, 2007). According to Gay and Airasian (2003), "Validity is concerned with the appropriateness of the interpretations made from the test scores" (p. 133). To be effective, studies look at both internal and external validity. Internal validity is checked using face validity (Reilly, 2007). According to Sirkin (1999), "face validity is the extent to which the measure is subjectively viewed by knowledgeable individuals as covering the concept" (p. 74).

In other words, internal validity refers specifically to whether an experiment or study makes a difference or not; and whether or not there is sufficient evidence to support

the claim (Yu & Ohlund, 2010). External validity is the validity of generalized (causal) inferences mostly used in scientific studies, usually based on experiments (Mitchell & Jolley, 2001). In other words, external validity refers to the generalizability of the treatment/condition outcomes (Yu & Ohlund, 2010).

Validity Checking Process and Results

Validity of this instrument was measured through the face validity process. To do this, the instrument was given to two professors who have extensive experience in teaching mathematics education courses and supervising doctoral and professional research as well as three doctoral students who have experience in using information technology in mathematics education and conducting research. These five reviewers were given 46 Likert-type items in random order (Appendix B). They were asked to determine whether each item was appropriate for measuring participants' attitudes toward the blogging activity, participants' perceived effectiveness of the blogging activity, or neither.

Only items on which at least four of the five experts agreed were appropriate for measuring either attitudes or effectiveness were considered acceptable for use on the final instrument. Based on these criteria, 16 Likert-type scale items were deemed appropriate for measuring participants' attitudes toward the blogging activity and 19 Likert-type scale items were deemed appropriate for measuring participants' perceived effectiveness of the blogging activity. However, keeping the split-half reliability test in mind one item measuring effectiveness was removed from the survey. Finally, 16-attitude measuring and 18-effectiveness measuring items, a total of 34 Likert-type 6-point scale items were

selected for the instrument. Thus, it could be considered that each of the Likert-type scale items used in this survey has at least 80% face validity.

Reliability

Reliability measures the degree of consistency between two measures of the same construct (Mehrens & Lehman, 1987). According to Gay and Airasian (2003), "Reliability is the degree to which a test consistently measures whatever it is measuring" (p. 141). Reliability is the measure of the stability, dependability, trustworthiness, and consistency with which a test measures the same construct each time conducted (Worthen, Borg, & White, 1993). In other words, reliability measures whether the same result is obtained if the study is replicated in a similar situation (Reilly, 2007). For instance, if a person's height is measured on a standard scale, the scale should register the same measure every time the person's height is measured (Assuah, 2010).

There are several methods to measure the reliability of an instrument for internal consistency. These include the split-half method, Cronbach's alph**a,** Kuder-Richardson Formula 20 (K-R 20), and Kuder-Richardson Formula 21 (K-R 21)**.** Split-half is the easiest method and eliminates the need for multiple administrations of a test and eliminates the need to develop another form of the instrument. The simplest way to perform split-half reliability is to first administer the test; and split the items into two halves with all odd numbered items in the first half and all even numbered items in the second half. Then the total score for the odd number items is correlated with the total score for the even number items. Finally, the following Spearman-Brown prophecy formula was applied to the correlation to determine the reliability (Siegle, 2002):

$$\text{Reliability of scores on total test} = \frac{2 \times \text{reliability for ½ test}}{1 + \text{reliability for ½ test}}$$

Cronbach's alpha (α) is another method used to measure the internal consistency of a test. It is often used for instruments with items that have two or more possible answers, for instance, Likert-type scale items (Siegle, 2002). Cronbach's alpha is written as a function of the number of test items and the average inter-correlation among the items.

For conceptual purposes, the following formula is used to calculate the standardized Cronbach's alpha: $\alpha = \frac{N\overline{C}}{\overline{V} + (N-1).\overline{C}}$; where N is the number of items, $\overline{C}$ is the average inter-item covariance among the items, and $\overline{V}$ is the average variance (George & Mallery, 2003; Gliem & Gliem, 2003; UCLA Academic Technology Services, nd). From the above formula it can be seen that if the number of items increases, Cronbach's alpha, and thus, the reliability of an instrument, increases.

Cronbach's alpha is interpreted as the percent of variance an observed scale would explain in the hypothetical true scale composed of all possible items in the universe. It is considered that when α = 0, the true score is not measured at all, and there is only an error component; when α equals 1, all items measure only the true score and there is no error component. Thus, the closer α is to 1, the greater the internal consistency of the test is and the more internally reliable the instrument is considered to be. George and Mallery (2003) provided the following rule of thumb for the Cronbach's alpha: α > 0.9

(Excellent), $\alpha > 0.8$ (Good), $\alpha > 0.7$ (Acceptable), $\alpha > 0.6$ (Questionable), $\alpha > 0.5$ (Poor), and $\alpha \leq 0.5$ (Unacceptable), as cited in Gliem & Gliem (2003).

Reliability Checking Process and Results

The reliability of this instrument was measured using both split-half and Cronbach's alpha methods with both SPSS-PASW for Windows and Reliability Calculator developed by (Siegle, 2002). These calculations were first performed by combining all 34 attitude and effectiveness items as a single instrument and later as separate instruments, one measuring attitude and the other measuring effectiveness. For the combined attitude and effectiveness items, using SPSS-PASW for Windows, Cronbach's alpha was calculated as 0.968 and split-half reliability was calculated as 0.96963 (Table 3). Using Reliability Calculator developed by (Siegle, 2002), Cronbach's alpha was calculated as 0.9696 and split-half reliability was calculated as 0.9677 (Table 4). In both cases, the reliability coefficients were found to be consistent; and thus, the Cronbach's alpha was considered to be greater than 0.9, suggesting the reliability of this instrument was excellent.

Table 3
Split-Half Reliability Statistics of the Survey Instrument with SPSS for Windows

Cronbach's Alpha	Part 1	Value	0.933262
		N of Items	17[a]
	Part 2	Value	0.937706
		N of Items	17[b]
	Total	Value	.968
		N of Items	34
Correlation Between Forms (split-half reliability)			0.96963

a. The items are: 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40.
b. The items are: 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41.

Table 4

Reliability Statistics with Reliability Calculator Developed by Siegle (2002)

Cronbach's Alpha	Split-Half (odd-even) Correlation	N of Items
. 9696	.9677	34

The calculation on attitude items, only, using SPSS-PASW for Windows, yielded a Cronbach's alpha of 0.927 and split-half reliability of 0.892 (Table 5). Using Reliability Calculator developed by (Siegle, 2002), Cronbach's alpha was calculated as 0.8923 and split-half reliability was calculated as 0.9273 (Table 6). In both cases, the reliability coefficients were found to be consistent; and thus, the Cronbach's alpha was considered to be close to 0.9, suggesting the reliability of the attitude component of this instrument was excellent.

Table 5

Split-Half Reliability Statistics for the Attitudes Items with SPSS for Windows

Cronbach's Alpha	Part 1	Value	.844
		N of Items	8[a]
	Part 2	Value	.875
		N of Items	8[b]
	Total	Value	.927
		N of Items	16
Correlation Between Forms (split-half reliability)			.892

a. The items are: 8, 10, 12, 14, 16, 18, 20, 22.

b. The items are: 9, 11, 13, 15, 17, 19, 21, 23.

Table 6
Reliability Statistics for the Attitudes Items with Siegle (2002) Calculator

Cronbach's Alpha	Split-Half (odd-even) Correlation	N of Items
. 8923	.9273	16

The calculation on effectiveness items, only, using SPSS-PASW for Windows, yielded a Cronbach's alpha of 0.958 and a split-half reliability of 0.940 (Table 7). Using Reliability Calculator developed by (Siegle, 2002), Cronbach's alpha was calculated as 0.9579 and split-half reliability was calculated as 0.9401 (Table 8). In both cases, the reliability coefficients were consistent; and thus, the Cronbach's alpha was considered to be greater than 0.9, suggesting the reliability of the effectiveness component of this instrument was excellent.

Table 7
Split-Half Reliability Statistics for the Effectiveness Items with SPSS for Windows

Cronbach's Alpha	Part 1	Value	.925
		N of Items	9[a]
	Part 2	Value	.909
		N of Items	9[b]
	Total	Value	.958
		N of Items	18
Correlation Between Forms (split-half reliability)			.940

a. The items are: 24, 26, 28, 30, 32, 34, 36, 38, 40.
b. The items are: 25, 27, 29, 31, 33, 35, 37, 39, 41.

Table 8
Reliability Statistics for the Effectiveness Items with Siegle (2002) Calculator

Cronbach's Alpha	Split-Half (odd-even) Correlation	N of Items
.9579	.940	18

It should be noted that when performing the split-half reliability test, the accepted items measuring attitudes and effectiveness, respectively were listed in the same order in the final instrument as they had been randomly listed in the determination of validity. This ensured a random and unbiased splitting of these items. The entire process was, therefore, not subject to any researcher bias with regard to putting particular items in an odd or even position. Therefore, the reliability found for the survey instrument is claimed to be accurate.

Data Collection

Prior to collecting data, permission was sought from the Institutional Review Board (IRB) of the university where the study was conducted (Appendix E). At the conclusion of the blogging activity, a survey was administered to collect data regarding preservice mathematics teachers' perceptions of using a blog as a supportive teaching-learning tool in a college Euclidean Geometry course. Before administrating the survey, participants were given a participant consent form (Appendix F). Additionally, an information script (Appendix G) describing the purpose of the survey was read aloud to the students. The students were given a choice to participate or not participate in the study without any penalty or loss of rights to which they were entitled in the course. All individuals who agreed to participate were given the survey to complete in the absence of the researcher.

Quantitative data were gathered from the first four sections of the survey. Another form of quantitative data, students' cumulative quiz scores, was obtained from the course

instructor after final grades had been submitted. Qualitative data were collected from the last section of the survey as well as from the students' postings to the online discussion board on the blog. Thus, the researcher did not have control of participants' feedback in this study.

Working Definitions

Working Definitions for the Independent Variables

Two independent variables (IVs) were considered for the purposes of answering the research questions in this study. The first IV was participants' gender – a categorical variable with two categories: male and female. The second IV was participants' self-reported total time spent on the Internet per week – measured in hours. These values were divided into two categories using a median split.

Working Definitions for the Dependent Variables

As stated earlier, the purpose of this study was to examine preservice mathematics teachers' perceptions of using a blog to support a college Euclidean Geometry course. Student perceptions were measured by two different dependent variables (DVs):

(1) Participants' attitudes toward the blogging activity; and

(2) Participants' perceived effectiveness of the blogging activity.

The first DV, participants' attitudes toward the blogging activity, was measured by calculating the median response of the 16 Likert-type scale items (item numbers 8 to 23 of the instrument, in Appendix A) measured on a six-point scale. The second DV, perceived effectiveness of the blogging activity, was measured by calculating the median

response of the other 18 Likert-type scale items (item numbers 24 to 41 of the instrument, in Appendix A) measured on a six-point scale.

Another DV, the cumulative quiz scores attained on eight in-class quizzes was correlated with the participants' median scores on the attitude and perceived effectiveness scores, respectively, to see whether or not there were relationships between the quiz total and either of these other variables.

Analysis of Quantitative Data

The study was limited to 28 participants in a single college Euclidean Geometry course. The application of parametric tests was deemed inappropriate due to the ordinal nature of data for the dependent variables that measure participants' attitudes toward and perceived effectiveness of the blogging activity. Therefore, the non-parametric Wilcoxon-Mann-Whitney U test, which is the alternative to the parametric t-test, was used to analyze research questions 1a, 1b, 2a, and 2b.

Usually a 0.5 effect size (d) is considered appropriate for a two-tailed independent sample t-test and the Wilcoxon-Mann-Whitney U tests. A power analysis with GPower 3.1 revealed that even considering a large effect size $d = 0.8$, power of 0.8, and probability of 0.05, a minimum of 26 participants in each group is required for a two-tailed independent sample t-test for two groups. With that effect size $d = 0.8$, power of 0.8, and probability of 0.05, a minimum of 27 participants in each group is required for a two-tailed Wilcoxon-Mann-Whitney U test for two independent groups. However, considering 14 participants in each group with an effect size (d) of 0.8 and probability of 0.05, a two-tailed Wilcoxon-Mann-Whitney U test for two independent groups yields a

power of 0.51, revealed by a power analysis with GPower 3.1. This means the study had only about 51% chance of getting a significant mean difference between the groups, if that difference really exists. That represents a major limitation of this study.

Specific Tests for the Quantitative Research Questions

Research question 1a: Are there significant differences by gender with regard to preservice mathematics teachers' attitudes toward the blogging activity in a college Euclidean Geometry course? To answer this research question, a non-parametric Wilcoxon-Mann-Whitney U test was performed on median attitude scores with gender as the independent variable.

Research question 1b: Are there significant differences by gender with regard to preservice mathematics teachers' perceived effectiveness of the blog for the learning of Euclidean Geometry? To answer this research question, a non-parametric Wilcoxon-Mann-Whitney U test was performed on median perceived effectiveness scores with gender as the independent variable.

Research question 2a: Do preservice teachers who report spending more time on the Internet differ significantly from those who report spending less time on the Internet with regard to their attitudes toward the blogging activity in a college Euclidean Geometry course? To answer this research question, a non-parametric Wilcoxon-Mann-Whitney U test was performed on participants' median attitude scores with their self-reported total time spent on the Internet per week as the independent variable.

Research question 2b: Do preservice teachers who report spending more time on the Internet differ significantly from those who report spending less time on the Internet

with regard to their perceived effectiveness of the blog for the learning of Euclidean Geometry? To answer this research question, a non-parametric Wilcoxon-Mann-Whitney U test was performed on participants' median perceived effectiveness scores with their self-reported total time spent on the Internet per week as the independent variable.

Research question 3a: Is there a relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry course and their attitudes toward the blogging activity in a college Euclidean Geometry course? To answer this research question, a Spearman correlation *r* was calculated for cumulative quiz scores and median attitude scores.

The research question 3b: Is there a relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry course and their perceptions of the effectiveness of the blog for the learning of Euclidean Geometry? To answer this research question, a Spearman correlation *r* was calculated for cumulative quiz scores and median perceived effectiveness scores.

Rationale for Using Median Scores

In the case of a within subjects study, such as a pretest/posttest design, it would probably be appropriate to use mean scores for each participant instead of median scores for each participant. In that case, each participant's score on the first survey item is compared to that participant's corresponding score on the second survey item. Similarly, if a researcher uses a single instrument and each participant rated two different things with it – for example, if a panel of judges rated the taste of a food item prepared in two

different ways using the same instrument twice, with dependent data like these where the difference scores for each pair are used in the equation or each participant serves as his/her own control, use of mean scores makes sense.

In this study, however, the researcher compared the scores of two completely independent groups – such as, male versus female participants, and participants who spent less time on the Internet versus participants who spent more time on the Internet. For this reason, it was determined to be more appropriate to use median scores, instead of mean scores.

Moreover, in this study, the researcher developed and used a survey instrument that has not been used before. Therefore, the instrument had not been improved over time in a way that might allow experts to argue that the distance between each point on the Likert-type scale was the same or very similar. For these reasons, the researcher felt more comfortable using the median scores of the participants for analyzing the quantitative research questions of this study.

Analysis of Qualitative Data

There were two qualitative research questions in this study. These were research question 4: *What do preservice secondary mathematics teachers perceive as the advantages and disadvantages of using a blog as a supportive tool in a Euclidean Geometry course?* and research question 5: *What trends emerge in the analysis of preservice secondary mathematics teachers' contributions to an online discussion board on a blog used in a college Euclidean Geometry course?* The data collected for these qualitative research questions were analyzed using MAXQDA, Qualitative Data Analysis

software, to explore the advantages and disadvantages/problems of the blogging activity in the college Euclidean Geometry course as reported by the students; and to determine trends that emerge in the students' self-posted discussion on the blog.

Chapter Summary

This chapter includes five main sections. The first section repeats the research questions and discusses the research design. The next section describes the blogging activity and the selection of participants followed by the significance of choosing the college Euclidean Geometry course for this study. Next, the survey instrumentation and validity and reliability checking processes were discussed. Then, the data collection procedures, working definitions for the independent and dependent variables, and the specific statistical tests for the quantitative research questions are explained followed by the researcher's arguments for using median scores, instead of mean scores. Finally, the qualitative data analysis procedures were discussed.

CHAPTER FOUR: DATA ANALYSIS AND RESULTS

Introduction

This study examined preservice secondary mathematics teachers' perceptions of a blogging activity used as a supportive teaching-learning tool in a college Euclidean Geometry course. Self-reported attitudes toward the blogging activity and the perceived effectiveness of the blogging activity were measured and analyzed quantitatively using SPSS-PASW for Windows. Attitudes and perceived effectiveness scores were compared across gender and self-reported time on the Internet to determine if differences existed across these categories. Additionally, this study determined if a relationship exists between either participants' attitudes toward the blog or perceived effectiveness of the blog to their total quiz scores measured by eight in-class quizzes. The qualitative component of this study analyzed the advantages and disadvantages of the blogging activity as reported by the students and determined the trends that emerged in the students' contributions to the unguided discussion section of the blog. The qualitative data were analyzed using MAXQDA. Quantitative and qualitative analyses are presented separately.

This chapter presents the data and findings of this study. More specifically, it provides an analysis of the demographic information of the sample gathered for this study; an overview of participants' attitudes and perceived effectiveness scores followed by results of specific research questions. It closes with a brief summary of the results.

Demographic Information of Sample

The study was conducted in a college Euclidean Geometry course offered in a university in the western United States in the fall 2011 semester. There were 29 students enrolled in the course; all 28 students who attended the course regularly participated in the study. Descriptive statistics on the demographic information of study participants is shown in the following tables (Table 9 to Table 13). Twelve (42.86%) of the participants were male, and 16 (57.14%) were female. The participants ranged in age from 20 to 61 years old with a mean, median, and range of 26.43, 22.0, and 41 years respectively, and a standard deviation of 10.149 years. The participants were asked to state the approximate total time they spend on the Internet per week in hours for all purposes. The mean, median, and range of these responses were 22.43, 20.50, and 55 hours respectively, with a standard deviation of 10.823 hours (Table 9).

Table 9
Descriptive Statistics of Participants' Age and Time Spent on the Internet per week

			Age in Years	Time Spent on the Internet/Week
N	Male	12		
	Female	16		
	Total	28		
Mean			26.43	22.43
Std. Error of Mean			1.918	2.045
Median			22.00	20.50
Mode			20[a]	10[a]
Std. Deviation			10.149	10.823
Range			41	55

a. Multiple modes exist. The smallest value is shown

Thus, for analyzing research questions 2a and 2b, participants are divided into two groups, those who report spending less than 21 hours on the Internet per week and those who report spending 21 or more hours on the Internet per week.

The participants were also asked to respond to a number of items pertaining to use of smart phones or Internet connected handheld cellular devices to get access to the Internet; their self-reported skills in using the Internet in terms of sending or receiving emails, browsing web pages, searching information, reading news on the Internet, etc.; their interest/engagement in Web 2.0 applications such as: blog, Facebook, podcast, twitter, wikis, etc.; and their previous experience in blogging before participating in this activity.

Nine (75%) of the male and eleven (68.8%) of the female participants – in total 20 (71.4%) out of the 28 participants reported that they used smart phones or handheld cellular devices to get access to the Internet. Only three (25%) of the male and five (31.2%) of the female participants – in total eight (28.6%) out of the 28 participants reported that they did not use smart phones or handheld cellular devices to get access to the Internet (Table 10).

Table 10

*Gender * Use of Smart Phone Crosstabulation*

Gender	Use a Smart Phone	Do Not use a Smart Phone	Total
Male	9 (75.0%)	3 (25.0%)	12 (100.0%)
Female	11 (68.8%)	5 (31.2%)	16 (100.0%)
Total	20 (71.4%)	8 (28.6%)	28 (100.0%)

Ten (83.3%) of the male and ten (62.5%) of the female participants – in total 20 (71.4%) out of the 28 participants reported that they had excellent skills in using the Internet in terms of sending or receiving emails, browsing web pages, searching information, reading news on the Internet, etc.; and only two (16.7%) of the male and six (36.5%) of the female participants – in total eight (28.6%) out of the 28 participants reported that they had good skills in these areas. No one reported average or poor skills in using the Internet (Table 11).

Table 11

*Gender * Internet Skills Crosstabulation*

Gender	Excellent	Good	Average	Total
Male	10 (83.3%)	2 (16.7%)	0	12 (100.0%)
Female	10 (62.5%)	6 (37.5%)	0	16 (100.0%)
Total	20 (71.4%)	8 (28.6%)	0	28 (100.0%)

Six (50%) of the male and eight (50%) of the female participants – in total 14 (50%) out of the 28 participants reported very much interest/engagement in Web 2.0 applications such as: blog, Facebook, podcast, twitter, wikis, etc. The remaining 50% of the male and 50% of the female participants reported *Average* interest/engagement in Web 2.0 applications such as: blog, Facebook, podcast, twitter, wikis, etc. No one reported little interest/engagement in Web 2.0 applications such as: blog, Facebook, podcast, twitter, wikis, etc. (Table 12)

Table 12

*Gender * Engagement in Web 2.0 and Gender Crosstabulation*

Gender	Very Much	Average	Little	Total
Male	6 (50.0%)	6 (50.0%)	0	12 (100%)
Female	8 (50.0%)	8 (50.0%)	0	16 (100%)
Total	14 (50%)	14 (50%)	0	28 (100%)

However, only one (8.3%) of the male and one (6.2%) of the female participants – in total 2 (7.1%) out of the 28 participants reported that they had very much previous experience in blogging before participating in this activity. Six (50%) of the male and eight (50%) of the female participants – in total 14 (50%) out of the 28 participants reported that they had *Average* previous experience in blogging before participating in this activity; and five (41.7%) of the male and seven (43.8%) of the female participants – in total 12 (42.9%) out of the 28 participants reported that they had little previous experience in blogging before participating in this activity (Table 13).

Table 13

*Gender * Previous Experience in Blogging Crosstabulation*

Gender	Very Much	Average	Little	Total
Male	1 (8.3%)	6 (50%)	5 (41.7%)	12 (100%)
Female	1 (6.2%)	8 (50%)	7 (43.8%)	16 (100%)
Total	2 (7.1%)	14 (50.0%)	12 (42.9%)	28 (100.0%)

An Overview of the Attitude and Perceived Effectiveness Scores

Participants' Attitudes toward the Blogging Activity

Participants responded to 16 specific questions (item numbers 8 to 23 of the instrument, in Appendix A) designed to measure their attitudes toward the blogging activity in a college Euclidean Geometry course. These questions included a 6-point Likert-type scale allowing participants to indicate whether they *Very Strongly Agree* (VSA), *Strongly Agree* (SA), *Agree* (A), *Disagree* (D), *Strongly Disagree* (SD), or *Very Strongly Disagree* (VSD) to each item. These sixteen 6-point Likert-type scale items were combined to attain a median attitude score toward the blogging activity in the college Euclidean Geometry course for each participant.

Each item had a possible range of 1 to 6; where for positively worded items, 1 indicated *Very Strongly Disagree* (VSD) and 6 indicated *Very Strongly Agree* (VSA). There were 6 negatively worded Likert-type scale items (items numbers 9, 11, 13, 16, 19, and 23 in Appendix A) in this section. The same Likert scale options were given for those six negatively worded Likert-type scale items; however, those items were coded in reverse order with a possible range of 1 to 6; where 1 indicated *Very Strongly Agree* (VSA) and 6 indicated *Very Strongly Disagree* (VSD). The possible range for the attitude score for each item was 1 to 6 with a higher number representing a more positive attitude toward the blogging activity for the learning of college Euclidean Geometry. The median score on the 16-question attitude survey was determined for each participant.

An overview of participants' attitudes toward the blogging activity is shown in the following table (Table 14).

Table 14

An Overview of Participants' Attitude Scores toward the Blogging Activity

Participants		Items in the Survey Instrument Pertaining to the Measurement of Attitude																Median	Mode
No.	Gender	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
1	M	5	6	6	6	5	6	6	5	6	5	5	6	6	6	6	6	6	6
2	M	3	5	4	6	5	6	6	6	5	6	6	5	6	6	6	6	6	6
3	F	4	3	5	6	5	4	4	4	5	3	4	4	4	4	4	6	4	4
4	F	5	4	4	4	4	4	5	4	2	4	4	4	4	4	4	4	4	4
5	F	4	3	2	3	3	4	3	2	2	2	4	4	3	4	4	4	3	3
6	F	4	4	3	4	3	4	4	4	4	3	4	4	4	4	4	4	4	4
7	M	6	6	4	5	5	5	6	6	6	5	5	4	5	5	5	5	5	5
8	M	5	5	5	5	5	5	5	5	5	5	5	5	6	6	6	6	5	5
9	M	5	4	4	4	4	5	3	3	4	3	5	5	5	4	5	4	4	4
10	M	1	6	1	5	6	5	5	6	6	4	1	6	4	1	6	1	5	6
11	M	4	4	3	4	4	4	3	4	5	4	4	4	3	4	5	3	4	4
12	F	3	3	2	3	3	5	3	4	4	3	4	4	3	3	3	3	3	3
13	F	3	4	3	5	3	5	5	4	5	5	5	4	4	5	4	3	4	5
14	M	6	4	3	4	5	3	4	4	3	5	3	4	5	4	5	3	4	4
15	F	2	2	2	1	3	2	5	1	3	3	4	6	3	4	4	5	3	3
16	F	3	3	2	2	3	2	3	3	4	3	3	4	3	3	3	2	3	3
17	M	4	4	4	4	5	5	5	4	6	5	4	4	5	4	6	5	4.5	4
18	F	6	6	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
19	M	3	5	3	4	4	4	4	4	4	4	4	5	3	4	5	3	4	4
20	F	5	6	5	5	6	5	5	5	6	5	6	4	4	6	6	6	5	6
21	F	4	4	4	4	4	5	5	5	6	5	5	5	4	4	4	4	4	4
22	F	4	4	4	6	4	5	6	4	5	5	6	4	5	5	6	6	5	5
23	M	3	4	4	5	3	4	2	2	4	2	3	4	3	2	5	5	3.5	4
24	F	4	3	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
25	F	2	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4
26	F	3	5	3	5	4	4	4	3	6	5	5	5	4	4	4	4	4	4
27	M	2	1	5	1	2	1	2	4	6	4	2	5	6	2	6	1	2	2
28	F	4	5	4	4	4	5	4	4	5	4	4	5	4	4	4	4	4	4
Median		4	4	4	4	4	4.5	4	4	5	4	4	4	4	4	5	4	4	4
Mode		4	4	4	4	4	5	4	4	6	5	4	4	4	4	4	4	4	4

Perceived Effectiveness of the Blogging Activity

The participants also responded to 18 specific questions (item numbers 24 to 41 of the instrument, in Appendix A) pertaining to the perceived effectiveness of the blog for the learning of Euclidean Geometry. These questions included a 6-point Likert-type scale allowing participants to indicate whether they *Very Strongly Agree* (VSA), *Strongly Agree* (SA), *Agree* (A), *Disagree* (D), *Strongly Disagree* (SD), or *Very Strongly Disagree* (VSD) to each item.

These eighteen 6-point Likert-type scale items were combined to attain a median perceived effectiveness score of using the blog for the learning of Euclidean Geometry for each participant. Each item had a possible range of 1 to 6; where 1 indicated *Very Strongly Disagree* (VSD) and 6 indicated *Very Strongly Agree* (VSA). All items in this section were worded positively. The possible range for the perceived effectiveness score for each item was 1 to 6 with a higher number representing a more positive perceived effectiveness of the blog for the learning of Euclidean Geometry. The median score on the 18-question perceived effectiveness survey was determined for each participant.

An overview of participants' perceived effectiveness of the blog is shown in the following table (Table 15).

Table 15

An Overview of Perceived Effectiveness Scores of the Blogging Activity

Participants		Items in the Survey Instrument Pertaining to the Measurement of Perceived Effectiveness																		Median	Mode
No.	Gender	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41		
1	M	5	6	4	3	3	4	5	5	3	4	5	5	4	4	5	4	5	3	4	5
2	M	6	6	4	3	4	6	5	5	3	4	4	5	6	3	4	4	6	4	4	4
3	F	4	5	5	3	4	6	6	4	3	5	5	5	4	6	6	5	4	3	5	5
4	F	4	4	4	3	4	4	5	5	3	3	4	4	4	4	4	4	4	4	4	4
5	F	4	3	4	1	2	3	4	4	2	2	3	3	3	1	2	3	4	4	3	4
6	F	4	4	4	2	4	4	4	4	2	3	4	4	4	3	4	4	4	4	4	4
7	M	5	6	4	3	4	6	6	5	2	5	5	4	4	5	6	5	6	4	5	5
8	M	6	6	6	5	5	6	6	6	6	6	6	6	6	6	6	5	6	5	6	6
9	M	5	5	4	3	3	4	4	5	3	4	2	5	4	3	4	5	5	5	4	5
10	M	3	6	3	3	3	6	4	4	4	4	4	4	3	4	6	3	6	3	4	3
11	M	5	5	3	3	3	4	4	4	3	4	4	4	4	2	4	4	4	4	4	4
12	F	3	4	4	3	3	3	2	3	3	3	3	3	3	3	4	3	3	4	3	3
13	F	6	6	5	4	5	6	6	4	4	6	6	5	6	5	5	5	6	5	5	6
14	M	5	5	4	2	3	5	6	4	2	3	4	4	3	2	5	3	5	2	4	5
15	F	4	4	5	1	4	5	5	4	3	2	4	4	4	1	2	4	4	5	4	4
16	F	3	3	3	3	1	3	3	4	3	3	3	3	3	3	3	3	3	3	3	3
17	M	5	5	5	3	4	6	4	4	3	4	4	6	5	5	5	5	5	6	5	5
18	F	6	6	6	6	6	6	6	6	4	5	6	6	5	5	5	5	5	6	6	6
19	M	4	4	4	2	3	4	4	5	3	3	4	3	3	2	2	3	4	4	3.5	4
20	F	6	5	5	5	5	6	5	6	5	5	5	6	6	6	6	5	6	5	5	5
21	F	5	5	5	5	5	5	5	5	3	4	5	6	6	5	5	5	5	6	5	5
22	F	4	4	5	3	4	6	5	6	4	6	5	5	6	5	6	5	6	6	5	6
23	M	6	3	3	4	3	4	2	4	3	3	3	4	4	2	5	3	4	5	3.5	3
24	F	4	4	4	3	3	3	4	4	3	3	4	4	4	3	4	4	4	6	4	4
25	F	3	4	3	3	3	4	4	4	3	3	3	4	4	3	4	3	4	3	3	3
26	F	4	4	3	1	3	4	3	4	4	3	3	4	4	3	3	3	4	6	3.5	4
27	M	4	4	2	2	1	3	2	2	2	4	2	2	4	5	1	1	2	1	2	2
28	F	4	4	4	3	3	4	4	4	2	4	4	4	4	4	4	4	4	4	4	4
Median		4	4.5	4	3	3	4	4	4	3	4	4	4	4	3.5	4	4	4	4	4	4
Mode		4	4	4	3	3	4	4	4	3	3	4	4	4	3	4	5	4	4	4	4

In order to maintain meaningful and complete attitude scores the researcher used median scores instead of mean scores. While a mean score might allow for an easier interpretation (i.e., the mean was somewhere between *Strongly Agree* to *Agree*), the mean was inherently meaningless with this Likert-type scale. For a Likert-type scale, data cannot be treated as an interval data as the distances between points on the scale are not equal (Cash, 2010). As Likert-type scale data are ordinal in nature, the researcher used median and mode scores to interpret the non-parametric ordinal data. An overall measure of the median attitude and median perceived effectiveness scores is shown in Table 16.

Table 16
Descriptive Statistics of Median Attitude and Median Perceived Effectiveness Scores

	Median Attitude Scores	Median Perceived Effectiveness
Valid N	28	28
Mean	4.1786	4.1250
Median	4.0000	4.0000
Mode	4.00	4.00
Std. Deviation	.95466	.92921

Descriptive statistics of these median attitude scores yielded a mean, median, and mode of 4.18, 4.0, and 4.0 respectively with a standard deviation of 0.95. This indicates that the typical response of participants corresponds to slightly more than agreement that they held a positive attitude toward the blogging activity in the College Euclidean Geometry course. Similarly, descriptive statistics of the median perceived effectiveness scores yielded a mean, median, and mode of 4.13, 4.0, and 4.0 respectively with a standard deviation of 0.93, indicating that the typical response of participants corresponds to slightly more than agreement that the blogging activity was an effective means of teaching and learning Euclidean Geometry.

Results Specific to the Research Questions

Results of Research Question 1a

Research Question 1a: *Are there significant differences by gender with regard to preservice mathematics teachers' attitudes toward the blogging activity in a college Euclidean Geometry course?*

Table 17
Median Attitude Scores by Gender

Male Participants	Female Participants
6	4
6	4
5	3
5	4
4	3
5	4
4	3
4	3
4.5	6
4	5
3.5	4
2	5
	4
	4
	4
	4
N = 12	N = 16

The data for Research question 1a was analyzed using a non-parametric Wilcoxon-Mann-Whitney U test on the median attitude scores by gender (Table 17). The Wilcoxon-Mann-Whitney U test result indicated a non-significant difference ($N = 28$, $U = 68.0$, $p > .05$) that failed to reject the null hypothesis that the median attitudes of the

participants did not differ in terms of their gender in using the blogging activity as a supportive teaching-learning tool in a College Euclidean Geometry course (Table 18).

Table 18
Wilcoxon-Mann-Whitney U Test Statistics for Attitude Scores on Participants' Gender

	Median Attitudes
Mann-Whitney U	68.000
Z	-1.377
Asymp. Sig. (2-tailed)	.169
Exact Sig. [2*(1-tailed Sig.)]	.205[a]

a. Not corrected for ties.

This means that the study did not find any significant difference in the median attitude scores of the participants in terms of their gender in using the blogging activity as a supportive teaching-learning tool in a College Euclidean Geometry course.

Again, based on the ranks of the median attitude scores by gender (Table 19), it was determined that male participants had a mean rank of 16.83 and the female participants had a mean rank of 12.75 for their attitudes toward the use of a blogging activity as a supportive teaching-learning tool in a college Euclidean Geometry course. The difference in these means was not significant.

Table 19
Ranks of the Median Attitude Scores by Gender

Gender	N	Mean Rank	Sum of Ranks
Male	12	16.83	202.00
Female	16	12.75	204.00
Total	28		

Results of Research Question 1b

Research Question 1b: *Are there significant differences by gender with regard to preservice mathematics teachers' perceived effectiveness of the blog for the learning of Euclidean Geometry?*

Table 20
Median Perceived Effectiveness Scores by Gender

Male Participants	Female Participants
4	5
4	4
5	3
6	4
4	3
4	5
4	4
4	3
5	6
3.5	5
3.5	5
2	5
	4
	3
	3.5
	4
N = 12	N = 16

The data for Research question 1b was analyzed using a non-parametric Wilcoxon-Mann-Whitney U test on the median perceived effectiveness scores by gender (Table 20). The Wilcoxon-Mann-Whitney U test result indicated a non-significant difference ($N = 28$, $U = 94.50$, $p > .05$) that failed to reject the null hypothesis that the median perceived effectiveness of the blog for the learning of Euclidean Geometry did not differ significantly in terms of the gender of the participants (Table 21).

Table 21
Wilcoxon-Mann-Whitney U Test Statistics for Perceived Effectiveness Scores on Participants' Gender

	Median Perceived Effectiveness
Mann-Whitney U	94.500
Z	-.073
Asymp. Sig. (2-tailed)	.942
Exact Sig. [2*(1-tailed Sig.)]	.945[a]

a. Not corrected for ties.

This means that the study did not find any significant difference in the median perceived effectiveness scores of the blog for the learning of Euclidean Geometry in terms of the gender of the participants. Again, based on the ranks of the median perceived effectiveness scores by gender (Table 22), it was determined that the male participants had a mean rank of 14.38 and the female participants had a mean rank of 14.59 in the perceived effectiveness of the blog for the learning of Euclidean Geometry. The difference in these means was not significant.

Table 22
Ranks of the Median Perceived Effectiveness Scores by Gender

Gender	N	Mean Rank	Sum of Ranks
Male	12	14.38	172.50
Female	16	14.59	233.50
Total	28		

Results of Research Question 2a

Research Question 2a: *Do preservice teachers who report spending more time on the Internet differ significantly from those who report spending less time on the Internet*

with regard to their attitudes toward the blogging activity in a college Euclidean Geometry course?

Table 23
Median Attitude Scores by Time Spent on the Internet

<21 hours /week	≥21 hours /week
4.0	6.0
4.0	6.0
3.0	5.0
4.0	4.0
5.0	4.0
5.0	3.0
4.0	4.5
3.0	6.0
4.0	5.0
3.0	4.0
4.0	5.0
3.5	4.0
4.0	2.0
4.0	4.0
N = 14	N = 14

The data for Research question 2a was analyzed using a non-parametric Wilcoxon-Mann-Whitney U test on the participants' median attitude scores by their self-reported total time spent on the Internet per week (Table 23).

Table 24
Wilcoxon-Mann-Whitney U Test Statistics on Participants' Median Attitude Scores on their Total Time Spent on the Internet per week

	Median Attitudes
Mann-Whitney U	61.500
Z	-1.777
Asymp. Sig. (2-tailed)	.076
Exact Sig. [2*(1-tailed Sig.)]	.094[a]

a. Not corrected for ties.

The Wilcoxon-Mann-Whitney U test result indicated a non-significant difference ($N = 28$, $U = 61.50$, $p > .05$) that failed to reject the null hypothesis that the median attitudes of the participants, in using the blogging activity as a supportive teaching-learning tool in a College Euclidean Geometry course, did not differ in terms of their self-reported total time spent on the Internet per week (Table 24).

This means that the study did not find any significant difference in the median attitude scores of the participants, in terms of their self-reported total time spent on the Internet per week. Again, based on the ranks of the median attitude scores by time spent on the Internet (Table 25), it was determined that the participants who spent less than 21 hours on the Internet per week had a mean rank of 11.89 and the participants who spent equal or more than 21 hours on the Internet per week had a mean rank of 17.11 in their attitudes toward using the blogging activity as a supportive teaching-learning tool in a College Euclidean Geometry course. The mean ranks of attitudes were relatively different; however, this difference was not significant.

Table 25
Ranks of the Median Attitude Scores by Time Spent on the Internet

Group by Time Spent on the Internet	N	Mean Rank	Sum of Ranks
<21 hours per week	14	11.89	166.50
>=21 hours per week	14	17.11	239.50
Total	28		

Results of Research Question 2b

Research Question 2b: *Do preservice teachers who report spending more time on the Internet differ significantly from those who report spending less time on the Internet*

with regard to their perceived effectiveness of the blog for the learning of Euclidean Geometry?

Table 26
Median Perceived Effectiveness Scores by Time Spent on the Internet

<21 hours /week	≥21 hours /week
5.0	4.0
4.0	4.0
3.0	6.0
4.0	4.0
5.0	5.0
4.0	4.0
4.0	5.0
3.0	6.0
4.0	5.0
3.0	5.0
3.5	5.0
3.5	3.5
4.0	2.0
3.0	4.0
N = 14	N = 14

The data for Research question 2b was analyzed using a non-parametric Wilcoxon-Mann-Whitney U test on the participants' median perceived effectiveness by their self-reported total time spent on the Internet per week (Table 26).

Table 27
Wilcoxon-Mann-Whitney U Test Statistics for Median Perceived Effectiveness Scores on Total Time Spent on the Internet per week

	Median Perceived Effectiveness
Mann-Whitney U	53.000
Z	-2.155
Asymp. Sig. (2-tailed)	.031
Exact Sig. [2*(1-tailed Sig.)]	.039[a]

a. Not corrected for ties.

The Wilcoxon-Mann-Whitney U test result indicated a significant difference (N = 28, U = 53.00, p <.05) that rejected the null hypothesis that the median perceived effectiveness of the blog for the learning of Euclidean Geometry did not differ in terms of the participants' self-reported total time spent on the Internet per week (Table 27).

This means that the study found a significant difference in the participants' median perceived effectiveness scores in terms of their self-reported total time spent on the Internet per week. Again, based on the ranks of the median perceived effectiveness scores by time spent on the Internet (Table 28), it was determined that the participants who spent less than 21 hours on the Internet per week had a mean rank of 11.29 and participants who spent 21 or more hours on the Internet per week had a mean rank of 17.71 in their perceived effectiveness of the blog for the learning of Euclidean Geometry. These mean ranks were deemed to be significantly different. This indicated that participants who spent more time on the Internet perceived better effectiveness of the blogging activity as a supportive tool for the learning of Euclidean Geometry than participants who spent less time on the Internet.

Table 28
Ranks of the Median Perceived Effectiveness Scores by Time Spent on the Internet

Group by Time Spent on the Internet	N	Mean Rank	Sum of Ranks
<21 hours per week	14	11.29	158.00
>=21 hours per week	14	17.71	248.00
Total	28		

Results of Research Question 3a

Research Question 3a: *Is there a relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry*

course and their attitudes toward the blogging activity in a college Euclidean Geometry course?

The data for Research question 3a was analyzed by calculating a non-parametric Spearman correlation r on cumulative quiz scores and median attitude scores (Table 29).

Table 29
Cumulative Quiz Scores vs. Median Attitude Scores

Cumulative Quiz Scores	Median Attitude Scores
74.5	6.0
77.5	6.0
73.0	4.0
80.0	4.0
76.0	3.0
66.5	4.0
70.0	5.0
49.0	5.0
64.0	4.0
33.0	5.0
58.5	4.0
78.0	3.0
72.5	4.0
70.5	4.0
69.5	3.0
65.0	3.0
58.5	4.5
64.5	6.0
65.5	4.0
73.5	5.0
67.5	4.0
73.0	5.0
77.0	3.5
60.5	4.0
68.5	4.0
72.5	4.0
70.5	2.0
72.0	4.0
N = 28	N = 28

The Spearman correlation test result indicated a non-significant correlation (N = 28, r_s = -0.145, p >.05) that failed to reject the null hypothesis that there is no relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry course and their attitudes toward the blogging activity in a college Euclidean Geometry course (Table 30).

This means that the study did not find a significant correlation between attitudes toward the blog and total quiz score measured by eight in-class quizzes.

Table 30
Spearman Correlation Test Results on Median Attitude Scores

Spearman's rho		Cumulative Quiz Score	r_s
Cumulative Quiz Score	Correlation Coefficient	1.000	-.145
	Sig. (2-tailed)	.	.461
	N	28	28
Median Attitudes	Correlation Coefficient	-.145	1.000
	Sig. (2-tailed)	.461	.
	N	28	28

Results of Research Question 3b

Research Question 3b: *Is there a relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry course and their perceptions of the effectiveness of the blog for the learning of Euclidean Geometry?*

The data for Research question 3b was analyzed by calculating a non-parametric Spearman correlation r on cumulative quiz scores and median perceived effectiveness scores (Table 31).

Table 31
Cumulative Quiz Scores vs. Median Perceived Effectiveness Scores

Cumulative Quiz Scores	Median Perceived Effectiveness Scores
74.5	4.0
77.5	4.0
73.0	5.0
80.0	4.0
76.0	3.0
66.5	4.0
70.0	5.0
49.0	6.0
64.0	4.0
33.0	4.0
58.5	4.0
78.0	3.0
72.5	5.0
70.5	4.0
69.5	4.0
65.0	3.0
58.5	5.0
64.5	6.0
65.5	3.5
73.5	5.0
67.5	5.0
73.0	5.0
77.0	3.5
60.5	4.0
68.5	3.0
72.5	3.5
70.5	2.0
72.0	4.0
N = 28	N = 28

The Spearman correlation test result indicated a non-significant correlation (N = 28, r_s = -0.232, p >.05) that failed to reject the null hypothesis that there is no relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry course and their perceptions of the effectiveness of the blog for the learning of Euclidean Geometry (Table 32).

This means that the study did not find a significant correlation between perceived effectiveness of the blog and total quiz score measured by eight in-class quizzes.

Table 32
Spearman Correlation Test Results on Median Perceived Effectiveness Scores

Spearman's rho		Cumulative Quiz Score	r_s
Cumulative Quiz Score	Correlation Coefficient	1.000	-.232
	Sig. (2-tailed)	.	.235
	N	28	28
Median Effectiveness	Correlation Coefficient	-.232	1.000
	Sig. (2-tailed)	.235	.
	N	28	28

Results of Research Question 4

The first qualitative research question investigated in this study was Research Question 4: *What do preservice secondary mathematics teachers perceive as the advantages and disadvantages of using a blog as a supportive tool in a Euclidean Geometry course?*

This question focused on the advantages and disadvantages of using blogs as supportive tools in a Euclidean Geometry course. Data for this question were collected through two separate open-ended items: *What were the advantages of this blogging activity?* and *What were the disadvantages of this blogging activity?* These questions are item 42 and 43 of the survey instrument, respectively (Appendix A).

All of the respondents typed their response to each of these questions, based on their practical experience in participating in the blogging activity over a period of 12 weeks. Although data were collected from individual participants, themes related to the advantages and disadvantages of the blogging activity in the Euclidean Geometry course were reported.

The participants in the 12-week long blogging activities found a number of advantages and some minor problems, with no major disadvantages, of using the blog as a supportive tool in a Euclidean Geometry course. While coding this portion of the qualitative data with MAXQDA ten major themes related to advantages and six major themes related to the disadvantage/problems of using the blogging activity as a supportive tool in the college Euclidean Geometry course were found. However, five major themes related to some minor problems of using the free blog, reported by

participants, were found. Each of these major themes was labeled by two or more in vivo codes (actual word or phrase used by one or more of the participants), called subthemes. This was done in order to preserve the actual words used by the participating preservice mathematics teachers in describing particular advantages or disadvantages/problems of using the blogging activity as a supportive tool in a Euclidean Geometry course. These themes were not independent of one another, but instead show interconnected aspects of an overall phenomenon.

Advantages of the Blogging Activity

Table 33 depicts the themes and subthemes related to the major advantages of the blogging activity in the Euclidean Geometry course, taken from the survey data. The table also delineates the subthemes, which emerged within the major themes.

Table 33
Themes and Subthemes Related to the Major Advantages of the Blogging Activity

Themes	Subthemes (in vivo codes)
24/7 Accessible	Anytime accessible, anywhere accessible
Alternative Source	Alternative solution, another resource, easier solution
Collaborative	Collaborative, interact, correct each other's mistake
Convenient	Easy to use, effective, familiar,
Enjoyable	Enjoyed, excited, interest
Encouraging	Forced to think, showing to integrate technology
Engaging	It was engaging, exposed to analyze more
Getting Feedback	Feedback, positive critique
Safe and Secured	Anonymous, pseudonym, privacy, security
Technology Savvy	More technology savvy, it was technology savvy

Figure 2 depicts the major advantages of the blogging activity drawn by the *MAXMaps* feature of MAXQDA.

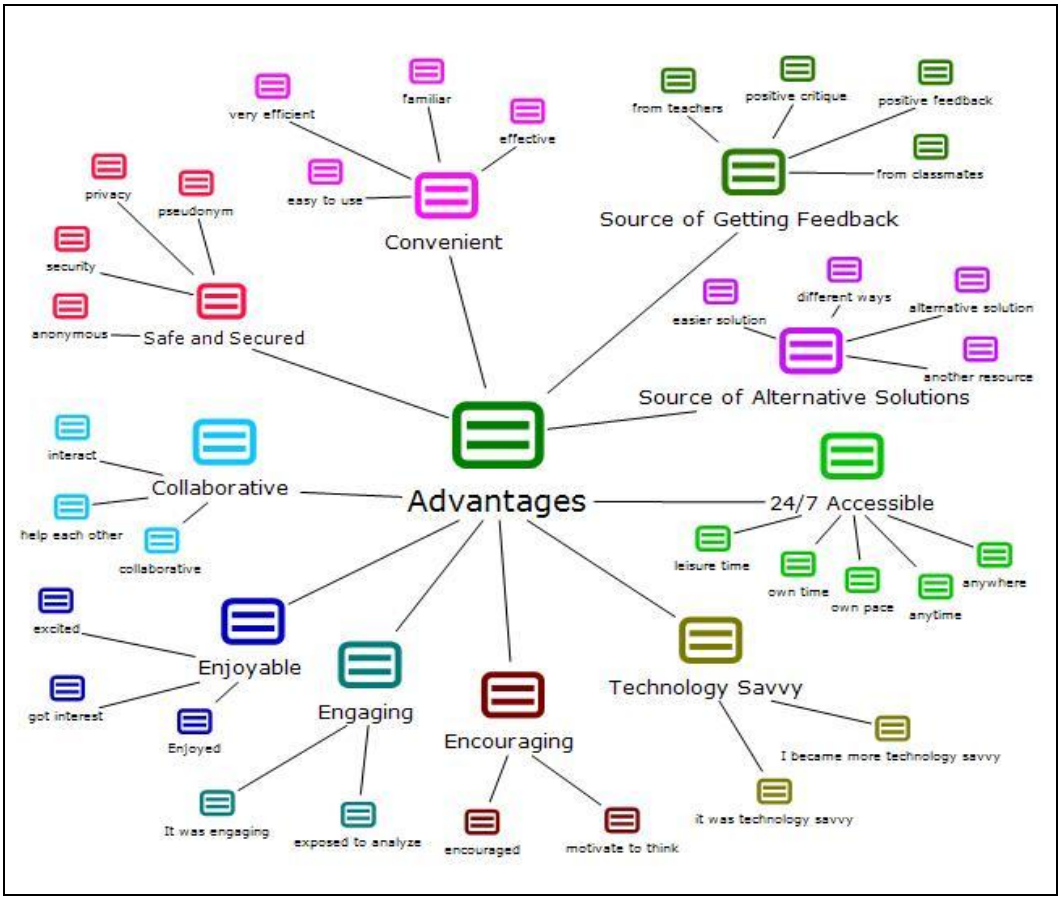

Figure 2. Major Advantages of the Blogging Activity

The following section describes the major advantages of using the blogging activity as a supportive tool in a Euclidean Geometry course. Participants' pseudonyms are used throughout this discussion.

24/7 Accessible. Anytime and anywhere accessibility was one of the most common advantages of the blog that most of the participants reported. They found the blog accessible through their computers, laptops, iPods, and iPhones on a 24/7 basis. One

male participant *Nevadatude* mentioned, “One of the advantages [of the blog] was the ability to check what you need to do anytime anywhere.” Another female participant, *Wally,* elaborated on her similar experience, “I was able to work on it anytime throughout the week. It was different than other activities I have done in the past, which was cool. It is a more modern way to engage students.” While another male participant, *Reynold,* mentioned, “Having the ability to discuss questions and post comments at any time throughout course was very beneficial.” Another male participant, *Heron,* noted, “You could post or reply as things occurred to you, at your own pace.” That was supported by another male participant’s note, “I can take as much time as I need.” (Batman); and two other female participants’ notes, “I could post comments/discussions at my leisure time.” (Pythagoras); and “I was able to do this on my own time.” (Giggles)

Alternative Source. The participants found the blogging activity to be an alternative source of getting different or easier solutions to the problems they attempted to solve. One female participant, *Twoqayl,* noted, “I think that the blogging activity helped students find different ways to solve problems.” While another female participant, *Giggles*, reported, “This [blogging activity] offered another resource to practice from.” Another male participant, *Ricky Martin,* mentioned, “If I didn’t know how to complete a problem, I could look at how other students answered it on the blog.” Another female participant, *Scooter,* noted, “It [blogging] was an interactive activity outside of class which allowed students to apply what they had learned and found errors or alternative solutions on others’ work.” While according to another male participant, *Nevadatude*, “Another benefit was the different ways of solving problems which allowed me to find an

easier solution. I also thought that the blog allowed me to get a better feel of the students in my class. Another benefit is if a tutor needed a reference to help a student in the class the tutor could refer to the blog to help."

Collaborative. The participants found the blogging activity to be a collaborative platform for effective communication with the instructor and other participants in the course. One female participant, *MathTeach,* commented, "It was a different way to incorporate collaboration of classmates. The feedback given from other students to my solutions was helpful to my future teaching techniques." Another female participant, *Scooter,* elaborated, "We were exposed to a variety of problems relating to Geometry. We were presented with alternative methods in solving, as well as different reasoning procedures. We were forced to think through our solving process and analyze and critique others." While another male participant, *Walter Sobchok,* noted, "The ability to interact with classmates and correct each other's mistakes or comment on solutions was an advantage."

Convenient. The participants found the blog to be an easy and effective tool for learning and practicing Euclidean Geometry. One male participant, *Erdos,* noted, "It was very accessible; and the means of blogging was very efficient." Another female participant, *Scooter,* narrated, "It [blogging] was an interactive activity outside of class which allowed students to apply what they had learned and found errors or alternative solutions on others' work. It was easy, accessible, and effective." While another male participant, *Erdos,* elaborated, "Students were used to the [blogging] technology and were excited when they incorporated something they were familiar and skilled with to

something they were learning. This technology has so much potential and efficiency, if it utilized correctly, it can be such a useful tool."

Enjoyable. The participants found the blogging activity to be an enjoyable learning tool. One male participant, *Erdos*, commented, "I enjoyed the connection to modern media. I think it helped to hold student-centered discussion." He also noted:

> Students are used to this technology and are excited when they incorporate something they are familiar and skilled with to something they are learning. This technology has so much potential and efficiency, if it utilized correctly, it can be such a useful tool.

While another male participant, *Razor,* noted, "I think it would work to the interest of most students."

Encouraging. The participants found the blogging activity to be a means of encouraging themselves for being active participants. One female participant, *Scooter,* commented, "We were forced [ourselves] to think through our solving process and analyze and critique others." Another female participant, *Eamesor,* reported, "Showing us all as future educators another way to integrate technology into the classroom." While a male participant, *Razor,* reported, "Getting a grade based on the future activity rather than just one problem enforced the advantage of learning from the activity."

Engaging. The participants found the blogging activity to be an engaging tool of learning Euclidean Geometry. One female participant, *Nemo,* commented, "It provided more examples to problems, it was engaging, because it was online I liked that the activity was continuous all the way through the semester. It was not difficult to figure

out." Another female participant, *Winnifred*, stated, "This blogging activity was great for preparing for quizzes. The questions were very similar to those we did in class and saw on the quizzes. It also allowed me to talk what topics related to education, but not necessarily Geometry." Another female participant, *Scooter,* elaborated, "We were exposed to a variety of problems relating to Geometry. We were presented with alternative methods in solving, as well as different reasoning procedures." While another female participant, *Sam's*, comment was concise but very notable, "It made me analyze the chapter problems more."

Getting Feedback from Others. Getting feedback from fellow classmates' on the blog was important to the participants. One male participant, *Reynold,* mentioned, "It's very useful to have feedback from fellow classmates along with feedback from the teachers." Another female participant, *Twoqayl,* noted, "I think that the blogging activity … also helped students come up with ways to positively critique other student's answer and thoughtfully reply to questions." While another male participant, *Razor,* stated his similar experience, "The main advantage was doing a problem and getting feedback from classmates."

Safe and Secured. The impersonal nature of the blogging activity was considered to be a great advantage to many participants. Due to using pseudonyms instead of their actual names, the participants found the blog to be a safe and secured platform to express their opinions anonymously. One female participant, *Pythagoras,* reported, "No one knew my pseudonym so if I got something wrong it wouldn't directly link back to me." While another female participant, *Justin,* stated it concisely, "Not shy about speaking out

since pseudonyms." Another male participant, *Erdos,* noted, "It [blog] allowed for privacy and security for students."

Technology Savvy. The blogging activity not only required a certain level of technology savvy from participants, it also, served to improve the level of technological savvy of many of them. One female participant, *Justin,* reported, "[With the blogging activity] I became more technology savvy." While another female participant, *Woohoo,* commented, "[The blogging activity was] convenient, easy, [and] more technology savvy."

Disadvantages/Problems of the Blogging Activity

Most of the participants did not find any major disadvantage of the blogging activity as a supportive tool in a Euclidean Geometry course. However, some participants found and reported some minor problems of using the blog as a supportive tool in a Euclidean Geometry course.

Table 34

Themes and Subthemes Related to the Major Disadvantages/Problems of the Blogging Activity

Themes	Subthemes (in vivo codes)
No Disadvantage	None, no disadvantage, no problem
Difficult for New Bloggers	Difficult to start, hard to follow, I was not sure
Difficulty in Using Geometric Notations	Could not add a picture, could not draw a figure, could not use symbols, difficult to write equations
Enforcing	Forced me to collaborate, personally got tired
Isolated	Boring, I did not get interest, no one there to help
Personal Dislike	I did not like blogging, I do not like criticize others

Table 34 delineates the major themes related to the disadvantages/problems of the blogging activity in the Euclidean Geometry course, taken from the survey data. The table also delineates the subthemes that emerged within these major themes. The following figure depicts the major disadvantages/problems found in the blogging activity drawn by the *MAXMaps* feature of MAXQDA.

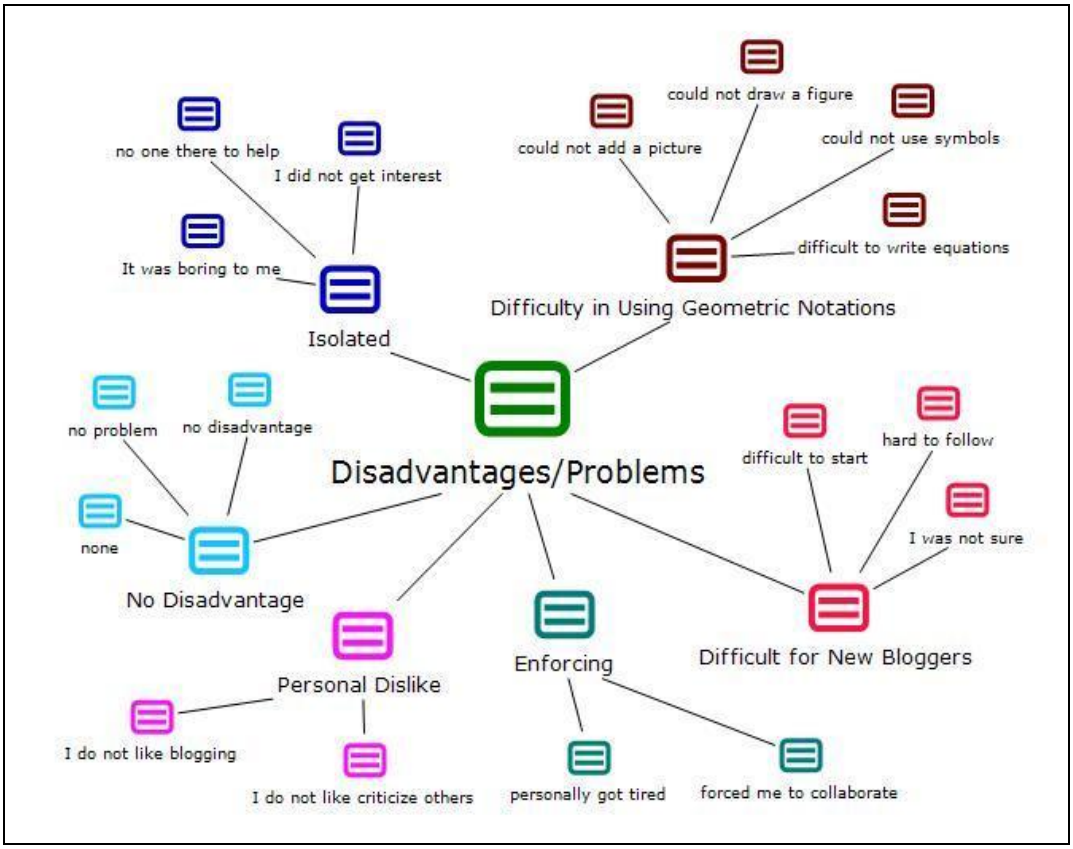

Figure 3. Major Disadvantages/Problems of the Blogging Activity

The following section describes the major disadvantages/problems of using the blogging activity as a supportive tool in a Euclidean Geometry course. The presentation includes representative excerpts from participant responses, along with the corresponding respondent's pseudonym either in italicized format or in the parentheses.

No Disadvantage. In response to the question: What were the disadvantages of this blogging activity? One male participant, *Ricky Martin,* commented, "None, really." Another female participant, *Twoqayl,* noted, "There were really no practical disadvantages that I can see." Another female participant, *Winnifred,* noted, "The blogging activity was time consuming but not difficult. Surprisingly, access to submitting limited number of solutions and comments was also considered as a limitation to a participant. While another female participant, *Nemo,* noted, "The only disadvantage is that students were not getting practice with all different types of problems. We were only shown two different week's problems." Thus, it seemed that the participants would like to participate and spend more time on the blogging activity.

Difficult for New Bloggers. Some participants who did not have previous experience in blogging had difficulty starting up with the blog and writing comments. One female participant, *Jane Doe,* noted, "Substantive comments were hard for me to do. I was never sure how to do them and I didn't know what to write." Another female participant, *Fertis McCertis,* noted, "The discussion was hard to follow, would have been easier if the threads were separated."

Difficulty in Using Mathematics Notations. Inserting mathematical symbols and equations was a limitation mentioned with regard to the free blog used in this study. This difficulty was found to be a considerable problem to some participants. One female participant, *MathTeach,* noted, "The blog didn't allow me to draw a diagram of the word problems in my solution. It made it difficult to articulate my ideas clearly." While another female participant, *Pythagoras,* noted, "Typing math equations on the blog was difficult."

Enforcing. Working with other students in their groups and doing so in a timely manner were mentioned as one kind of enforcement or pressure to a few participants. One female participant, *Fertis McCertis,* noted, "[The blogging activity] forced me to collaborate with other students in the class and solve problems together." Another male participant, *Razor,* elaborated:

> There were several students who were almost too critical of our answers. Some participants didn't give everyone an opportunity to leave comments. I personally got tired of reading some participants' comments on every set of problems. This made me not want to even go to the blog page.

Isolated. A few participants did not like the insulated nature of the blogging activity as they considered it to be an isolated activity. One male participant, *Batman,* noted, "There was no one there to help me if I had a problem." Another female participant, *Justin,* noted, "No interaction if you cannot figure it out, you can't ask teacher." Another female participant, *Giggles,* noted, "I could not talk to people face to face and interact on paper." While another female participant, *Mathgirl,* noted, "I would rather give face to face explanations so I can see the other persons understanding or not."

Personal Dislike. Some participants did not like the impersonal nature of the blogging activity. One female participant, *Mathgirl,* noted, "I personally did not like this kind of learning tool." Another female participant, *Sam,* noted, "I did not like commenting on other students work. I don't like the impersonal nature of the blog discussions." Another female participant, *Wally,* noted, "I did not like commenting on

other students answer, because it comes across as rude. If you give an alternative answer it can be difficult to do it in a way that adds to the problem."

Results of Research Question 5

The second qualitative research question investigated in this study was Research Question 5: *What trends emerge in the analysis of preservice secondary mathematics teachers' contributions to an online discussion board on a blog used in a college Euclidean Geometry course?* Data for this research question was collected through participants' self-contributed postings to the online discussion board on the blog. The web address of the online discussion board was: http://edsc353fall2011.wordpress.com/discussion-board/

There were 174 responses with 66 threads on the discussion board during the 12-week activity. MAXQDA, a qualitative data analysis software, was used to identify the emerging trends in posted blogs by students. While coding this portion of qualitative data with MAXQDA, approximately twenty major themes of the discussion topics were revealed. Each of the major themes raised on the participant discussion was labeled by two or more in vivo codes (actual word or phrase used by one or more of the participants), called subthemes. This was done in order to preserve the words used by the participants regarding the discussion topics. These themes are not independent of one another; instead, they are interconnected aspects of an individual overall phenomenon.

Major Themes Emerged on the Discussion Board of the Blog

Table 35 depicts the themes and subthemes of major trends that emerged on the discussion board of the blog, taken from the survey data. The table also delineates the subthemes that emerged within the major themes.

Table 35
Themes and Subthemes of Major Trends that Emerged in the Discussion Board

Themes	Subthemes (in vivo codes)
Geometry in Real-life	Geometry in real life, real world, real situation, everyday
Difficulties in Geometry	Barriers, difficulty, hard, problem, struggle
Interest on Geometry	Interest on Geometry, like Geometry, love Geometry
Teaching-Learning Geometry	Teaching Geometry, learning Geometry
Hands-on Activities	Hands-on activities, hands-on learning, hands-on techniques
Drill and Kill Methods	Drill and kill, kill and drill
Using Formula Sheets	Making formula sheet, using formula sheet
Creating Lesson Plans	Lesson plan, lecture sheet, lesson sheet
Test Creation Strategies	Test creation, test making, standardized tests
Grading Policy	Grading policy, no points, partial points, full points,
Word Problems	Difficulties, importance, understanding word problems
Career Plan	Career plan, career goal, master's, PhD degree
Payment and Benefits	Benefits, incentives, payment, salary
Self-motivation	Self-motivation, self-satisfaction, motivated
Professionalism	Professionalism, professional life, personal life
Overloaded Homework	Assignment, homework, classwork
Use of Smart Board	Smart board, overhead projector, new technology
Math Jokes	Math jokes, fun, fallacies
Mathematics Websites	Mathematics programs, software, websites

The following figure depicts the major trends that emerged in the online discussion board of the blogging activity, drawn by the *MAXMaps* feature of MAXQDA.

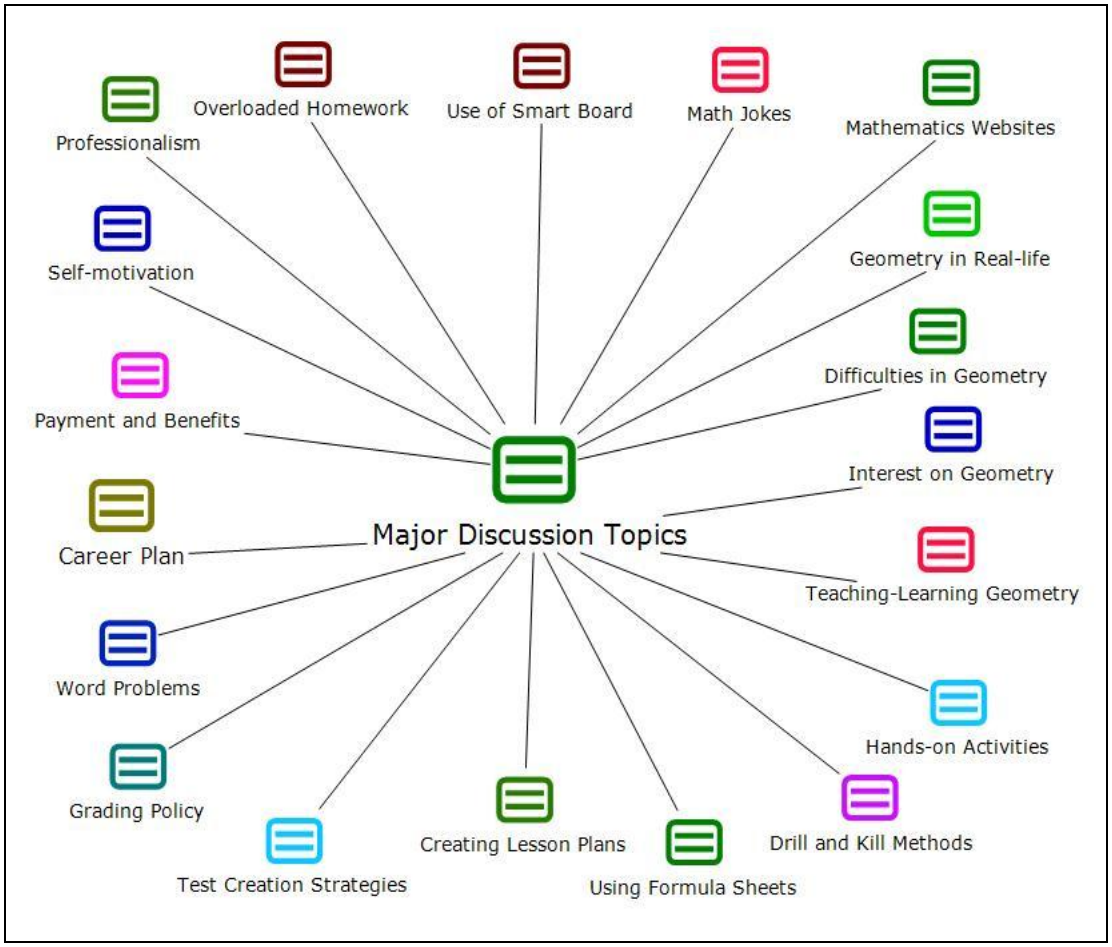

Figure 4. Major Trends that Emerged in the Discussion Board of the Blog

The following section uses participant's pseudonyms and describes the major themes raised on the discussion topics.

Geometry in Real-life. Preservice mathematics teachers realize that Geometry is a branch of math that is all around them. They feel that Geometry is one of those subjects that can easily be applied to real life situations. A female participant, *Twoqayl,* raised this

topic as follows, “Has there ever been a time where you have used Geometry in a real life situation when you were not planning to? Have any of you had any similar experiences?” Many of the participants liked this topic, as one female participant, *Nemo,* mentioned, “I definitely feel that Geometry is one of those subjects that can easily be applied to real life situations. This may make it not as hard to teach to students if we are able to link the mathematics to the real world.” While another female participant, *Sam,* mentioned, “There are a lot of jobs that require an understanding of Geometry.” Another male participant, *Razor,* mentioned, “In my previous career in construction management I was able to quickly check if 2 walls were square by measuring out a 3-4-5 ft triangle. There were several ‘quick’ checks that I was able to use to make sure we were on track.” *TacoTuesday*, a male participant, considered it as one of the best applications of Geometry in real life.

Another female participant, *Nemo,* mentioned, “I used Geometry the other day when I was trying to center my television that is mounted on the wall. Similar to the picture frame, if I just found the midpoint between two endpoints then I would know where to place the middle of my television.” *Giggles,* a female participant supported this idea, as she stated:

> I remember last summer my dad was putting in this fake tile floor and he had to measure out everything ahead of time to buy the correct amount of tile pieces. Then he had to cut and fit everything together. Even hanging a picture so it is straight involves Geometry.

The participant discussion continued with applications of Geometry in real life situations. Some preservice mathematics teachers believe that real life applications of Geometry should be stated in the mathematics textbooks much earlier than high school. According to a female participant, *Wally,* "High school students, in particular, want to know when they will use the [mathematical] information outside of class." Another female participant, *Fertis McCertis,* noted, "In math I think it is especially important to show students that math really does apply to everyday life."

Many of the female participants (e.g., Pythagoras, Sam, and Scooter) like the idea of having their students do a research assignment on how Geometry is used in the real world. That idea was supported by another female participant, *Scooter*, as she stated:

> I like [the] idea of having students do a research assignment on how Geometry is used in the real world. I think that assignment could be done across the board with the different levels and subjects of mathematics. I think it's important to give students opportunity to discover on their own how math applies to their everyday lives, instead of us just telling them.

Another male participant, *Ricky Martin,* raised a new thought as he mentioned:

> I just thought about skiing. Boots and bindings are built (in part) to keep your legs at certain angles relative to the skis, in the hopes of minimizing injury and making skiing easier. So if kids ever want to build ski equipment… In fact, just about all sports equipment is based on precise Geometry.

Interest on Geometry. A number of participants discussed their interest and enjoyment of Geometry. One male participant, *TacoTuesday,* mentioned, "I loved Geometry in High School. So far I don't think I have run into a math subject that didn't agree with me or me with it." While another female participant, *Giggles*, mentioned:

> I have always loved Geometry because it is math that you can visualize and even hold in your hand. It helps to learn concepts through hands-on activities so you can see why things work the way they do rather than just being told about certain abstract concepts.

Another female participant, *Justin,* mentioned:

> The reason I like [Geometry] is because there is always a set of ways (steps) to do a problem, and generally you always get one answer that you can double check and see if you are right. When it comes to proofs, there are many ways to attempt a problem. I like to have a set of ways of attempting a problem.

Difficulties in Geometry. A number of participants discussed difficulties inherent in teaching-learning Geometry, including personal reflections and potential ways to minimize these difficulties. One female participant, *Jane Doe,* raised the topic as follows:

> I have heard many students say that Geometry was the hardest math course that they had to take. Many times students are great at algebra but have trouble understanding Geometry. Did any of you experience this? And if so, is there any specific topic or section that you are most nervous to teach? Was there one area that you really struggled with?

Jane Doe went on to say, "When I took Geometry I struggled with proofs. It was my first experience with that kind of problem solving and it took me a while to understand how to do it." While another female participant, *Justin,* mentioned:

> I think I was one of these struggling students that over achieved in Calculus and Algebra; and had my biggest struggles with Geometry and Trigonometry. Now that I am older, I have a better understanding for it, and definitely do not have a fear of teaching it with the exception of proofs.

Another male participant, *Erdos,* mentioned:

> It's so difficult for teachers to not only teach how something is important, but why something is important. If we, as teachers can understand this… well, that has to be everything that we need to continue to pursue helping others.

Teaching-Learning Geometry. Some participants discussed their personal experience and opinion of teaching-learning strategies of Geometry. One female participant, *Justin,* mentioned, "I think when I teach Geometry, I will definitely try to create real life applications and use multiple strategies with my students to hopefully prevent more students from being lost." Another female participant, *Winnifred,* mentioned, "Creating real life applications for any math class is the most important thing a teacher can do to help students understand the material." While another female participant, *Sam,* presented her personal thought as follows, "I think the self-discovery approach in the context of a group activity, followed by teacher-led instruction would help enhance the learning of all students including ESL students or students who have learning difficulties." Another male participant, *Indiana,* elaborated:

> Explaining a real life situation where what we are learning that day could be used will help not only them but other students who hear the conversation that this work is not in vain. In addition, having thoughtful problems to solve that involve real life situations using the lessons of the week will reiterate my statements throughout the week that the lesson is worth understanding.

Hands-on Activities. A number of participants discussed various hands-on activities for teaching-learning Geometry. They also presented their views regarding how to create and use hands-on activities. One female participant, *MathTeach,* raised the topic as follows:

> How many of you are planning on using more hands-on techniques for lessons rather than textbook work? What do you think is gained by hands on lesson planning? How will it help your students grasp the concepts you are teaching? What kinds of lessons have you already thought of that incorporate this type of lesson?

While another female participant, *John Wayne,* gave anecdotal evidence stating her personal experience in developing and using hands-on activities, as she stated:

> I developed a few lessons last semester that are hands on. One was a math bingo game that was pretty cool. I had different bingo cards that were passed out to all the students. Then I randomly pulled an equation and the students had to find the missing variable. The answer was somewhere on their bingo card. The process was continued until someone gets a bingo. It's great for review.

A male participant, *TacoTuesday,* mentioned, “I like hands on learning.” Another female participant, *Winnifred,* mentioned, “I absolutely love hands on learning. I think I will use it as much as I possibly can when I start teaching.” Another male participant, *TheDude53,* elaborated:

> Hands-on projects and activities is a great way I think to get students to understand what they are doing. I do more hands-on things now that I am in college than I did when I was in high school. I wish I could go back to my Geometry class I took and do some of the activities that we have done in this class.

Another female participant, *Twoqayl,* supported this idea as she mentioned, “I do think that hands-on learning is important though, it’ll solidify their knowledge and give them confidence. I plan on using a lot of hands-on techniques in my classroom.” Another female participant, *John Wayne,* mentioned, “Not all people can learn from lecture, there are many people who learn through hands on experiences. Hands on activities help students visualize the concept they are trying to learn.”

While another male participant, *TacoTuesday,* presented his plan of developing and using hands-on activities in the future when he will be teaching. As he stated:

> I plan to use hands-on techniques in my classroom, but only if those hands are on a touch screen, or a smart board, or something else that can truly express the interrelated nature of these topics. I think that ‘conventional’ hands on methods

> are actually hurting math education, because they present the topic as being static and unrelated to anything outside that single example.

Drill and Kill Methods. A number of participants discussed the advantages and disadvantages of using drill and kill methods. One male participant, *Heron*, broached the topic as follows:

> I have an interesting conundrum. My practicum teacher is a proponent of the 'drill and kill' school of instruction. Pretty much every day, from bell to bell, he's working problems. The students take notes or do assignments from worksheets, with more problems. The notebooks are checked and graded frequently, along with homework. The busyness of his class seems to be a major component of his behavior management. Any thought?

A female participant, *Wally,* supported this method by stating, "I too like the traditional 'drill and kill' technique. I was able to learn with that method and enjoy it. In turn, I was successful and now want to teach math." Another female participant, *Twoqayl,* stated, "Personally, I think a lot of drill work is necessary and beneficial. I think it's an important life skill to get used to as well as being a good way to practice."

While another female participant, *Sam,* presented her personal experience in drill and kill methods as she stated:

> I also learned well with the 'kill and drill' technique, and I think, with math in particular, a lot of practice solving problems is necessary for successful learning. However, I think the most effective approach is to find a balance between using

> self-discovery investigations with students and providing sufficient time for them to practice solving the problems once a concept is learned. I think a combination of both approaches is going to lead to better results as far as students learning math.

However, some participants presented negative views of drill and kill methods. As one male participant, *Razor,* stated:

> After doing research for other classes I discovered that students that are taught using this method lack a deep, comprehensive understanding of the subject matter. Even if it raised test scores, it fails to help students truly grasp the key concepts. It may have worked for some of us but in general it does nothing but help students pass tests. I think that teachers who want to raise test scores must promote deep conceptual understanding of the subject matter. Getting practice in math does not need to be drill and kill.

Using Formula Sheets. Some participants discussed the importance of and their experience in using formula sheets for mathematics courses. One male participant, *Razor,* mentioned, "I was required by my Geometry teacher to have a small notebook to write all the formulas, proofs, postulates etc. It made it very easy to reference while working on practice problems." A female participant, *Scooter,* elaborated:

> One of our required education classes I created a 'formula sheet' rubric, which the students filled out each time a different formula were given. On that sheet, students fill out the name of the formula, where is it found (chapter or page in the book), the actual formula itself, an example of how it is used, and when and why

> we use it. Through this sheet, I believe students are given the opportunity to practically apply the math they are learning and discover why we use it.

Some female participants (e.g., Pythagoras, Sam) supported this idea. *Pythagoras* stated:

> Scooter, I really like your idea of the formula sheet with all the different sections for students to write in. I once had a math teacher who had a poster in the back of her class that had every part of our Algebra 2 class on it as well as a job/activity that required those skills. Whenever a student asked that question she sent them to look. I think that was clever but I honestly would have preferred your 'Formula Sheet'.

Another female participant, *Sam,* stated:

> What I support [is] the idea for encouraging students to develop a more comprehensive understanding of math formulas. As part of a class project, students could bind all the Formula Sheets they have completed, using the school's spiral binding machine. By this way students would have a reference guide of formulas, that they could use for future math classes as well as everyday real world problems they might encounter.

While a male participant, *Ricky Martin,* stated:

> I understand the argument that learning the formulas first makes it easier to figure out the word problems. But I still think there is something to be said for trying to get the students to 'discover' the formulas on their own by giving them time to work with a real life scenario. This way, they not only learn the formulas, but they

> also get comfortable figuring out the formulas as they need them in life. Not just memorizing.

A female participant, *Fertis McCertis,* stated anecdotal evidence:

> I have personally met and worked with foreign students who don't know much English and have recently come to the U.S. to start school. It would be a much smarter approach to put problems and formulas because I know that it's much easier for them to understand that rather than a complex word problem.

Creating Lesson Plans. Some participants discussed the importance of creating lesson plans and the strategies needed to do so in teaching Geometry. One female participant, *Jane Doe,* mentioned, "Creating lesson plans is the best way to not get overwhelmed. And as you become a more experienced teacher, the grading and planning will get easier." Another female participant, *Pythagoras,* elaborated:

> Lesson plans are supposed to be your best friend. They help you stay on track and make sure everything is getting done as planned. You may not even use an entire lesson plan but rather a guideline for the day to help you get through.

Test Creation Strategies. A number of participants discussed test creation strategies. One female participant, *Wally,* raised the issue as follows:

> Because we were given the question creation assignment, I have been thinking about the most effective way to create testing questions for students. Is it better to create questions directly based on homework assignments or should they be more challenging and combine multiple concepts or should they prepare them for

> standardized tests? Obviously, we can choose to combine the three, but are there advantages to one vs. another? Thought?

A male participant, *Ricky Martin,* presented his thought as follows:

> I guess it depends on what kind of test you are conducting. If it's a regular test for a grade, I don't think the questions should be harder than the homework/ classwork that they've seen. I think the time to pose more challenging questions is during class and homework. During tests, I think the questions should be as straightforward as possible, just to make it a fair assessment of the students.

While another female participant, *Scooter,* supported this as she elaborated:

> I also agree with Ricky Martin: Test questions should be a fair assessment and should be straightforward. There are a lot of students who get test anxiety and just can't seem to perform well on tests. However, we still want to challenge our students, so allowing them to experiment with more abstract problems would be beneficial to do as a class or with partners so that they are able to think through the problems together, using what they've learned from the material.

A number of male and female participants agreed with *Ricky Martin*'s thought. As one female participant, *MathTeach,* stated, "I agree with what you are saying. Maybe a challenge question could be considered for extra credit." Another female participant, *Scooter,* supported this as she stated, "I agree, challenge questions for extra credit is a great idea." A male participant, *Reynold,* agreed with this idea as he stated, "Making test

questions simple doesn't help the students at all. Expose students to some challenging questions and they will be able to approach the other questions with confidence."

Some female participants (e.g., Eamesor, MathTeach) agreed that tests should be based on homework assignments. *Eamesor* stated, "I definitely agree with how beneficial it is to be tested on something that we have actually worked with." *MathTeach* stated her personal experience as follows:

> I am currently in Calc 2 and my teacher creates test questions based on the homework assignments. This is beneficial to me, as a student, because it is easy to know what to study. I also believe that it makes her job easier by creating less work.

Another female participant, *Fertis McCertis,* presented a different thought as she stated:

> I think that the best math tests are the ones with a multiple choice section as well as a free response section. The multiple choice section would feature questions that are more calculation driven and the free response would feature questions that had more steps and could be more easily graded on a partial credit curriculum.

While another female participant, *MathTeach,* presented her well organized thought for creating a test based on standardized tests. As she stated:

> I don't know if I necessarily would create a test based on standardized tests, but possibly would consider those types of questions for a quiz. I just think that too much of what teachers teach on is based on the standardized tests. I would like to know if students understand the topics based on the county/state/country

standards that I have to follow as a teacher and what I deem worthy as an educator.

Grading Policy. A number of participants discussed grading policies that teachers use to assess students' tests and assignments. One female participant, *Jane Doe,* raised the issue as follows, "Should a [math] teacher award full-point on the assignments if students do the problems right but make simple math errors or should teachers only grade according to getting the right answers?" Participants considered this to be an important topic, as a number of participants joined in the discussion. One male participant, *Walter Sobchok,* mentioned, "This is a million dollar question." Most of the participants presented their views on partial credit for partially correct solutions based on students' understanding and presentation of the content on tests and assignments. While another male participant, *Heron,* mentioned, "I think it's a mistake to award full points for work that doesn't lead to a correct answer, but I think it's a bigger mistake to give a zero to a student who clearly understood the method and analysis required for a problem." Another male participant, *Walter Sobchok,* mentioned, "Personally, I am all for partial credit if a student shows a solid understanding of the concepts and methods, but simply misses the correct answer due a computational error."

One female participant, *Eamesor,* mentioned, "I actually think that teachers should give partial credit. Make it clear that you have to show your work, or if you do not have to show work make it a simple multiple choice answer and have the question worth less points. Another female participant, *John Wayne,* elaborated:

> I think partial credit should be given for showing correct work but obtaining the wrong answer. If the student understands the concept and did all the work correctly but accidentally made a subtraction error and obtained the wrong answer, I do not believe they should get a zero on the entire problem. However, if both the work and answer is wrong, then no point is obvious.

While some male participants (e.g., TheDude53, Heron, Walter Sobchok) agreed that it is really difficult for math teachers to grade students' tests and assignments identically; and they agreed that the grading system depends of the teachers' skill and expertise. *TheDude53* mentioned, "I think math is one of those subjects that are hard to grade because you know what you are looking for compared to someone else." *Heron* mentioned, "I think a tougher question is how much credit I should give for a correct answer, with no work shown." Another male participant, *Walter Sobchok,* mentioned, "The amount of zero/partial/full credit will vary from teacher to teacher depending on his/her belief system on the matter."

Finally, the participants recommended that math teachers should use rubrics during the grading process. As one female participant, *Winnifred,* suggested, "I would recommend having a rubric that clearly states how many points a student gets for doing the work completely (solving it for the correct answer and showing how they solved it)."

Word Problems. Some participants discussed the importance of understanding and solving word problems in Geometry and other mathematics courses and the

difficulties involved in this process. One male participant, *Walter Sobchok,* raised the issue as follows:

> Students' greatest struggles generally come with word problems and how to generate and formulate given the information they are presented. Given that this is the case, how could we expect our students to process the information and generate the formulas without prior experience simply processing the number problems and gaining that grasp of how the formulas work?

A female participant, *Scooter,* supported this issue by stating:

> I agree word problems are the most challenging for students, even for me. So, I think presenting the students with a real life situation and/or word problem in the beginning of the lecture, but not revealing necessarily how to solve it until the end will keep their interest, challenge them to find connections between the math/formulas and real-life situations, and provide clarity on how the math is applied and how to carry out applications.

While some participants presented their views that some textbooks have made the issue critical by presenting word problems in the wrong place in exercise and problem sets. *Ricky Martin,* a male participant stated, "In every math textbook I've ever had, the chapter starts out with the numbers, and word problems don't come about till the very end." He suggested that "word problems should be at the front of each chapter–learn context first, then there is a reason to learn the formulas." However, some participants presented different views. One female participant, *Pythagoras,* stated:

> I think the reason the chapters start out with numbers and lead into word problems is because the formulas and numbers are what your main lesson is, not necessarily the word problem. I just think it would be difficult to change the order of the textbook. If 'every math textbook' you have looked at is organized the same it must be working somehow.

Another female participant, *Winnifred,* supported this view by stating:

> Another problem I would have with giving word problems first is, what about the students who do not speak English fluently? If they cannot read the question properly, you cannot expect them to give you the right answer unless someone translated for them. With number problems and formulas first, they might be able to scan a problem and pull out the important numbers and deduct where that number goes in the formula.

Winnifred believes that "the books can be structured in any way, but it is up to the teacher to cover the material and give the students enough practice to understand/master the material." Another female participant, *Scooter,* presented a different thought to minimize this problem, as she stated:

> The teacher would present word problems at the beginning of class, introduce the math and formulas for the section (referring back to the word problem periodically throughout the lecture), and end the lecture by demonstrating how to solve the problems using the math that was just taught. That way the students have real world application throughout the lecture and are able to see how to apply math to solve problems.

Career Plan. A number of participants discussed their career plans and their ambition of achieving higher degrees and becoming math teachers. One female participant, *Mathgirl,* mentioned, "I personally want to earn a master's degree. Not for the pay benefit, however, for the chance to move into teaching college math." Another female participant, *Justin,* agreed with *Mathgirl* and stated:

> I agree with Mathgirl. I also want to get my Master's and then hopefully PhD in Math, so that I can teach at a university level. It's not for the extra income, it's just for the simple fact that I want to try teaching high school and college and see which I like better. I think after doing so many years of high school, I might be ready to move on and actually teach to those students who ENJOY math and choose to take it, rather than just fulfilling a requirement.

A male participant, *Reynold,* agreed with *Justin* and stated:

> I completely agree. I doubt any of us are going into teaching with money being the first thing they expect. I'm doing it to make some kind of impact on the students and because I enjoy math. I also would like to continue on and get a masters and perhaps a PhD, not necessarily for the job advancement or money, but because I would like to continue developing my own understanding in something I have a passion for.

While another male participant, *Walter Sobchok,* explained the fact elaborately as follows:

> I think a lot of it depends upon your personal aspirations moving forward in your career. If you are content with teaching at the secondary level for the duration of

> your career, then there may not be much incentive to further your education for any reason other than for your own self-satisfaction. Likewise, if you would like to pursue teaching at the college level, then furthering your mathematical education would prove to be a worthwhile venture. I think it comes down to each individual's personal goals and desires. However, I do agree that there is no incentive provided for teachers to further their education and remain in the secondary teaching field.

Payment and Benefits. Some of the participants discussed math teachers' salaries and benefits compared to their degree and responsibilities. One female participant, *Nemo,* raised the topic as follows, "I thought of an interesting topic that was brought up in my education class regarding the future of all teachers. It is amazing to me that they are considering making the pay scale equal for people with all different educational backgrounds." While a male participant, *Walter Sobchok,* agreed with *Nemo* as he stated, "I do agree that there is no incentive provided for teachers to further their education and remain in the secondary teaching field."

Some participants expressed their frustration regarding this issue, as one male participant, *Heron,* stated, "Why is it that in all American organizations I can think of, managers/administrators get paid some multiple of what a worker directly involved in the production of goods and services can hope for?" Another female participant, *Twoqayl,* stated:

> In this economy, there is a large amount of people who are 'overqualified' for most jobs and are therefore not being hired. If what you say comes to fruition I

> think that there would, indeed, be very little incentive to go further into one's education to get higher degrees.

However, some participants did have a positive hope regarding their salary and benefits. As one male participant, *Batman,* stated, "I think that eventually a new type of incentive system will come along and when it does people will do what they need to do in order to qualify for it."

Self-Motivation. With relevance to payment and benefits, a number of participants discussed their opinion on how to motivate themselves to achieve higher degrees in mathematics. One female participant, *Nemo,* raised the topic as follows:

> It seems as though getting a Master's [degree] will not be worth it due to the fact that they may not be paying us more? How are teachers going to be motivated to further their education if there is no increase in pay?

Another female participant, *Twoqayl,* replied as follows:

> I can say that for myself I am not even sure that with a pay increase I'd want to get a Master's degree. I suppose that for some, self-satisfaction would be an incentive, but internal motivation can only go so far in a world that demands a capitalistic mentality. Money is the great necessary evil and if furthering one's education can't get one farther up on the pay scale, then I don't know what would encourage the vast majority of American teachers to get more esteemed degrees.

A male participant, *Batman,* mentioned:

> The question really depends on what kind of incentives they put in its place. If you get a pay increase based on how your students do on tests you might want to learn more effective ways to teach. I agree that if they take away the pay increases for having a higher degree it will decrease the number of people seeking higher degrees.

A number of participants supported this discussion. One female participant, *Nemo,* mentioned:

> I completely agree with your statement. For some students the teacher is all they have in life in terms of guidance and motivation. It is our jobs as teachers to help every student achieve. Yes, it does take work from the student, but if we give up on them then how are doing our jobs. We are the adults and we must remember what it's like to be students. If we give them respect and show them that they care, hopefully they will take our classes seriously and work hard to do well.

While a male participant, *Erdos,* mentioned:

> Perhaps one of the most difficult parts about being an educator is to know how to help students do more than work, but to learn; that is, motivate students to want to learn what is offered to them. Although many students have the thirst for knowledge, many turn away from the most valuable thing one can possess - an education. As mathematics teachers, we have a particularly difficult time offering motivation to students, and it can be difficult for us to let them know how important math is.

Professionalism. A number of participants discussed professionalism. They raised the issue of bringing a teacher's personal problems into the classrooms and presented their views on how to keep a teacher's personal issues out of the school environment. One female participant, *Winnifred,* raised the topic as follows:

> I was recently talking with a friend about her practicum experience and how horrible her lead teacher is. She was describing to me how the teacher is going through some serious life issues and then claims certain students just cannot be helped by anyone and that they will never make it in life. I guess what I want to know is: How can a teacher keep his/her self from letting their personal life affect how they treat their students and prevent oneself from becoming overwhelmed? Is there really a student who is hopeless?

Many participants agreed that as human beings it might be difficult for many teachers to keep their personal and professional lives separate from one another. Another female participant, *John Wayne,* stated, "Teachers are human just like everybody else. So they have their good days and their bad days. However, teachers still work in a professional working environment and they should not let their personal issues clash with work."

Some participants presented their personal experience and anecdotal evidence regarding how to maintain professionalism. As one male participant, *Walter Sobchok,* mentioned, "It's simple enough to say that we just need to keep our personal and professional lives separate from one another. However, one must remember that we are still human." Another female participant, *Pythagoras,* supported this view as follows:

> Walter Sobchok, I agree with you completely. As the 'professional' you have to check your problems at the door and try to do the best for your students any way you can and not let your personal problems get the best of you and cloud your judgment as a teacher.

A female participant, *John Wayne,* presented her personal thought as she stated:

> When I am having a really bad day and need to go to work. I take a breath and say to myself, there is nothing I can do about it right now so just go to work and do your job. If I let myself think about my problems at work my work performance goes down.

However, many did agree that it is really tough to put aside real life situations while in the workplace. Thus, they suggested making a balance as much as possible. One female participant, *Jane Doe,* stated, "Putting aside your personal life when you enter the classroom is not necessarily the best thing to do and is not the easiest thing to do either. Making a balance is better." A male participant, *Nevadatude,* supported this idea as he stated, "Jane Doe, I agree that there needs to be a balance." Another female participant, *Woohoo,* stated, "I agree that there should definitely be a balance between knowing your students and letting them know you and in letting them get too involved in your life or vice versa." While another female participant, *Pythagoras,* supported this idea as she stated, "You don't always have to separate your personal and professional life but there should be boundaries you never cross. If you are a teacher and are having a bad day, it shows during your instruction if you can't separate the two."

Some participants suggested high school teachers should be careful in using social media. As one female participant, *Jane Doe,* noted, "high school students are old enough to realize when you aren't having the best day." While another female participant, *John Wayne,* suggested that, "teachers should … not let any student become your friend on Facebook. When you become a teacher you are a professional and should not post stupid status updates."

Overloaded Homework. A number of participants discussed their experiences and opinions related to students' problem with homework assignments. One male participant, *TheDude53,* mentioned:

> One thing that I have noticed when I am helping my little cousin doing his math homework is that some of the problems on the homework don't really go with the notes that he had taken is class. I think if a teacher is going to assign a problem on homework and not give some kind of an example of how to solve it that they are actually hurting the kids.

A number of participants believe that many teachers give homework without teaching the appropriate material in class. One female participant, *Eamesor,* noted:

> Lately, I've been helping my younger family members with their math homework & I've noticed that they tend to throw in a question that the kids have to learn how to do them. They come to me saying 'I don't understand this question', me countering with 'Did you learn this in class?', and they always respond 'No.'

Many participants believe that assigning more homework without teaching the material in class can overwhelm young students. Thus, they recommended that teachers

should assign less homework to their students. One female participant, *Jane Doe,* noted, "Less homework may work as long as your students don't suffer because of it." While another female participant, *Pythagoras,* supported this as she noted:

> Less homework may work but if you lower your expectations of your students because you don't have time to dedicate to them (which is basically your job) they will suffer. They won't learn as much and will suffer if you suddenly bring your expectations back up and they aren't at the level you want them to be.

However, some participants discussed assigning less homework as a means of saving time in the grading process. As another female participant, *Winnifred,* noted, "Do you assign less homework so you have less grading to do?" Another female participant, *Mathgirl,* very harshly criticized this as follows:

> Assigning less homework is not an option either, especially in math. If this teacher is that overwhelmed, she could apply for a teacher aid or take a leave of absence. I honestly think this teacher needs to take some time off to remember why he/she wanted to teach in the first place; and if they cannot remember, then maybe they need to find a new job!

Use of Smart Board. A number of participants discussed the advantages and importance of using advanced technology such as a smart board in Geometry and other mathematics classes. One female participant, *Nemo,* raised the issue as follows:

> I have worked with smart boards in my middle school practicum. I actually used it for one of my lessons. I think that it provides engagement for the students but sometimes I felt that is was hard to fit all of my notes on a single page. You are

> able to flip between pages, but it is still hard to go back and forth sometimes. Does anyone feel that even when a teacher is using a board it is hard to keep your back to your students when you are writing? I also prefer an overhead [projector] so that I am able to visualize the entire class at all times. Any more thought?

Another female participant, *Winnifred,* presented her thoughts of some advantages of using a smart board in the classrooms. As she stated:

> One of the things I like about the smart board is you can save your notes, whether hand written or typed, and you can also use templates on it that the textbooks have given you. It also has an undo [option] in case you erase something you didn't mean to whereas on the white board once it's erased it's gone for good. I've talked with teachers who save their daily notes and sometimes email them to students who are absent because a classmates notes are not always accurate.

While a male participant, *Batman,* stated:

> I think that one of the major benefits of smart boards, especially for Geometry, is the ability to insert specific shapes. I know that when I personally draw on the board it can get a little sloppy cramped if I did not draw a diagram big enough or something like that. So I think being able to insert shapes and manipulate them the way you want helps your notes look more professional and easy to understand. I know when I was in school and even now if the diagram is drawn poorly I have a harder time making sense of it so that is why I think it is so beneficial to be able to do that.

Math Jokes. A number of participants discussed math jokes and mathematical fallacies and presented their views of sharing these with their students. One female participant, *Scooter,* raised the topic as follows:

> I [have] this idea of sharing a riddle or math joke with my students every morning or at least every Friday. With that said, I need more jokes. So, does anybody have any good math riddles or jokes they would like to share?

Another female participant, *Wally,* presented a math joke that her math teacher told in class.

> 'I'm going to prove that the number 2 is odd…'
>
> List of prime numbers: 2, 3, 5, 7, 11, 13, 17, 19, etc…
>
> '2 is the only even prime number… isn't that odd?'
>
> It's silly, but it made me smile!

While a male participant, *TacoTuesday,* presented a website http://xkcd.com/ that presents a lot of math jokes and comics.

Mathematics Websites. The participants visited and mentioned a number of websites and applets suitable for teaching-learning mathematics. Some of the websites they mentioned are: http://khanacademy.org, http://www.mathimp.org, http://www.metacafe.com/, http://wolframalpha.com, http://www.learner.org/ http://www.sites.google.com/site/missnickellshomepage/honors-geometry

They also encouraged other participants to visit and use these websites by presenting the beneficial features of these websites. One male participant, *Indiana,*

mentioned that [it] is a well-organized thoughtful use of a webpage for a math class. While a female participant, *John Wayne,* mentioned, "I just checked out the khanacademy.org website and it was really cool. That website really does have the answers to almost everything." While another male participant, *Erdos,* supported this by elaborating:

> Websites like the Khan Academy, Stanford's Home Page, and TED [Technology, Entertainment and Design] all provide online instruction to students in a way which is informal, direct, and, most importantly, personal. Because this instruction is provided to students in a comfortable, convenient, and concise [format], many a student will learn better in this environment than in a typical classroom setting. We should not deny the effectiveness of these types of media and what they can give to students who find themselves struggling in school.

Chapter Summary

This chapter includes four main sections. The first section presents and describes the demographic information of the sample gathered for this study followed by an overview of participants' attitudes toward the blogging activity and perceived effectiveness of using the blog in the Euclidean Geometry course. Next, the analyses of the quantitative data are presented, followed by results specific to each of the quantitative research questions. Analyses of most of the quantitative research questions did not find any significant difference between the test variables, with the exception of research question 2b. Analysis of the first qualitative research question presents the advantages

and disadvantages of the blogging activity, respectively; and the second qualitative research question presents the trends that emerged in the preservice mathematics teachers' contributions to the online discussion board of the blogging activity.

CHAPTER FIVE: DISCUSSION, IMPLICATIONS, AND CONCLUSIONS

Introduction

This chapter begins with a brief summary of the study beginning with the rationale. Findings are then presented and discussed in sections according to the theoretical framework of this study with a brief description of connections between the quantitative and qualitative findings. Next, limitations and delimitations of the study are presented followed by implications for practice. Based on the implications and limitations of the study, recommendations for further research are then presented. Finally, the conclusions section presents an overview of the study and closes with the researcher's personal thoughts.

Summary of the Study

The importance and effect of technology on U.S. mathematics education; the cost and limited access to mathematics teaching-learning software and traditional web-based programs; the rapid growth of internet and mobile web usage; the trends of young students' use of Web 2.0 technologies; and, the interactive features of Web 2.0 technologies and their potential for supporting and promoting teaching-learning mathematics; among other factors, served as the impetus for the researcher to conduct this study.

A review of the literature revealed that Web 2.0 tools are already being adopted in many technical, professional, and academic fields; however, they have not been widely adopted in teaching-learning mathematics and mathematics education programs, yet. Thus, this study was conducted with the intention of examining preservice mathematics

teachers' perceptions of a blogging activity as a supportive teaching-learning tool in a college Euclidean Geometry course. Twenty-eight preservice secondary mathematics teachers participated in this study during the fall semester of 2011 in a university in the western United States.

The effect of a 12-week blogging activity that was a standard component of a college Euclidean Geometry course offered for preservice secondary mathematics teachers was investigated in this study. At the end of the semester, preservice mathematics teachers' attitudes toward and self-reported effectiveness of the blogging activity were measured using an instrument developed by the researcher. Validity and reliability of the instrument were measured through appropriate procedures and were found to be authentic and consistent.

The study examined six quantitative research questions as well as two qualitative research questions. To address the quantitative research questions the study used two independent variables: (1) participants' gender, and (2) participants' self-reported total time spent on the Internet per week. The study also used the following dependent variables: (1) participants' attitudes toward the blogging activity in the college Euclidean Geometry course, (2) participants' perceived effectiveness of the blog for the learning of Euclidean Geometry, and (3) participants' cumulative quiz scores attained on eight in-class quizzes.

First and foremost, this study compared participants' gender and self-reported total time spent on the Internet per week for all purposes with their median attitude scores toward the blogging activity and median perceived effectiveness scores of using the blog,

respectively. The study did not find any significant difference in participants' attitudes toward, and perceived effectiveness of, the blogging activity across gender. This might be due to the fact that the study was conducted in a single course with a small number of participants.

Similarly, the study did not find any significant difference in the median attitude scores of the participants in terms of their self-reported total time spent on the Internet per week. However, the study found a significant difference in the median perceived effectiveness of the participants in terms of their self-reported total time spent on the Internet per week with an indication that participants who spent more time on the Internet perceived the blogging activity to be more effective as a supportive tool for the learning of Euclidean Geometry than participants who spent less time on the Internet.

Moreover, this study sought to determine if a relationship exists between either participants' attitudes toward the blogging activity or their perceived effectiveness of the blog to their total quiz scores measured by eight in-class quizzes. The results did not show any significant correlation between the participants' cumulative quiz scores and their median attitude scores toward the blogging activity; or between the participants' cumulative quiz scores and their median perceived effectiveness scores of using the blog for the learning of Euclidean Geometry.

Furthermore, the study qualitatively analyzed the advantages and disadvantages/ problems of the blogging activity. Not surprisingly, the results revealed that the preservice mathematics teachers reported numerous advantages of the blogging activity as a supportive tool in the college Euclidean Geometry course. Despite the limitations of

the free blog service being used, no mentionable disadvantages were noticed. Only a few minor problems of using the free blog were reported by some participants.

Additionally, this study analyzed the major trends that emerged in an unguided online discussion board on the blog. Interestingly, this component of the study revealed approximately twenty major themes raised by preservice secondary mathematics teachers. Finally, based on the findings of the study the researcher provided some recommendations and further investigation ideas regarding the use of blogs and other Web 2.0 applications in the teaching and learning of mathematics.

Discussion of the Findings

This study quantitatively examined preservice mathematics teachers' attitudes toward and perceived effectiveness of using a blog as a supportive teaching-learning tool in a college Euclidean Geometry course. Qualitatively, the advantages and disadvantages/ problems of the blogging activity and the trends that emerged in the discussion topics of the unguided discussion board of the blog were studied. Detailed findings are presented in the previous chapter. In this section, major findings are presented and discussed briefly in accordance with the theoretical framework of this study.

Participants' Perceptions toward the Blogging Activity

The median score on the 16-question attitude survey was determined for each participant. Descriptive statistics of these median attitude scores yielded a mean, median, and mode of 4.18, 4.0, and 4.0 respectively with a standard deviation of 0.95 (Table 16). This indicates that the typical response of participants corresponds to slightly more than

agreement that they held a positive attitude toward the blogging activity in the College Euclidean Geometry course. Similarly, the median score on the 18-question effectiveness survey was determined for each participant. Descriptive statistics of the median perceived effectiveness scores yielded a mean, median, and mode of 4.13, 4.0, and 4.0 respectively with a standard deviation of 0.93 (Table 16), indicating that the typical response of participants corresponds to slightly more than agreement that the blogging activity was an effective means of teaching and learning Euclidean Geometry.

Perceptions Based on Gender

Research question 1a compared male and female participants' median attitude scores toward the blogging activity. Results for research question 1a: *Are there significant differences by gender with regard to preservice mathematics teachers' attitudes toward the blogging activity in a college Euclidean Geometry course*?, indicated no significant difference ($N = 28$, $U = 68.0$, $p > .05$) in the median attitude scores of the participants toward the blogging activity in terms of their gender.

Research question 1b compared male and female participants' median perceived effectiveness scores of the blogging activity. Analysis of the research question 1b: *Are there significant differences by gender with regard to preservice mathematics teachers' perceived effectiveness of the blog for the learning of Euclidean Geometry?,* indicated no significant difference ($N = 28$, $U = 94.50$, $p > .05$) in the median perceived effectiveness scores toward the blogging activity in terms of the gender of the participants.

These results do not support some other studies that found that men and women use the Internet very differently, with women sending and receiving emails in a richer

and more engaging way and that women appear to have overtaken men in online shopping, while more men perform online financial transactions and pursue and consume information online more aggressively than women (Bimber, 2000; Fallows, 2005; Grove, 2010). However, the gender-based perception results, both attitudes toward and perceived effectiveness of the blogging activity, of this study does support another doctoral dissertation that found "gender did not have a significant relationship with Web 2.0 usage" (Cash, 2010, p. 81).

The result of the present study may be due to the fact that it was conducted in a single course with a small number of participants; Moreover, the median attitude and median perceived effectiveness scores in this study implied that both male and female participants experienced consistent perceptions that the blogging activity was appropriate and effective in the Euclidean Geometry course.

Perceptions Based on Time Spent on the Internet

Research question 2a compared participants' median attitude scores toward the blogging activity with their self-reported total time spent on the Internet per week. Analysis of the results of research question 2a: *Do preservice teachers who report spending more time on the Internet differ significantly from those who report spending less time on the Internet with regard to their attitudes toward the blogging activity in a college Euclidean Geometry course?*, indicated no significant difference ($N = 28$, $U = 61.50$, $p > .05$) in the median attitude scores of the participants toward the blogging activity in terms of their self-reported total time spent on the Internet per week.

Research question 2b compared participants' median perceived effectiveness scores of the blogging activity with their self-reported total time spent on the Internet per week. Analysis of the results of research question 2b: *Do preservice teachers who report spending more time on the Internet differ significantly from those who report spending less time on the Internet with regard to their perceived effectiveness of the blog for the learning of Euclidean Geometry*, found a significant difference ($N = 28$, $U = 53.00$, $p < .05$) in the median perceived effectiveness scores of the participants in terms of their self-reported total time spent on the Internet per week. This significant result indicates that participants who spent more time on the Internet perceived the blogging activity to be more effective than participants who spent less time on the Internet.

According to The Nielson Company's (2010) prediction that there might be a strong positive correlation between time spent on the Internet and time spent on social network sites, one possible explanation is that participants who spend more time on the Internet were more familiar with blogs and/or other social network sites than those who spend less time on the Internet. Thus the participants who spent more time on the Internet were more likely to perceive the use of a blogging activity for the learning of Euclidean Geometry to be more effective than those who spend less time on the Internet.

Another possible explanation is that participants who spend more time on social network sites might perceive the blog to be more effective than those who spend less time on the Internet and thus less time on social network sites. This prediction is consistent with the finding of a recent study on students' perceptions of collaboration, self-regulated learning, and information seeking in the context of Internet-based learning and traditional

learning, conducted by Lee and Tsai (2011) who found "students who spent a moderate amount of time online for learning actually perceived higher capability and more experience of collaboration than the group who spent less time" (p. 909). In another contemporary study Chu and Tsai (2009) found that "more time spent on Internet practice may increase adult learners' Internet self-efficacy, which may strengthen their preferences for Internet-based learning environments" (p. 1).

Perceptions Based on Cumulative Quiz Scores

Research question 3a correlated participants' attitudes toward the blog to their total quiz scores measured by eight in-class quizzes. Analysis of research question 3a: *Is there a relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry course and their attitudes toward the blogging activity in a college Euclidean Geometry course?,* did not indicate a significant correlation ($N = 28$, $r_s = -0.145$, $p > .05$) between the participants cumulative quiz scores and their median attitude scores toward the blogging activity.

Research question 3b correlated participants' perceived effectiveness of the blog to their total quiz scores measured by eight in-class quizzes. Analysis of research question 3b: *Is there a relationship between the cumulative quiz scores attained by preservice mathematics teachers enrolled in a college Euclidean Geometry course and their perceptions of the effectiveness of the blog for the learning of Euclidean Geometry?,* did not indicate a significant correlation ($N = 28$, $r_s = -0.232$, $p > .05$) between the participants cumulative quiz scores and their median perceived effectiveness scores of the blogging activity.

These findings imply that all participants, regardless of their relative strength in mathematics problem solving, reasoning, and understanding skills, as measured by the in-class quizzes, tended to have positive attitudes toward the blogging activity and considered it to be effective in the teaching and learning of Euclidean Geometry. This finding coincides with Cash's (2010) doctoral dissertation research that found that Web 2.0 usage level did not have a significant relationship with high school students' letter grade (performance) in mathematics, science, and social studies.

Advantages and Disadvantages/Problems of the Blogging Activity

Research question 4: *What do preservice secondary mathematics teachers perceive as the advantages and disadvantages of using a blog as a supportive tool in a Euclidean Geometry course?,* was qualitatively analyzed to determine the advantages and disadvantages of the blogging activity, as reported by the participants. This analysis revealed that the preservice mathematics teachers reported numerous advantages and a few minor problems of the blogging activity as a supportive tool in the Euclidean Geometry course. No major disadvantage was found.

The themes identified regarding the use of the blog were: 24/7 accessible; alternative source of solution; collaborative; convenient; enjoyable; encouraging; engaging; source of getting feedback from others; safe and secured; and technology savvy. One problem mentioned was that some participants who were first time users of the blog found it difficult to start, and follow the directions. Another problem was that the participants were unable to use mathematical symbols, equations, and construction tools on the blog.

Participants reported the collaborative nature of the blog and its ability to be engaging as the most beneficial features of using a blog in a Euclidean Geometry course. These findings are analogous to Shihab's (2008) findings:

> Web 2.0 tools allowed teachers to be more efficient in establishing a collaborative environment than what was originally possible in their traditional classrooms. …. With Web 2.0 tools, teachers reported achieving exceptional levels of student engagement. The ease of use and the online nature of these tools allowed all students to interact with almost everyone in the class. . . . Students learned from each other and developed their commentary skills by commenting on each other's blogs. (p. 89-90)

Trends of Preservice Math Teachers' Discussion on the Blog

Research question 5: *What trends emerge in the analysis of preservice secondary mathematics teachers' contributions to an online discussion board on a blog used in a college Euclidean Geometry course?*, qualitatively analyzed the trends that emerged in an unguided online discussion board on a blog. This analysis revealed that the preservice mathematics teachers raised approximately twenty major themes throughout the online discussion. These themes include: participants' personal interest in Geometry; difficulties in teaching-learning Geometry; real-life applications of Geometry; teaching-learning strategies in Geometry; hands-on activities; drill and kill methods; use of a formula sheet; creating lesson plans; the importance and difficulty of word problems; career plans; math teachers' pay and benefits; self-motivation of becoming a math teacher; how to maintain professionalism; overloaded homework; test creation strategies; grading policy; use of

advanced technology such as a smart board and overhead projector use in Geometry classrooms; math jokes and fallacies; and, mathematics websites.

Although, the participants' discussion did not focus in any specific direction, interestingly, most of the topics were related to the improvement of teaching-learning and professional development, topics that are often not discussed in the classroom. This result is analogous to Hendron's (2008) argument as he stated that blogs can provide students with the social collaborative edge that they can never experience on paper and in traditional classrooms.

In fact, use of the online discussion board of the blog was found to be effective and appropriate by the participants as they brought up a number of issues that were important for them to be aware of and presented their perceptions to resolve or manage these issues. Also, their discussion topics were found to be appropriate and effective in improving their teaching-learning techniques, career goals, and professional development. These findings are somewhat analogous to Shihab's (2008) findings and recommendations regarding the use of a blog and a discussion board in an English Learning course. He found the following:

> Teachers report that blogs helped students share ideas and opinions on the topics being studied in class and have improved learning in the English classroom. Students recommend that blogs be used in various school subjects, especially subjects that require sharing of information and opinions. In addition to sharing ideas on discussion boards, blogs may serve as personalized spaces for students to

write their own thoughts and experiences in an organized way. It provided an organized paperless track of all student discussion. (p. 93)

Connections between the Quantitative and Qualitative Findings

Although there was no explicit relationship between the quantitative and qualitative research questions, as an expectation of the mixed-methods analyses employed in this study, the researcher sought to find some connections, if they exist, between the quantitative and qualitative findings.

Table 36
Male vs. Female Participation Rates on Major Advantages and Disadvantages/ Problems of the Blogging Activity

Area of View	Theme	Male (%)	Female (%)
Advantages of the blogging activity	24/7 Accessible	4 (33.3%)	3 (18.75%)
	Alternative Source	2 (16.67%)	3 (18.75%)
	Collaborative	1 (8.33%)	2 (12.5%)
	Convenient	2 (16.67%)	1 (6.25%)
	Enjoyable	2 (16.67%)	0
	Encouraging	1 (8.33%)	2 (12.5%)
	Engaging	1 (8.33%)	3 (18.75%)
	Getting Feedback	2 (16.67%)	1 (6.25%)
	Safe and Secured	1 (8.33%)	2 (12.5%)
	Technology Savvy	0	2 (12.5%)
	Average	1.6 (13.33%)	1.9 (11.88%)
Disadvantages/ Problems of the blogging activity	No Disadvantage	1 (8.33%)	3 (18.75%)
	Difficult for New Bloggers	0	2 (12.5%)
	Difficulty in Using Geometric Notations	0	2 (12.5%)
	Enforcing	1 (8.33%)	1 (6.25%)
	Isolated	1 (8.33%)	2 (12.5%)
	Personal Dislike	0	3 (18.75%)
	Average	0.5 (4.16%)	2.1 (13.54%)

Note. For Male N = 12, Female N = 16

Table 36 presents an overview of male vs. female participation rates in the various themes identified as major advantages and disadvantages/problems of the blogging activity. This analysis shows that on average male and female participants hold similar views regarding the major advantages and disadvantages/problems of the blogging activity. Although a few more females reported difficulty in blogging and personally disliked the activity, that rate was not much higher than that of the male participants. These similarities support the findings of research questions 1a and 1b, which found no significant differences between male and female participants' attitudes toward and perceived effectiveness of the blogging activity.

Table 37 provides an analysis of male and female participation rates in the various themes that emerged from the online the discussion board. This table indicates that on average more females (23.02%) participated in these online discussion topics than males (15.79%). Further analysis suggests that females were more likely to discuss real-life applications of Geometry, Geometry teaching-learning strategies, test creation strategies, overloading homework, and professionalism. Male participants, on the other hand, tended to discuss grading policy, and payment and benefits. While these observations of the data are interesting in and of themselves, they do not have a strong connection with any part of the quantitative results and due to the small sample size for this study, cannot be claimed to be generalizable.

Table 37
Male vs. Female Participants' View Emerged on the Discussion Board of the Blog

Discussion Topics	Male (%)	Female (%)
Geometry in Real-life	3 (25%)	10 (62.5%)
Interest on Geometry	1 (8.33%)	2 (12.5%)
Difficulties in Geometry	1 (8.33%)	2 (12.5%)
Teaching-Learning Geometry	1 (8.33%)	3 (18.75%)
Hands-on Activities	3 (25%)	3 (18.75%)
Drill and Kill Methods	2 (16.67%)	3 (18.75%)
Using Formula Sheets	2 (16.67%)	4 (25%)
Creating Lesson Plans	0	2 (12.5%)
Test Creation Strategies	1 (8.33%)	7 (43.75%)
Grading Policy	6 (50%)	4 (25%)
Word Problems	2 (16.67%)	4 (25%)
Career Plan	2 (16.67%)	2 (12.5%)
Payment and Benefits	3 (25%)	2 (12.5%)
Self-motivation	2 (16.67%)	3 (18.75%)
Professionalism	2 (16.67%)	9 (56.25%)
Overloaded Homework	1 (8.33%)	5 (31.25%)
Use of Smart Board	1 (8.33%)	2 (12.5%)
Math Jokes	1 (8.33%)	2 (12.5%)
Mathematics Websites	2 (16.67%)	1 (6.25%)
Average	1.9 (15.79%)	3.7 (23.02%)

Note. For Male N = 12, Female N = 16

Implications for Practice

The results of this study have possible implications not only to researchers in the field of mathematics education, but also for mathematics students, teachers, teacher educators, curriculum developers, instruction designers, and policy makers regarding the use of a blog and other Web 2.0 applications as supportive or comprehensive tools for teaching, learning, and planning purposes. The remaining part of this section presents some possible implications of this study.

First, this study found that participants generally reported positive attitudes toward a blog and perceived the blog to be effective without any significant differences based on their gender. One implication of these results might be that, professors and teachers who wrongly believe that males are being given an unfair advantage when computers and information technology are incorporated into a class should reconsider this thought. This study suggests that implementing a blogging activity should not provide any advantage to either males or females as some educators may wrongly believe to be the case. Therefore, professors and teachers should feel confident about implementing this type of activity without having to worry about unfairly advantaging male or female students.

Second, another implication of these results might be that, since undergraduate college students and preservice mathematics teachers responded positively to this activity and perceived it to be effective then there is a good chance that high school and middle school students and/or in-service mathematics teachers might, also, find it positive and effective. Thus, middle or high school teachers should consider implementing activities

similar to those used in this study in their own classrooms. Further teacher educators should provide instruction to preservice teachers regarding the implementation of blogging activities and encourage these future teachers to use them in the future. Additionally, curriculum developers and policy makers should use their influence to encourage the inclusion of blogs and or/other Web 2.0 technologies in the middle school, high school, and teacher education mathematics curricula.

Third, this study found that although participants generally reported positive attitudes toward the blog regardless of the amount of time they spend on the Internet, those who spend more time on the Internet perceived the blogging activities to be more effective than those who spend less time on the Internet. Based on these results, professors and teachers who want to use this type of activity in their classroom need to be careful about some points before starting. Of course, it is critical to determine whether or not all of the students in the course actually have access to the Internet, since this lack of access may be the reason why some students spend little or no time online. Clearly these students would be disadvantaged by such an activity unless the teacher or professor made Internet access more accessible to them. Additionally, if students spend less than 21 hours per week online, they may need additional support regarding their Internet skills. Providing special training and support for these students may lead them to see these activities as being effective just as those who spend more than 21 hours on the Internet already do.

Fourth, this study did not find a significant correlation between the participants' cumulative quiz scores, and either their median attitude scores, or their median perceived

effectiveness scores toward the blogging activity. One implication of these results might be that mathematical content knowledge and problem-solving skills are not determining factors regarding whether or not a blogging activity should be included in a particular course. This result suggests that teachers should implement blogging activities in their low level courses as well as their upper level courses. Unfortunately, we have probably all heard stories of upper level courses being provided with interesting activities while lower level courses are often relegated to completing boring worksheets under the guise that these students couldn't handle the more interesting activities. This study directly refutes this idea and provides a strong justification for implementing blogging activities with courses of all levels.

Fifth, the participants in this study found a number of advantages of using the blogging activity in the college Euclidean Geometry course. One such advantage was the collaborative nature of this type of activity. Not surprisingly, collaboration is considered to be an important aspect of learning mathematics, as stated in the NCTM (2000) Principles and Standards, "Technology also provides a focus as students discuss with one another and with their teacher" (p. 25). Through collaboration, preservice mathematics teachers gain "a better appreciation of mathematics content and pedagogical strategies that lie beyond the grades they will likely teach" (Edwards, 2006, p. 1). Thus, as this study suggests, blogs could be a vehicle to improve teaching-learning mathematics because in such an activity students get more opportunities to communicate and collaborate with the teacher and their peers. This might also apply to mathematics

teachers engaged in professional development activities. This idea is supported by the findings of Tinzmann, Jones, Fennimore, Bakker, Fine, and Pierce (1990):

> Collaborative teachers encourage students' use of their own knowledge, ensure that students share their knowledge and their learning strategies, treat each other respectfully, and focus on high levels of understanding. They help students listen to diverse opinions, support knowledge claims with evidence, engage in critical and creative thinking, and participate in open and meaningful dialogue. (p. 1)

Sixth, the blog was found to be a source of alternative solutions and positive feedback from other students in the course, which have been identified as effective components in the teaching and learning of mathematics. The importance of encouraging alternative solutions is emphasized by the NCTM (2000) Principles and Standards as:

> Different strategies are necessary as students experience a wider variety of problems. Students must become aware of these strategies as the need for them arises, and as they are modeled during classroom activities, the teacher should encourage students to take note of them. (p. 54)

The importance of encouraging alternative solutions, also, is witnessed by Stipek, Givvin, Salmon, & MacGyvers (2001) who state that “teachers should emphasize process and encourage students to seek alternative solutions rather than to find a single correct solution” (p. 216); and by Cohen and Ball (1990) who contend that “teachers should encourage students to offer alternative solutions to problems and invite them to collaborate in figuring out what makes sense and why” (p. 3).

Regarding positive feedback, Lou and MacGregor (2004) found that, in a collaborative learning environment, "receiving positive feedback from other groups was rewarding and encouraging" (p. 435). Lou and MacGregor (2004) also found that:

> Providing feedback to each other across groups helps students to develop critical thinking skills, self-regulating skills, as well as the skills in evaluating the work of others – a professional skill important for educators. Through evaluating each other's work, the students become more aware of possible areas of weakness in their projects. It enhances the transfer between conceptual understanding and applying newly learned concepts in their own projects and in evaluating other projects. (p. 437)

Seventh, the 24/7 accessibility of the blog might provide students with easy and convenient communication with the teacher and their classmates while they are at home, on the school bus, in the family car, or at a shopping mall. Perhaps, the convenient, enjoyable, encouraging, engaging features of the blog might be a way to motivate students to spend more time learning mathematics. Notably, these features of blogs and/or other Web 2.0 technologies might help change the lackluster attitudes toward learning mathematics held by many students who are more willing to spend their time on social networking sites than on practicing mathematics.

Eighth, both the researcher, as the instructor of the blogging activity, and the participants discovered some minor difficulties in using the blog in the Euclidean Geometry course, such as being unable to use mathematics symbols, equations, and construction tools on the blog. The free version of the WordPress blog used in this study

did not allow the instructor to install and use any third party plugins for these purposes. Software developers should consider making the use of mathematical symbols easier on their free blog websites. Doing so will make their products more convenient to use and would most likely lead to an increase in the number of mathematics teachers and/or students who would opt to purchase upgraded versions of the product. Another potential solution for software developers would be to create low cost plug-ins that allow for easy use of mathematical and scientific symbols and equations that could be used in tandem with their free blogs. Policy makers could encourage software developers in this regard by investing in software development programs with the promise of purchasing successful and innovative software programs after they have been developed.

Ninth, this study found that preservice mathematics teachers found the blog to be a good forum to openly discuss numerous Geometry related topics. These include issues regarding their personal interest and experience in Geometry and mathematics; use of Geometry and mathematics for real-life purposes; teaching-learning strategies; use and importance of formula sheets, hands-on activities, drill and kill methods, lesson plans, smart board use, and word problems. They also discussed their career plans, interest in becoming a math teacher, and effective ways to maintain professionalism. Thus, it seems that blogs could be used for various purposes. For instance, a mathematics teacher could develop and maintain a blog for his/her course and invite the students to discuss various topics about the course. This kind of virtual platform could enrich their mathematical knowledge and understanding by allowing for the discussion of various mathematical topics: posting of related problems and quizzes; allowing class members to submit online

solutions to problems posted by others; and sharing thoughts about creating mathematics problems.

Finally, and most notably, the findings of this study might provide a great opportunity for students and classroom teachers who have not previously experienced blogging to share their voices and perspectives on an open and public forum. This opportunity will allow individuals who do not get a chance to publish their perspectives in typical print media to have an outlet for sharing their ideas. Further, this study suggests that using blogs could provide an effective opportunity for students who are involved in the process of learning and understanding mathematics. The relative low cost of using blogs can provide a strong alternative for those teachers and students who cannot afford costly mathematical software or Web-based applications. As more students participate in online discussion on various mathematics topics and take the opportunity to publish their voice on the open forum, the depth and breadth of their mathematics study should expand.

Limitations and Delimitations

The main limitation of this study was that it dealt with a single medium sized class of 28 students in a college Euclidean Geometry course. Thus, the findings of this study cannot be claimed to be generalizable. Moreover, given the quasi-interval type data of the two dependent variables that were used to measure participants' attitudes toward and perceived effectiveness of the blogging activity, respectively, it was not possible for the researcher to use more powerful parametric tests for analyzing quantitative data. Thus, the non-parametric Wilcoxon-Mann-Whitney U test, which is considered less

powerful than the corresponding parametric t-test, was used to analyze research questions 1a, 1b, 2a, and 2b. Moreover, due to limited sample size, a power analysis with GPower 3.1 revealed that this study had only about 51% chance of getting a significant mean difference between the groups, if that difference really existed.

Another notable limitation of this study was that unlike WebCT and many other mathematics software packages and websites, the free blog used in this study did not allow the participants to use constructions tools or upload images and graphs. To avoid this problem, geometric problems that needed construction were not uploaded to the blog. This is considered a delimitation of this study.

Moreover, the blog used for this activity was under a free server, so students faced problems in using mathematics symbols and equations. To avoid this problem, students were asked to type in the mathematics formulas in plain text format. For instance: (a+b)^2 = a^2 + 2ab + b^2; a^2 + b^2 = c^2; Area of a circle is: A = Pi.r^2 ; etc. This is considered another delimitation of this study.

This study did not use a control group, therefore, the researcher was not able to compare the participating (treatment group) students' attitudes toward and perceived effectiveness of the blogging activity with another group (control group) of students who did not participate in the blogging activity. Finally, this study did not measure the instructor's perceptions of using the blogging activity in the college Euclidean Geometry course.

Recommendations for Further Research

Not only did this study provide justification for using blogs as a supportive teaching-learning tool in a college Euclidean Geometry course, it, also, uncovered a variety of ideas for further research in these fields. For instance, the non-significant results for most of the quantitative research questions implied that the participants experienced almost consistent attitudes toward the blogging activity and perceived effectiveness of using a blog as a supportive teaching-learning tool in a college Euclidean Geometry course. However, due to the major limitation that the study was conducted in a single course with only 28 students, these findings cannot be claimed as generalizable. Thus, the researcher of this study suggests that prospective researchers investigate the use of blog and other Web 2.0 technologies in larger courses and/or by considering different aspects of the blog. Potential future studies include:

1) This study could be replicated in another college Euclidean Geometry course with a larger population in the United States or around the world, to see if similar findings would be obtained.
2) This study was conducted in a face-to-face college Euclidean Geometry course. It could be replicated in an online Euclidean Geometry course in order to see if similar findings would be obtained and to determine if the use of blogs is more compatible in online courses than in face-to-face courses.
3) The quantitative components of the present study could be replicated in another college Euclidean Geometry course to see if similar findings would be obtained. The results of this new study would provide additional insights into the

relationships studied in the present study among the independent variables: (1) participants' gender, and (2) participants' self-reported total time spent on the Internet per week; and dependent variables: (1) participants' attitudes toward using the blogging activity in the college Euclidean Geometry course, (2) participants' perceived effectiveness of the blog for the learning of Euclidean Geometry, and (3) an appropriate measure of classroom performance on assessments.

4) A quantitative study similar to the one implemented in this research could be conducted in a high school Euclidean Geometry course. By using a different population, high school students, this new study could provide insights into the relationship among the independent variables for this population: (1) participants' gender, (2) participants' race/ethnicity, and (3) participants' self-reported total time spent on the Internet per week; and dependent variables: (1) participants' attitudes toward the blogging activity in a high school Euclidean Geometry course, (2) participants' perceived effectiveness of the blog for the learning of Euclidean Geometry, and (3) an appropriate measure of classroom performance on assessments.

5) A quantitative study similar to the one implemented in this research could be conducted in two different high school or college mathematics courses, which cover different mathematical topics from one another. This new study could provide information regarding how content differences effect the relationship among the independent variables: (1) participants' gender, (2) participants'

race/ethnicity, and (3) participants' self-reported total time spent on the Internet per week; and dependent variables: (1) participants' attitudes toward the blogging activity in the mathematics course, (2) participants' perceived effectiveness of the blog for the learning of mathematics, and (3) an appropriate measure of classroom performance on assessments.

6) A quantitative study could be conducted in two similar high school mathematics courses or two similar college mathematics courses. A blogging activity would be implemented in one of these courses but not in the other. Results would determine if there is a difference between the experimental and control group students' satisfaction with the course or their enjoyment of course content. Such a control vs. experimental group study could provide insights into the relationship among the independent variables: (1) participants' gender, (2) participants' race/ethnicity, and (3) participants' self-reported total time spent per week on social network sites; and dependent variables: (1) participants' satisfaction with the course, (2) participants enjoyment of course content, (3) participants' perceived effectiveness of the instructional strategies used in the course, and (4) an appropriate measure of classroom performance on assessments.

7) A quantitative study could be conducted in a high school or college mathematics course that includes a blogging activity. A pretest/posttest design could be used to determine if there is a significant change in the participants' attitudes toward mathematics as a result of taking the course.

8) The quantitative components of the present study could be adapted and implemented in another high school or college mathematics course. The results of this new study could provide additional insights into the relationships among a different set of independent variables, such as: (1) participants' self-reported computer/Internet skills, (2) participants' self-reported engagement on Web 2.0 activities, (3) whether or not the participants use cell phones or smart phones to connect to the Internet, (4) gender, and (5) race/ethnicity; with a different set of dependent variables, such as: (1) participants' enjoyment of or satisfaction with the blogging activity, (2) participants' perceptions of the effectiveness of using the blogging activity in the mathematics course, and (3) participants' final grade achieved in the course.
9) The qualitative components of the present study could be replicated in a high school Euclidean Geometry course to see if the themes that emerge regarding the advantages and disadvantages/problems of using a blog as an aid in the teaching and learning of Euclidean Geometry are similar to or different from the themes found in the present study which was conducted at the college level.
10) The qualitative components of the present study could be conducted in a high school Pre-Algebra, Algebra, Pre-Calculus, Calculus, or Statistics course to see if the themes that emerge regarding the advantages and disadvantages/problems of using a blog as an aid in the teaching and learning of the selected course are similar to or different from the themes found in the present study which was conducted at the college level in a Euclidean Geometry course.

11) The qualitative components of the present study could be conducted sequentially or simultaneously in two or more different mathematics content areas in a high school or college Algebra, Euclidean Geometry, Calculus, or Statistics course to see if the themes that emerge regarding the advantages and disadvantages/ problems of using a blog as an aid in the teaching and learning of these different mathematics content areas are similar to or different from one another.
12) The qualitative components of the present study could be conducted in a general college Algebra or Calculus course for students in a variety of majors to see if the themes that emerge regarding the advantages and disadvantages/problems of using a blog as an aid in the teaching and learning of the selected course are similar to or different from the themes found in the present study which was conducted in a college Euclidean Geometry course designed specifically for preservice teachers.
13) The discussion board components of the present study could be conducted in a college Algebra, Calculus, or Euclidean Geometry course for students in a variety of majors to see if the themes that emerge in their discussion topics are similar to or different from the themes found in the present study which was conducted in a college Euclidean Geometry course designed specifically for preservice teachers.
14) A survey could be conducted with high school students, college students, and mathematics teachers/instructors at these levels with regard to their use of blog and other Web 2.0 technologies to see what percent of high school students, college students, and teachers/instructors like or are currently using Web 2.0

applications; and which Web 2.0 applications are most popular among these various populations. This research could provide a comparative view of the current use of Web 2.0 applications among these populations.

15) Additionally, future researchers should seek to improve the instruments used in the present study. Efforts to improve the Likert-point scale items of the survey instruments used in the present study as well as efforts to increase internal validity would be beneficial.

Conclusions

This study has revealed some important and notable results regarding the use of blogs in teaching-learning Geometry and other mathematics courses. As most of the participants of this study were preservice mathematics teachers, their perceptions were related to both teaching and learning perspectives. Quantitative measures of participants' attitudes toward and perceived effectiveness revealed that the use of a blog is both enjoyable, and perceived to be effective in a college Euclidean Geometry course. The study also revealed that gender did not have a significant relationship with preservice secondary mathematics teachers' attitudes toward or perceived effectiveness of using a blog as a supportive teaching-learning tool in a college Euclidean Geometry course. Thus, both male and female students and teachers appear to benefit from using a blog as a supportive teaching-learning tool.

Moreover, the study revealed that spending more time on the Internet did not have any significant effect on the participants' attitudes toward using a blog as a supportive teaching-learning tool in a college Euclidean Geometry course. Although, the study

revealed that participants who spent more time on the Internet found the use of a blog more effective as a supportive teaching-learning tool in a Euclidean Geometry course than those who spent less time on the Internet. This suggests that mathematics teachers who want to use such a blogging activity in their courses should be aware of the need to provide additional support and possibly even increased accessibility to the Internet to some of their students.

The study, also, revealed that students' mathematical content knowledge, problem solving, and understanding skills are not a significant factor with regard to using a blog as a supportive teaching-learning tool in a Euclidean Geometry course. This means that mathematics teachers who want to use a blogging activity in their courses should not be worried about whether the participants have a strong or weak background in mathematics. Through active collaboration and increased engagement both strong and weak students could benefit from the use of a blog as a supportive learning tool.

Furthermore, the study revealed that the effective use of a blog has numerous advantages as a supportive teaching-learning tool in a Euclidean Geometry course with only a few minor problems and no mentionable disadvantages. Additionally, it is likely that many of these problems will be overcome as software engineers continue to improve the quality of free or low cost blogging websites.

Finally, the study revealed that participants considered the blog to be an open and public forum where they can discuss issues and discussion topics of interest to them and present their personal views and experiences without hesitation. This has the potential to allow mathematics students and teachers to build and join in many virtual platforms on

blogs where they can share their voices and perspectives in a public forum. People from various corners of the world who love mathematics could be invited to participate in such an open discussion forum on the blog for learning and practicing mathematics.

Thus, the researcher strongly believes that the findings of this study suggest that blogs and other Web 2.0 technologies could provide an important avenue for fostering the teaching and learning of mathematics in today's technologically advanced society. Most teachers from the middle school to the college level have enough computing knowledge to create and maintain academic or personal blogs on a suitable server free of cost. Those who don't could be trained to do so in a few hours. Blogging activities similar to those discussed in this study could be utilized as is or with modification in the teaching of all areas of mathematics at almost any grade level. Educators need to capitalize on the proliferation of information technology and the fascination of students with the interactive features of emerging Web 2.0 applications that can be used wirelessly to positively impact the quality of mathematics education in the United States and abroad.

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APPENDICES

Appendix A: Survey Instrument

Please fill out this questionnaire based on your perceptions of the blogging activity in the course, EDSC 353: Teaching Secondary Geometry, in the fall semester of 2011.

I. Demographic Information

1. Please indicate your gender: ☐ Male ☐ Female

2. Please state your age: _____ years.

II. Experience in using Internet and Web 2.0 Application

3. Do you use a Smart Phone or Internet connected cell handheld device to get access to the Internet?

☐ Yes ☐ No ☐ I do not use a cell phone

4. How much total time do you spend per week on the Internet for all purposes?

_____ hours.

5. How do you rate your skills in using the Internet in terms of sending or receiving emails, browsing web pages, searching information, reading news on the Internet, etc.?

☐ Excellent ☐ Good ☐ Fair

6. How do you rate your interest/engagement in Web 2.0 applications such as: blog, Facebook, podcast, twitter, wikis, etc.?

☐ Very Much ☐ Average ☐ Very Little

7. Before participating in this activity how much experience in blogging did you have?

☐ Very Much ☐ Average ☐ Very Little

III. Attitudes toward the Blogging Activity

In this section, please express your response in **only one** of the following options:

VSA = Very Strongly Agree

SA = Strongly Agree

A = Agree

D = Disagree

SD = Strongly Disagree

V*SD* = Very Strongly Disagree

#	Question	Response					
8.	Participating in this blogging activity peaked my interest to learn how to conduct such an activity	VSA	SA	A	D	SD	VSD
9.	The blogging activity made me irritable	VSA	SA	A	D	SD	VSD
10.	After participating in this blogging activity I hope to see blogging activities in other mathematics courses I take in future	VSA	SA	A	D	SD	VSD
11.	I did not like participating in the blogging activity	VSA	SA	A	D	SD	VSD
12.	I enjoyed spending time online for this blogging activity	VSA	SA	A	D	SD	VSD
13.	The blogging activity was not worth the time and effort it involved	VSA	SA	A	D	SD	VSD
14.	I enjoyed reading solutions that my classmates posted on the blog	VSA	SA	A	D	SD	VSD
15.	I enjoyed posting topics or issues on the discussion board of the blog	VSA	SA	A	D	SD	VSD
16.	I felt uncomfortable participating in the blogging activity	VSA	SA	A	D	SD	VSD
17.	I enjoyed commenting on my classmates' contributions to the blog	VSA	SA	A	D	SD	VSD
18.	The blogging activity was interesting	VSA	SA	A	D	SD	VSD
19.	The blogging activity did not fulfill my initial expectations about it	VSA	SA	A	D	SD	VSD
20.	Blogging activities should be incorporated into other courses in the teacher education program	VSA	SA	A	D	SD	VSD
21.	I enjoyed posting solutions to the blog	VSA	SA	A	D	SD	VSD
22.	I felt comfortable with the blogging activity	VSA	SA	A	D	SD	VSD
23.	The blogging activity was boring	VSA	SA	A	D	SD	VSD

IV. Effectiveness of the Blogging Activity for Learning Euclidean Geometry

In this section, please express your response in **only one** of the following options:

VSA = Very Strongly Agree
SA = Strongly Agree
A = Agree
D = Disagree
SD = Strongly Disagree
V*SD* = Very Strongly Disagree

#	Question	Response					
24.	The blog provided me with an interactive tool for online learning	VSA	SA	A	D	SD	VSD
25.	The blogging activity encouraged me to share my ideas with other students in the course	VSA	SA	A	D	SD	VSD
26.	The blogging activity helped me understand difficult problems in easier ways	VSA	SA	A	D	SD	VSD
27.	The online discussion on the blog was more effective for learning Euclidean Geometry than in class discussion	VSA	SA	A	D	SD	VSD
28.	The blogging activity helped me get better scores on the quizzes	VSA	SA	A	D	SD	VSD
29.	My contributions to the blog increased the learning experience of other students in the course	VSA	SA	A	D	SD	VSD
30.	Writing a substantive comment to someone's solution on the blog encouraged me to think of an alternative solution to a problem	VSA	SA	A	D	SD	VSD
31.	The blogging activity helped me figure out how a specific problem could be solved in different ways	VSA	SA	A	D	SD	VSD
32.	Solving a problem on the blog was more effective for learning Euclidean Geometry than solving a problem face-to-face in class	VSA	SA	A	D	SD	VSD
33.	The blogging activity encouraged me to try other Web 2.0 technologies for teaching and learning Euclidean Geometry	VSA	SA	A	D	SD	VSD
34.	The contributions of my classmates to the blog helped me learn something new about Euclidean Geometry	VSA	SA	A	D	SD	VSD
35.	The blogging activity helped me better understand some concepts of Euclidean Geometry	VSA	SA	A	D	SD	VSD
36.	My contributions to the blog helped other students in the class learn something new about Euclidean Geometry	VSA	SA	A	D	SD	VSD
37.	The blogging activity helped me better utilize my leisure time for learning purposes	VSA	SA	A	D	SD	VSD
38.	The blogging activity encouraged me to collaborate with other students in the class	VSA	SA	A	D	SD	VSD
39.	The blogging activity provided me with some lifelong understanding of Euclidean Geometry	VSA	SA	A	D	SD	VSD
40.	The blogging activity created a collaborative learning environment in the Euclidean Geometry course	VSA	SA	A	D	SD	VSD
41.	The blogging activity was more effective for learning Euclidean Geometry than writing reflection papers on class readings	VSA	SA	A	D	SD	VSD

V. Open-ended Questions

In the following questions, please provide your response regarding your experience in this blogging activity.

42. What were the advantages of this blogging activity?

43. What were the disadvantages of this blogging activity?

44. Do you recommend the blog and other Web 2.0 technologies to be incorporated in other mathematics courses in the teacher education program and secondary school curricula? Why or why not?

45. Please briefly describe your personal experience of the blogging activity that is not asked in this survey?

Thank you for your participation.

Appendix B: Validity Checking Tool

Dear Sir/Madam,

As an expert in the field of mathematics education, I am requesting your help in determining the validity of a survey instrument that will be used in my doctoral dissertation research at the University of Nevada, Reno.

The purpose of the study is to examine preservice mathematics teachers' self-reported attitudes toward and perceptions of the effectiveness of a blog used to support a college Euclidean Geometry courses. Preservice mathematics teachers enrolled in EDSC 353: Teaching Secondary Geometry and CTL 728D: Problems in Teaching Secondary Mathematics courses will be asked to participate in this study. The perceptions of participants regarding a blogging activity that is a standard component of the course will be measured using an instrument I developed for this study. The blogging activities can be found at: http://edsc353fall2011.wordpress.com/.

Please carefully examine the items on the following pages and mark your opinion as to which of the following is measured by each item:

(A) Participants attitudes toward the Blogging Activity;
(B) Participants perceived effectiveness of the blogging activity for learning Euclidean Geometry; or
(C) Neither.

Please note that participants in this study will be asked to respond to each item on a 6-point Likert-type scale.

I appreciate your willingness to help us in this process. If you have any questions, please feel free to ask me or my dissertation advisor, Dr. Robert Quinn at 775-682-7526.

Thanks and regards,

Md Mokter Hossain
Email: mokter@gmail.com
Phone: 775-682-7538

- Please note that both positively and negatively worded items are included in this instrument. The same Likert scale options will be given for all items; however, in scoring negatively worded items, the point values for each response will be reversed. In the list below, the N or P in the second column indicates whether each item is phrased positively or negatively.

- **For each item, place an X in the column you feel is appropriate:**

#		**Item**	Appropriate for measuring		
			Attitude	Effectiveness	Neither
1.	P	The blogging activity was appropriate for this class			
2.	P	The blog provided me with an interactive tool for online learning			
3.	P	Participating in this blogging activity peaked my interest to learn how to conduct such an activity			
4.	P	After participating in this blogging activity I plan to use such activities in my future teaching			
5.	N	The blogging activity made me irritable			
6.	P	The blogging activity encouraged me to share my ideas with other students in the class			
7.	P	The blogging activity helped me understand difficult problems in easier ways			
8.	P	After participating in this blogging activity I hope to see blogging activities in other mathematics courses I take in future			
9.	P	The blogging activity encouraged me to show my talent and creativity on a public medium			
10.	P	Blogging activities should be implemented in other secondary mathematics classes			
11.	N	I did not like participating in the blogging activity			
12.	P	I enjoyed spending time online for this blogging activity			
13.	N	The blogging activity was not worth the time and effort it involved			

#		**Item**	Appropriate for measuring		
			Attitude	Effectiveness	Neither
14.	N	This blogging activity created problems for me			
15.	P	I enjoyed reading solutions that my classmates posted on the blog			
16.	P	The online discussion on the blog was more effective for learning Euclidean Geometry than in class discussion			
17.	P	The blogging activity helped me get better scores on the quizzes			
18.	P	I enjoyed posting topics or issues on the discussion board of the blog			
19.	N	The blogging activity was irrelevant to the Euclidean Geometry course			
20.	P	The contributions of my classmates to the blog improved my learning experience			
21.	N	I felt uncomfortable participating in the blogging activity			
22.	P	My contributions to the blog increased the learning experience of other students in the class			
23.	P	The blogging activity motivated me to be an active participant in this class			
24.	P	I enjoyed commenting on my classmates' contributions to the blog			
25.	P	Writing a substantive comment to someone's solution on the blog encouraged me to think of an alternative solution to a problem			
26.	P	The blogging activity helped me figure out how a specific problem could be solved in different ways			
27.	P	The blogging activity was interesting			
28.	P	The blogging activity gave me an opportunity to share my perspectives in a public forum			
29.	N	The blogging activity did not fulfill my initial expectations about it			
30.	P	Blogging activities should be incorporated into other classes in the teacher education program			

#		**Item**	Appropriate for measuring		
			Attitude	Effectiveness	Neither
31.	P	Solving a problem on the blog was more effective for learning Euclidean Geometry than solving a problem face-to-face in class			
32.	P	The blogging activity encouraged me to try other Web 2.0 technologies for teaching and learning Euclidean Geometry			
33.	P	The contributions of my classmates to the blog helped me learn something new about Euclidean Geometry			
34.	P	The blogging activity helped me better understand some concepts of Euclidean Geometry			
35.	P	My contributions to the blog helped other students in the course learn something new about Euclidean Geometry			
36.	P	The blogging activity created a new and more interesting approach to the teaching and learning of Euclidean Geometry			
37.	P	I enjoyed posting solutions to the blog			
38.	P	I felt comfortable with the blogging activity			
39.	P	The blogging activity helped me better utilize my leisure time for learning purposes			
40.	P	The blogging activity encouraged me to collaborate with other students in the class			
41.	P	The blogging activity provided me with some lifelong understanding of Euclidean Geometry			
42.	P	I enjoyed substantiating solutions that my classmates posted to the blog			
43.	P	The blogging activity created a collaborative learning environment in the Euclidean Geometry course			
44.	P	The blogging activity was interesting			
45.	P	The blogging activity was more effective for learning Euclidean Geometry than writing reflection papers on class readings			
46.	N	The blogging activity was boring			

Appendix C: Blogging Instruction

University of Nevada, Reno-Fall 2011
EDSC 353 –Teaching Secondary Geometry
Instructions of the Blogging Activities
25 Points

All students in EDSC 353-Teaching Secondary Geometry course will be expected to participate in a blogging activity related to the material covered in this course. Participating in this blog activity will provide you with an opportunity to discuss and explore your knowledge of Geometry. Your participation will include posting problem solutions as well as critiquing the solutions posted by others. Each week particular students will be identified as being responsible for posting complete solutions. All class members are welcome to comment substantively or briefly on posted solutions every week.

However, if you do not wish to participate in this activity, please inform the principal instructor of this class immediately so that he can provide you with an alternate assignment that will allow you to attain the 25 points designated for this activity.

The URL for this blog is: **http://edsc353fall2011.wordpress.com/**

You will need to have an email address in order to join this blog and to participate, you will need Internet access either at home or on a public computer at UNR or some other venue or a cellular device. If you do not have an email address or access to the Internet, please inform the principal instructor of this course immediately and he will provide you with an alternate assignment that will allow you to attain the 25 points designated for this activity.

The expectations of each aspect of this activity are described below.

1. Post complete solution of one problem during the week(s) assigned to you. (8 pts.)
2. Post at least five (5) substantive comments to solutions posted by other students. (10 pts.)
3. At least five (5) times active participation in the online discussion. (5 pts.)
4. Complete an anonymous questionnaire regarding this activity. (2 pts.)

In order to be awarded the maximum number of points in each category; (1) solutions must be complete and correct; (2) substantive comments must make a clear point regarding one of the problems or posted solutions; (3) participation in the online discussion should be active; and (4) the anonymous questionnaire must be submitted to the instructors.

If you have any problem or question regarding this activity please feel free to contact the section instructor at: mokter@gmail.com

Appendix D: Participants' Pseudonyms, Groups, and Schedule

Serial No	Gender	Pseudonym	Group	Assigned Weeks (Problem Sets)
1.	M	Heron	Greeks	Weeks 1st & 7th (Problem Sets A & G)
2.	M	Ricky Martin	Greeks	Weeks 1st & 7th (Problem Sets A & G)
3.	F	Sam	Greeks	Weeks 1st & 7th (Problem Sets A & G)
4.	F	Scooter	Greeks	Weeks 1st & 7th (Problem Sets A & G)
5.	F	Wally	Greeks	Weeks 1st & 7th (Problem Sets A & G)
6.	F	Eamesor	Geometers	Weeks 2nd & 8th (Problem Sets B & H)
7.	M	Indiana	Geometers	Weeks 2nd & 8th (Problem Sets B & H)
8.	M	Nevadatude	Geometers	Weeks 2nd & 8th (Problem Sets B & H)
9.	M	Razor	Geometers	Weeks 2nd & 8th (Problem Sets B & H)
10.	M	TheDude53	Geometers	Weeks 2nd & 8th (Problem Sets B & H)
11.	M	Golddust	The Squares	Weeks 3rd & 9th (Problem Sets C & I)
12.	F	Jane Doe	The Squares	Weeks 3rd & 9th (Problem Sets C & I)
13.	F	Twoqayl	The Squares	Weeks 3rd & 9th (Problem Sets C & I)
14.	M	Erdos	Mathletes	Weeks 4th & 10th (Problem Sets D & J)

Serial No	Gender	Pseudonym	Group	Assigned Weeks (Problem Sets)
15.	F	Fertis McCertis	Mathletes	Weeks 4th & 10th (Problem Sets D & J)
16.	F	Mathgirl	Mathletes	Weeks 4th & 10th (Problem Sets D & J)
17.	M	Reynold	Mathletes	Weeks 4th & 10th (Problem Sets D & J)
18.	F	Winnifred	Mathletes	Weeks 4th & 10th (Problem Sets D & J)
19.	M	Batman	Skittles	Weeks 5th & 11th (Problem Sets E & K)
20.	F	Giggles	Skittles	Weeks 5th & 11th (Problem Sets E & K)
21.	F	Justin	Skittles	Weeks 5th & 11th (Problem Sets E & K)
22.	F	Nemo	Skittles	Weeks 5th & 11th (Problem Sets E & K)
23.	M	Walter Sobchok	Skittles	Weeks 5th & 11th (Problem Sets E & K)
24.	F	John Wayne	Happy Barracudas	Weeks 6th & 12th (Problem Sets F & L)
25.	F	MathTeach	Happy Barracudas	Weeks 6th & 12th (Problem Sets F & L)
26.	F	Pythagoras	Happy Barracudas	Weeks 6th & 12th (Problem Sets F & L)
27.	M	TacoTuesday	Happy Barracudas	Weeks 6th & 12th (Problem Sets F & L)
28.	F	Woohoo	Happy Barracudas	Weeks 6th & 12th (Problem Sets F & L)

Appendix E: Certification of Approval for New Protocol

University of Nevada, Reno

Office of Human Research Protection
205 Ross Hall / 331, Reno, Nevada 89557
775.327.2368 / 775.327.2369 fax
www.unr.edu/ohrp

Certification of Approval for New Protocol: Social Behavioral
Social Behavioral Institutional Review Board

Date: November 18, 2011
To: Robert J Quinn, Ed.D.; Department of Curriculum, Teaching and Learning
Copy: Mokter Hossain

UNR Protocol Number: S12-043
Protocol Title: Preservice Mathematics Teachers' Perceptions of Using a Web 2.0 Technology as a Supportive Teaching-Learning Tool in a College Euclidean Geometry Course
Type of Review: Expedited 7 Minimal risk
Approval Period: November 18, 2011 to November 17, 2012

This approval is for:
SKMBT_60011110714220.pdf (Protocol support docs (all)), SKMBT_60011110714212.pdf (ICF), SKMBT_60011110714211.pdf (Protocol application), SKMBT_60011110714210.pdf (Suppl, exp review checklist)

Approved number of subjects: 29

The above-referenced protocol was reviewed and approved by one of UNR's Institutional Review Boards in accordance with the requirements of the Code of Federal Regulations on the Protection of Human Subjects (45 CFR 46 and 21 CFR 50 and 56).

PI Responsibilities

- Maintain an accurate and complete protocol file.
- Submit continuing projects for review and approval prior to the expiration date.
- Submit proposed changes for review and approval prior to initiation, except when necessary to eliminate apparent immediate hazards to subjects. Such exceptions must be reported to the IRB at once.
- Report any unanticipated problems which may increase risks to human subjects or unanticipated adverse events to the IRB within 5 days.
- Submit a closure request 10 days after project completion to the IRB.

Reference the protocol number on all related correspondence with the IRB. If you have any questions, please contact Nancy Moody at 775.327.2368.

For Veteran's Administration research only

VA Research: No
Flag VA Medical Record: No

Appendix F: Adult Informed Consent Form

University of Nevada, Reno Social Behavioral Institutional Review Board
Consent to Participate in a Research Study

TITLE OF STUDY: **Preservice Mathematics Teachers' Perceptions of Using a Web 2.0 Technology as a Supportive Teaching-Learning Tool in a College Euclidean Geometry Course**
INVESTIGATOR(S): Md. Mokter Hossain, Phone: (775) 682-7538
Robert J. Quinn, Ed.D., Phone: (775) 682-7526
PROTOCOL #: S12-043 UNR

Purpose
The purpose of this study is to examine preservice secondary mathematics teachers' attitudes toward and perceptions of a blogging activity in a college Euclidean Geometry course.

Participants
All students enrolled in EDSC 353- Teaching Secondary Geometry or the related CTL 728D-Problems in Teaching Mathematics, are being asked to participate in this study. Additionally, participants must be 18 years of age or older.

Procedures
If you agree to participate in this study, you will be asked to complete a researcher developed survey regarding your experiences in the blogging activity that is a standard component of the EDSC 353, Teaching Secondary Geometry course. In addition to your responses to this survey, comments you post on the blog using your pseudonym and your aggregate quiz score will be used as data for the analyses of this study.

Discomforts, Inconveniences, Risks, and/or Benefits
There are no known discomforts, inconveniences, risk, or direct benefits for you in participating in this study.

Confidentiality

The privacy of the participants in the research will be maintained throughout the study. There is no way that any form of your identity will be disclosed. You will not be personally identified in any reports or publications that may result from this study. The information obtained in this study may be published in national and international journals or presented at the conferences but the data will be reported as aggregated data.

TITLE OF STUDY: **Preservice Mathematics Teachers' Perceptions of Using a Web 2.0 Technology as a Supportive Teaching-Learning Tool in a College Euclidean Geometry Course**

INVESTIGATOR(S): Md. Mokter Hossain, Phone: (775) 682-7538
Robert J. Quinn, Ed.D., Phone: (775) 682-7526

PROTOCOL #: S12-043 UNR

Consent forms will be kept in a locked file cabinet in the Principal Investigator's office; and data from the study will be kept in a locked file cabinet in the Student Investigator's office until he has finished analyzing the data. At that time, all study materials will be securely stored at UNR for no more than five years. After that, all materials will be destroyed.

The Department of Health and Human Service (HHS), and the Social Behavioral Institutional Review Board at the University of Nevada, Reno have the legal right to monitor and review data obtained from this study.

Time, Costs/Compensation
This survey will take approximately 30 minutes to complete. There will be no cost to you nor will you be compensated for participating in this research study.

Right to Refuse or Withdraw
You may refuse to participate or withdraw from the study at any time without penalty.

Questions
If you have questions about this study or wish to report a problem related to this research, please feel free to contact Md. Mokter Hossain at (775) 682-7538 or mokter@gmail.com, at any time; or Robert J. Quinn, Ed.D. Professor of Mathematics Education, College of Education, University of Nevada, Reno, MS# 280, Reno, NV 89557, Phone: (775) 682-7526.

You may ask about your rights as a research subject or you may report (anonymously if you so choose) any comments, concerns, or complaints to the University of Nevada, Reno Social Behavioral Institutional Review Board, telephone number (775) 327-2368, or by addressing a letter to the Chair of the Board, c/o UNR Office of Human Research Protection, 205 Ross Hall / 331, University of Nevada, Reno, Reno, Nevada, 89557.

TITLE OF STUDY: **Preservice Mathematics Teachers' Perceptions of Using a Web 2.0 Technology as a Supportive Teaching-Learning Tool in a College Euclidean Geometry Course**

INVESTIGATOR(S): Md. Mokter Hossain, Phone: (775) 682-7538
Robert J. Quinn, Ed.D., Phone: (775) 682-7526

PROTOCOL #: S12-043 UNR

Consent, and Right to Receive a Copy
You are voluntarily making the decision of whether or not to participate in this research study. Selecting 'agree' certifies that you have decided to participate having read and understood the information presented. If you would like a copy of this form for your records, please ask the course instructor or either of the researchers.

Closing Statement

Please check one: I have read ( ) this consent form carefully, or have had it read to me ( ).

Md. Mokter Hossain has explained the study to me. If I do not take part in this study, my refusal to participate will involve no penalty or loss of rights to which I am entitled. I may withdraw from this study at any time without penalty [or loss of other benefits to which I am entitled].

I have been told my rights as a research subject, and I voluntarily give permission to participate in this study. I have been told what the study is about and how and why it is being done. All my questions have been answered.

I do agree ( ) to participate in this study.

Signature of Participant Date

Signature of Person Obtaining Consent Date

Signature of Investigator Date

Appendix G: Information Script

Hello Everybody,

My name is Md. Mokter Hossain. I am a doctoral candidate in Curriculum, Teaching, and Learning in the College of Education at the University of Nevada, Reno. For the last twelve weeks I conducted a blogging activity in which all of you participated. This blogging activity is a standard component of the EDSC 353 - Teaching Secondary Geometry course and the corresponding CTL 728D - Problems in Teaching Secondary Mathematics course.

In order to write my Ph.D. dissertation, I am conducting a study regarding this blogging activity. The main purpose of this study is to examine preservice secondary mathematics teachers' attitudes toward the blog and perceived effectiveness of using a blog as a supportive teaching-learning tool in a college Euclidean Geometry course. Additionally, these attitude and perceived effectiveness scores will be compared to the composite quiz score of each preservice math teacher. Finally, the discussion board of the blog will be analyzed qualitatively for emergent trends.

I am respectfully requesting your participation in this study. If you agree to participate, you will be asked to complete a consent form which indicates that you understand the study and agree to participate. If you agree to participate, you will be asked to complete a survey which I created which is designed to measure your attitudes toward and perceptions of the effectiveness of the blogging activity in this course. The survey should take approximately 30 minutes to complete. There will be no cost to you to participate in this study nor will you be compensated in any way. If you choose not to participate in this study, your refusal to participate will involve no penalty or loss of rights to which you are entitled. Additionally, you may withdraw from this study at any time without penalty, or loss of other benefits to which you are entitled.

There are no known discomforts, inconveniences, risk, or direct benefits for you in participating in this study. Your privacy will be maintained throughout the study and no form of your identity will be disclosed. The information obtained in this study may be published in national and international journals or presented at the conferences but the data will be reported as aggregated data. You will not be personally identified in any reports or publications that may result from this study.

If you have any question regarding this study, please feel free to ask me. I will be more than happy to answer your questions.

Thank you everybody.

Mokter Hossain
More at: http://m0kter.wordpress.com/