MAKING EFFECTIVE VIDEO TUTORIALS:
AN INVESTIGATION OF ONLINE WRITTEN AND VIDEO HELP TUTORIALS IN MATHEMATICS FOR PRESERVICE ELEMENTARY SCHOOL TEACHERS

by

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B.S., University of Kansas, 2002
M.S., University of Kansas 2004

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Elementary Education
College of Education

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Abstract

Online assessments afford many advantages for teachers and students. Okolo (2006) stated, "As the power, sophistication, and availability of technology have increased in the classroom, online assessments have become a viable tool for providing the type of frequent and dynamic assessment information that educators need to guide instructional decisions," (pp 67-68). As post secondary institutes use online learning environments, education has molded into hybrid experiences. Traditional courses now regularly infuse components of online learning and assessments by required student participation both in person and online. Research is needed to analyze online components of assessment and student achievement.

Data was gathered from an undergraduate mathematics course designed for students seeking a bachelor's degree in elementary education. The course was entitled *MATH 320: Mathematics for Elementary School Teachers*. Synergies of quantitative and qualitative data were evaluated to assess the impact of written and video help tutorials in online quizzes on student achievement. Three forms of data were collected: student interviews, surveys about students' online quiz experiences and learning style preferences, and student performance and tutorial usage statistics from seven online quizzes.

Student interviews were conducted mid-semester by the researcher who also transcribed and analyzed data. Graphical schemes were used to identify and categorize responses to interview questions. Students' responses were summarized and quantified in frequency tables. Surveys about students' online quiz experiences and learning style preferences were analyzed through descriptive statistical methods to describe the data with numerical indices and in graphical form. Correlation matrices and linear regression models were used to identify relationships among survey items. Additionally, Analysis of Variance (ANOVA) techniques were used to explore the data for statistical significance. Students were assigned seven online quizzes throughout the semester. Descriptive statistics were calculated to describe the online quiz data. Regression models were used to determine correlations between use of help tutorials and performance on online quizzes.

Data analysis revealed students were persistent and motivated to retake similar quizzes multiple times until a high or perfect score was obtained. After missing a problem, students selected written help tutorials more often than video help tutorials to identify mistakes and understand how to solve the particular problem. The proportion of students whose scores improved after using both written and video help tutorials was greater than those who used the written help tutorials alone. Although the number of students who benefited from the video help tutorials was smaller than expected, the increased performance could be appreciated by students and educators alike. The research presented herein should serve as a base for curriculum development in university mathematics programs utilizing or considering implementation of online tutorials coupled with student evaluation.

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Dedication

I would like to dedicate this dissertation to all of my former high school and college students; anything is possible if you work hard and persevere. Additionally, I would like to dedicate this dissertation to my friends, family and colleagues, for which completion would have been impossible without their support and encouragement.

CHAPTER 1 - INTRODUCTION

As assessment efforts have evolved to include online environments, an understanding of students' learning styles became more important. Multiple intelligences, learning styles, mathematical literacy, and theories of teaching and learning are significant contributors to the improvement of student learning and achievement in online environments. This study will explore the impact of written and video help tutorials in online math quizzes and student achievement. Launching this study inspired some questions to ponder: what selling qualities within video help tutorials are necessary to entice viewers? Will the written and video help tutorials benefit student learning?

Overview of the Study

Learning is a lifelong adventure essential for personal development and professional success. Technology has become an integral part of daily routines, and is essential to successfully function in the digital age. As post-secondary institutes use online learning environments, higher education is molding into hybrid experiences. Traditional courses have begun to regularly infuse components of online learning and assessments. Research is needed to analyze online components of assessment and student achievement.

The origination of online quizzes for the course in this study included written help tutorials that explain how to solve a specific math problem. For this study video help tutorials will be created on the basis that students who struggle with reading technical mathematical writing would benefit from an audio and visual approach. This research will explore students' behaviors regarding online quizzes including students' use of written and video help tutorials in online quizzes, number of attempts per quiz, number of help tutorials viewed, and overall achievement. Moreover, interviews and surveys will provide insight from students' point of views in regards to their online experiences in the course.

Okolo (2006) stated, "As the power, sophistication, and availability of technology have increased in the classroom, online assessments have become a viable tool for providing the type of frequent and dynamic assessment information that educators need to guide instructional decisions," (pp 67-68). Online assessments afford many advantages for teachers

and students. One particular benefit is immediate evaluation and analysis of student performance (Okolo, 2006; Ozden, Erturk, & Sanli, 2004; Smith 2007). These results allow for rapid instructional decisions by teachers to be made for the next class period if not the same day. Students have positive remarks about the instant feedback of results within online assessments, and students find the instantaneous feedback to be motivating, as well as encourage skills practice (Okolo, 2006; Ozden, Erturk, & Sanli, 2004; Smith 2007). Bromham and Oprandi (2006) found significant positive correlations between the number of completed online self-assessment questions related to lecture and course material, student in-class performance exams, and overall course grade. Smith (2007) also found significant positive correlations between frequent online formative assessments and exam scores, determining online quiz scores to be near predictors of exam scores.

While we have known we can predict overall course grades by exam scores there are other factors to consider. When planning and preparing for any course, online or face-to-face, Danielson (2007) discussed educators' need to consider contextual factors of students. Such factors should include, but not be limited to: students' background, socio-economic status, hobbies and personal interests, future goals, learning styles, prior content knowledge, as well as educational and personal experiences (Danielson, 2007; Fosnot, 2005; NCTM, 1991, 2000; Shunk, 2008; Van de Walle, 2007). Taking these factors into account produced a specific list of aspects to consider when analyzing data related to the effects of implementing written and video help tutorials into online quizzes. Knowledge about multiple intelligences, learning styles, mathematical literacy abilities, and theories of teaching and learning provide foundations to understand student learning and achievement in traditional and online environments.

Statement of the Problem

Multiple intelligences and learning styles impact how students learn and therefore should be taken into account by educators when they prepare a course (Gardner, 1983, 1999). Mathematical literacy is a critical component required when students are learning mathematics. Kramarski and Mizrachi (2006) describe mathematical literacy as involving the capacity to identify, understand and engage in mathematics. In this study students' require mathematical literacy to understand and learn from the written help tutorials. To meet the needs of students who lack mathematical literacy, video help tutorials will be created and available in addition to the written help tutorials. Assessments are significant elements in measuring students' achievement. Popular forms of assessments occur online and provide instant feedback to both the student and teacher. Current research pertaining to online assessments is primarily paired with pure online courses (Challis, 2005; Goodfellow & Lea, 2005). Therefore, research is needed to explore traditional or hybrid courses that use online assessments.

Purpose and Significance of the Study

The study intends to examine students' use of help tutorials in online quizzes in an undergraduate math course. Determining the circumstances under which students choose to view the written and video help tutorials is a goal of this study. Moreover, recognizing effective elements of video help tutorials, and if the video help tutorials improve student achievement are important factors for this research.

Online and hybrid courses are becoming common, and a better understanding is needed about how best to provide information to students in such a setting. Quantitative and qualitative data will be converged to better understand the impact of written and video help tutorials on student achievement. Understanding the effects and their importance toward student achievement will contribute to the decisions of developing additional courses with similar online testing environments. The results should offer insight to the professors teaching the course in regards to planning and preparation; in particular, learning generalizations about the student population who takes the course. Additionally, the

university mathematics program should learn how students will perform on online assessments given different online tools in the form of technical written help or video format.

Brief Description of the Methodology

The study presented herein will use quantitative and qualitative research methods to examine student selection of help tutorials in online quizzes in an undergraduate math course. Online quizzes will be used to measure the relationship between student selection of help tutorials and student achievement. A survey about students' online quiz experiences and learning style preferences, and student interviews will explore reasons for students' selection of the written and video help tutorials, and their learning preferences.

Descriptive statistics will describe the online quiz data and regression models will determine correlations between use of help tutorials and performance on online quizzes. Interviews will be conducted during mid-semester. Analyses will include color coding schemes to identify and group similar and different responses to interview questions. Frequency tables will summarize and quantify students' responses. Surveys about students' online quiz experiences and learning style preferences will be administered during the last two weeks of the course. Descriptive statistics will enable the researcher to meaningfully describe data with numerical indices and in graphical form. Correlation matrices should identify relationships among survey items and reduced the set of variables to a smaller number of factors. Cronbach alpha's will be computed among grouped survey elements to determine reliability of their groupings. Linear regression models will determine correlations among variables and ANOVA techniques will explore data for statistical significance.

Research Questions

The initial research question guiding the study is: What impact does written and video help tutorials have on online assessment experiences for students?

This question leads to exploring different components of students' online experiences, resulting in the following questions:

1. Under what circumstances do students choose to view written help tutorials?
2. Under what circumstances do students choose to view additional help in the form of a video help tutorial?
3. What elements contribute to the effectiveness of a video help tutorial?
4. Does making video help tutorials available improve student achievement?

Limitations of the Study

Inherent limitations generally hold in all research. The first limitation will be the restricted number of video tutorials available within the first two online quizzes, creating a lack of exposure and knowledge about the additional resource to students. The inability to determine the length of time students viewed the videos or if students actually watched the videos after they begun will also bound data and analysis. Another limitation will involve the inability to determine if students in fact read the written online help when it was offered. Additionally, the small number of students to be interviewed during the Spring 2009 semester will be a restraining factor of this research.

Definitions of Terms

Learning Style: Characteristic cognitive, affective, and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment (Sims & Sims, 1995, xii). Four categorized learning styles are: Auditory, Visual, Tactile, and Kinesthetic.

Intelligence: A biopsychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of value in a culture (Gardner, 1999, 33-34).

Multiple Intelligences (MI): Different types of intelligences that are grouped into eight categories: Linguistic, Bodily-Kinesthetic, Spatial, Musical, Logical-Mathematical, Intrapersonal, Interpersonal, and Naturalist Intelligences (Gardner, 1999).

Online Student Behaviors (Online Behaviors): Data tracked from the online assessment program students use to complete the quizzes. Information includes but is not limited to: dates and times of taking quizzes, number of attempts taking each quiz, number of written/video help tutorials used, and scores per quiz attempt.

Written Help Tutorials: A webpage accessible to students upon unsuccessful completion of a problem, which contains the problem solving process to the problem described in text (see Figure 1.1 and Appendix J).

Figure 1.1 Problem from Quiz 7 – Measurement

Problem:

If the radius of a sphere increases in size by 8%, then by what percentage does the volume increase? Give your answer to the nearest one percent.

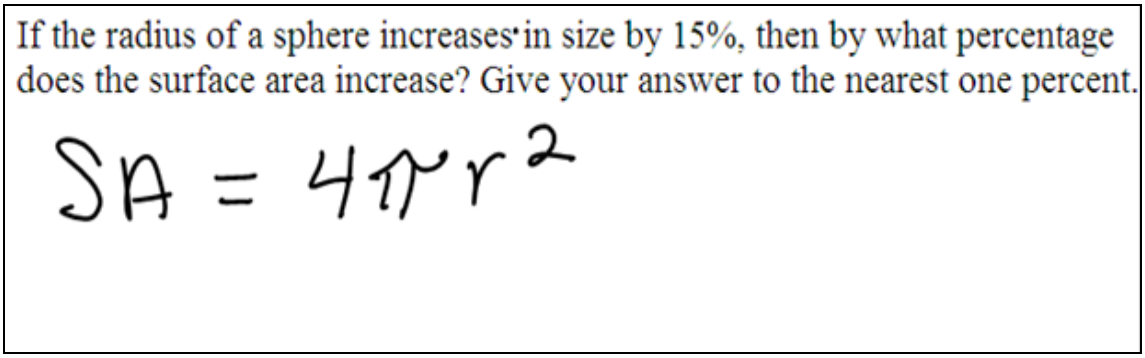
Written Help Tutorial:

The volume of a sphere is given by the formula $4 \cdot \pi \cdot r^3/3$.
Then the 8% increase in the radius of a sphere can be computed as follows:
$4\pi \cdot (1.08r)^3/3 = 1.08^3 \cdot (4 \cdot \pi \cdot r^3/3) = 1.259712 \cdot (4 \cdot \pi \cdot r^3/3)$.
Therefore the volume increased by (1.259712-1) = 0.259712, which to the nearest one percent is 26%.

Video Help Tutorials: A 1 to 2.5 minute video describing and demonstrating how to work through the solution to a similar problem (see Figure 1.2). The researcher used a Tablet PC laptop to digitally record handwritten work, while recording audio through the use of computer software for creating and editing videos. Students will hear the researcher discuss their thought processes to solve the problem, as well as see the handwritten work of the researcher as the problem is being solved. URL addresses to links of all online video help tutorials can be found in Appendix F.

Figure 1.2 Link to Video Help Tutorial for Quiz 7 - Measurement

For a video explanation of how to solve a similar problem, click the image below (opens in a new window).



CHAPTER 2 - LITERATURE REVIEW

The purpose of this study is to investigate the impact of written and video help tutorials in online quizzes on student achievement. A review of literature supporting this research will include teaching and learning theories that provide insight to how students learn, and what teachers should consider when preparing their course. To address why students might select written and video help tutorials a discussion of multiple intelligences and learning styles of students is provided. Additionally, a section pertaining to literacy and mathematical literacy was included to specifically consider foundations needed to learn from the written help tutorials. Finally, the literature review will contain information about assessing students in online environments.

Teaching and Learning Theories

The design of learning activities should be based on the learners' needs and interests to create opportunities for learners to analyze their experience and its application to their life situations (Bruner, 1966; Fosnot, 2005; NCTM, 2000; Sims & Sims, 1995). Focus has shifted from the teacher, the transmission of information and how it can be improved, to the learner and how best to promote learning. Therefore, an important question to be considered is "What is learning and how does it occur?" (Sims & Sims, 1995).

Learning and Constructivism

Understanding how students learn is important in this study because learning in online environments is not thoroughly researched at this time. According to Schunk (2008) learning involves developing new actions or modifying existing ones; it excludes temporary behavioral changes because, when removed the behavior returns to its original state. Learning is not determined by heredity, such as maturation, but actual development of behaviors depends on the environment. For example, as children's vocal apparatus matures they are able to produce sounds, but the actual words produced are learned from social interactions and teaching (Schunk, 2008).

Bruner (1966) a psychologist contributed to cognitive learning theory in educational psychology and to the general philosophy of education. Much of Bruner's work was influenced by Piaget and Vygotsky's (1978) theories of learning. Vygotsky was a prolific author in the early twentieth century, whose interests included education, child development, and developmental psychology. Piaget also a psychologist throughout the twentieth century was well known for his theory of cognitive development. The importance of discovering generalized principles that apply to the overall teaching process for the class, rather than devising a plan for individual interactions between teacher and individual students was discussed by Bruner. He continued to articulate that educators cannot mistake the importance of individual differences in students when considering instructional procedures to increase the effectiveness of teaching problem solving, which is consistent to current constructivist views. Bruner also urged educators should concentrate on teaching methods that urge the development of self-instruction devises that students may use in the classroom at their own pace. Such devices need to be created in a way that the student can select their own problems, secure the necessary guidance and stimulation, and find reward (Bruner, 1966). In this study, to aid in students online learning experiences they are provided with opportunities to select written and video help tutorials after submitting incorrect answers.

Behavioral and environmental factors influence learning. Learning principles that affect the learning of students and the success of teaching efforts are: setting the stage, increasing learning during teaching, and maintaining basic knowledge in particular areas (Bruner, 1966). Sims and Sims (1995) described setting the stage requires providing clear instructions and modeling appropriate behavior when emphasizing particular skills or competencies. To increase learning during teaching instructors should provide opportunities for active participation, help students increase self-efficacy, match teaching techniques to students' self-efficacy, provide diagnostic and practical feedback, as well as opportunities for students to practice new behaviors (Bruner, 1966; Sims & Sims, 1995). Maintaining basic knowledge in particular areas requires developing learning points to assist in knowledge retention, setting specific goals, teaching students how to reinforce their learning, and teaching students how to take responsibility for their own learning. These factors indicate that the teacher must ensure that the environment is made ready for learning (Bruner, 1966; Sims & Sims, 1995). More importantly, what students do with information, specifically how

they attend to, rehearse, transform, code, store, and retrieve information, are critically important components of learning (Schunk, 2008). Additionally, the way students process information determines what, when, and how they learn as well as what use they will make of the new knowledge (Schunk, 2008; Sims & Sims, 1995).

Bruner (1966) discussed the student's tendency to analyze, and the degree to which they reflect over the possibility of their answers, determines the probability of finding a successful solution. Bruner continued to state that the degree of involvement students have in the problem is a variable that determines the likelihood of proliferating hypotheses and persisting until they reach the solution. Such behavior is under the control of motivational and attitudinal variables and specific habits of reflection over the differential validity of alternatives and visual analysis. Maximizing identification between teacher and student and establishing a nurturing relationship can make the students want to master tasks in order to maintain the nurturing tie (Bruner, 1966). In this study, students' online behaviors will be examined, such as the number of quiz attempts, and number of written and video help tutorials used. These online behaviors could reflect levels of motivation towards successfully completing the problems.

One's motivation is a major variable that affects all phases of learning and performance (Brunner, 1966). Fosnot (2005) acknowledged motivation to participate and become actively involved in their education stems from high expectations set forth by the teacher. Additionally, setting a stage based on posing interesting problems, where questions and exploration are encouraged, and where an active approach to new tasks can be satisfying fosters motivation (NCTM, 2000). Students are more likely to become involved and invested in learning when they are able to choose the task or problem themselves and where they perform privately rather than in public (Schunk, 2008; Sims & Sims, 1995). Questioning and curiosity should never be punished because extinguishing the students early participation must be avoided at all costs (Bruner, 1966; Fosnot, 2005, Schunk, 2008; Sims & Sims, 1995).

Bruner (1966) said students strongly motivated to master learning situations will inhibit their participation if they are preoccupied with the notion of possibly failing. For such students, their participation becomes a test of their self-image and competence (Bruner, 1966). This is perpetuated in a classroom where the only acceptable answer is the correct

answer and where students are only rewarded for asking good questions or giving good answers (Bruner, 1966). Bruner declared active, question-asking, hypothesis-forming approaches and explorations should be strongly encouraged in the learning process. Students must learn to tolerate ambiguity and to use "not knowing" as an incentive for questions that are unanswerable. Bruner suggested that to extract participation the use of materials that have relevance and interest for all students is a necessity; gaining student participation requires inclusion of more material related to gender roles, age, and interest patterns.

The online learning environment in this study does not allow for active question-asking, hypothesis-forming approaches as described by Bruner (1966). However, students encounter those experiences within the face-to-face portion of the course. With the ability for students in this study to retake the online quizzes multiple times, they encounter opportunities to learn from their mistakes and have the chance to earn full credit on each quiz. The multi-retake option reflects the assumption of students being motivated either by mastery of content or by grades.

Influences of Constructivism

One popular learning theory in the 21 century is that of constructivism. Constructivism is a theory of learning in which the student and teacher work together to engage in inquiry, problem solving, and constructing knowledge (Fosnot, 2005). Marsh and Willis (2003) describe constructivism as "a theory that views knowledge as something constructed by individual human beings, not merely discovered, and that draws heavily upon recent work by cognitive psychologies" (p. 286-287). Constructivists recognize the impact environment plays in students learning along with the key role language plays in the acquisition of knowledge (Draper, 2002; Fosnot, 2005; Marsh & Willis, 2008; NCTM, 2000; Schunk, 2008). Teaching practices based on constructivism heavily involve rich conversation where the teacher is a facilitator, aiding the students as they create constructions by providing structure and support (Draper, 2002; Fosnot, 2005; Schunk, 2008). Furthermore, constructivist pedagogy involves a relationship between teacher and student in a self-regulated process of concrete experiences, collaborative discourse, and reflection (Marsh & Willis, 2003; NCTM, 2000; Schunk, 2008).

The foundations of the constructivist theory can be connected to Vygotsky's (1978) theories of learning and social development. Vygotsky claimed social interactions play a fundamental role in the process of cognitive development. Moreover, Vygotsky discussed the Zone of Proximal Development (ZPD), as the distance between a student's ability to perform a task under guidance and/or with peer collaboration, and the student's ability of problem solving independently.

Constructivist perspectives have important implications for the design of curriculum and instruction. Research suggests building upon students' knowledge base facilitates their learning (Fosnot, 2005; Marsh & Willis, 2003; NCTM, 2000; Schunk, 2008). There is much to be gained in better understanding students prior experiences that they bring into the classroom. Educators can do this by working within Vygotsky's (1978) theory of learning. Recommendations include actively involving students in their learning and provide experiences that challenge their thinking. Social interactions are critical and enable students to learn with and from one another. This can lead to increased development of skills, knowledge, and understanding. Self-regulation is developed through internal representation of actions and mental operations that occur in social interactions. Human development occurs through the cultural transmission of tools such as language and symbols, where language is also the most critical tool as it develops from social speech, to private speech, to inner speech. Vygotsky is well known for the Zone of Proximal Development (ZPD), which is the difference between what children can do on their own and what they can do with assistance from others. Interactions with adults and peers in the ZPD promote cognitive development. Constructivism also emphasizes the reflective teacher and stresses social group learning and collaboration, which is functional for effective learning (Vygotsky, 1978). Schunk (2008) agrees modeling and observation allow students to experience higher levels of self-efficacy for learning. Vygotsky's theory of learning could be misguided in this study as students engaged in individual learning tasks with the online environment and minimal social interactions existed in lecture classes.

The online quizzes in this study support constructivism through the interaction of the help tutorials during the problem solving process, enhancing the face-to-face learning experience from attending class. Students sometimes work together when completing the online quizzes, providing students with critical interactions for them to learn from one

another. Moreover, the written and video help tutorials produce different forms of modeling and problem solving that is a component of constructivism.

NCTM : Supporting Constructivism

Steering away from teaching students rote memorization of isolated skills and facts, the National Council of Teachers of Mathematics (NCTM), *Principles and Standards for School Mathematics* (2000), emphasizes a more student-centered math classroom through problem solving and communication, which are chief aspects of constructivism. NCTM's theories of teaching and learning stemmed from well-known and influential educational contributors such as John Dewey, George Polya, Nel Noddings, Liping Ma, and Pierre van Hiele, just to name a few. All of them discuss aspects of constructivism educational views. NCTM acknowledges differences in students, claiming not all students learn alike, as they should have access to and engage in high-quality mathematics instructional programs (NCTM, 1989, 1991, 1995, 2000).

NCTM's (2000) support of constructivism is shown through the engagement of five process standards within teaching and learning mathematics, which include: problem solving, communication, connections, reason & proof, and representations. Problem solving is of high interest for this study. NCTM (2003) stated, "Children's thinking has often been described as similar to a staircase on which children first use one approach to solve problems, then adopt a more advanced approach, and alter adopt a yet more advanced approach," (p. 293). The staircase description leads to cognitive variability, where students use multiple thinking strategies when solving problems of the same type (NCTM, 2003). Kuhn, Garcia-Mila, Zohar, and Anderson (1995) and Schauble (1996) as cited in NCTM (2003) said,

> Even when children master strategies that are both faster and more accurate, they continue to use older strategies that are slower and less accurate as well. That continued use occurs not just with young children but with preadolescents, adolescents, and even adults. (pg 293)

Therefore, regardless of age or level of education, students' problem solving skills need practice and fine tuning. NCTM (2003) asserted, students actually learn better when allowed to choose their own strategy. Further, students who use a greater variety of different problem solving strategies also tend to learn better subsequently (NCTM, 2003).

As previously attended to, educators need to consider student diversity and contextual factors. NCTM (2003) contended challenges when learning mathematics reflect a combination of limitations with background content knowledge, processing capacity, and conceptual understanding. Students may learn mathematics with a high level of proficiency if those limitations are addressed (NCTM, 2003). Moreover, educators can attend to such limitations by providing appropriate problem solving opportunities; that allow students to construct new knowledge using hands-on and collaborative experiences, which support constructivist theories of learning.

Creating a Constructivist Classroom

Draper (2002) explains how constructivism offers teachers a way to consider how students think and come to know new knowledge. Constructivist pedagogy requires educators to investigate what students know, what they want to know, what they need to know, and how to move students toward the desired knowledge. Students' interests may shift over time and learning experiences may vary, creating unpredictable and tenuous situations that effect teacher facilitation. Constructivist teachers should seek and value students' points of view and structure lessons to challenge students' inferences. Therefore, teaching with a constructivist approach requires teacher responsiveness and receptivity (Draper, 2002; Fosnot, 2005; Marsh & Willis, 2003).

From the evolution of NCTM's teaching and learning mathematics theories, a constructivist approach has been evident. The *Professional Standards for Teaching Mathematics* (NCTM, 1991), set the stage for the first set of six standards that encompass NCTM's vision of core dimensions: worthwhile mathematical tasks, role of discourse, the learning environment, and the analysis of teaching and learning. Comparing the original 1991 S*tandards* to the 2000 *Principles for Teaching School Mathematics*, there is a noticeable progression of improving the role of the teacher and student in a constructivist education. The *Principles and Standards for Teaching School Mathematics* (NCTM, 2000) describes crucial issues that are deeply intertwined with mathematics programs and elicit qualities of a constructivist approach towards teaching and learning mathematics through problem-based situations and engaging discourse among students.

This is consistent with this study as students encounter problem-based learning both in class and through the online quizzes. Students choosing to attempt the online quizzes

multiple times receive more problem solving experiences. Even though each quiz is comprised of similar problems, students are allowed to practice and master skills attempt after attempt. The written and video help tutorials are created with constructivist pedagogy in mind, as they take into account what students know, what they need to know, and how to move students toward the desired knowledge.

Multiple Intelligences and Learning Styles

Multiple Intelligences

Gardner (1983) developed a theory of multiple intelligences through his studies on intelligence and cognition. His theory suggested the existence of a number of different intellectual competencies. The study of intelligence quotient, or IQ, influenced his research and theory behind multiple intelligences. An IQ score predicts one's ability to handle school subjects; however, it foretells little of one's success for the future (Armstrong, 2003; Gardner, 1983, 1999). Gardner's work resulted in defining eight intelligences (see Table 2.1) that are important for identifying students' abilities in different modalities. Gardner proposed that understanding students' multiple intelligences will lead toward knowing students' learning styles and best practices for providing effective instruction.

Table 2.1 Gardner's Eight Intelligences

(Gardner, 1983, 1999)

1. **Linguistic Intelligence** – The understanding of syntax, the semantics of language, and its practical uses to help one to remember information, and communicate or explain knowledge. Examples include the storyteller, spokesperson, poet, editor, and novelist.

2. **Bodily-Kinesthetic Intelligence** – The ability to control one's bodily motions and the ability to handle objects skillfully. Examples include the actor, mime, craftsperson, athlete, sculptor, and dancer.

3. **Spatial Intelligence** – The ability to perceive the visual world accurately, to perform modifications and transformation upon one's initial perceptions, and to be able to re-create aspects of one's visual experience (even in the absence of the relevant physical stimuli). Examples include the architect,

surveyor, inventor, and graphic artist.

4. **Musical Intelligence** – The ability to understand and express components of music, including rhythmic patterns and patterns in melody, through figural or intuitive means (the natural musician) or through formal analytic means (the professional musician). Examples include the composer, pianist, percussionist, music critic, and singer.

5. **Logical-Mathematical Intelligence** – The understanding and use of logical structures including patterns, relationships, statements and propositions, through experimentation, quantification, conceptualization, and classification. Examples include the scientist, mathematician, logician, computer programmer, and statistician.

6. **Intrapersonal Intelligence** – The ability to access one's own emotional life through awareness of inner moods, intentions, motivations, potentials, temperaments, and desires, as well as having the capacity to symbolize these inner experiences, and apply these understandings to help one live one's life. Examples include the psychotherapist, entrepreneur, creative artist, and spiritualist.

7. **Interpersonal Intelligence** – the ability to notice and make distinctions among other individuals with respect to moods, motivations, intentions, and to use this information in pragmatic ways, such as to persuade, influence, mediate, or counsel individuals or groups toward some purpose. Examples include the teacher, therapist, administrator, and political leader.

8. **Naturalist Intelligence** – The capacity to recognize and classify the numerous species of flora and fauna in one's environment (as well as natural phenomena such as mountains and clouds), and the ability to care for, tam, or interact subtly with living creatures, or with whole ecosystems. Examples include the zoologist, biologist, veterinarian, hunter, and forest ranger.

The written help tutorials reach students linguistic and logical-mathematical intelligences through their abilities to read examples and explanations of the math problems. Whereas, the video help tutorials not only support linguistic and logical-

mathematical intelligences but also the spatial intelligence, by providing handwritten and verbal explanation of similar problems students missed in the online quizzes.

Learning Styles

Many educators' knowledge of learning styles is associated with the familiarity of Gardner's (1983, 1993) research on Multiple Intelligences (MI) in the 1980s and 1990s. Due to a lack of knowledge about student diversity, students' learning styles are often overlooked by educators (Danielson, 2007). Identification of students' individual learning styles would open the opportunity for the creation of various teaching and learning models. Teachers with large classes are challenged to bring quality instruction to each individual student and identify his or her unique learning styles, while managing the entire class. By understanding learning styles teachers can create effective lessons to meet the needs of students (Sims & Sims, 1995; Sloan, 2004).

Teachers of large class sizes are faced with the challenge of bridging the gap between teaching approaches that are geared at the class level, to take place at the individual student level. Hence, gaining insight on students' learning styles can provide critical information for planning effective lessons and increasing student self-knowledge. Learning style inventories provide information about students learning preferences within: 1) instruction and environment, 2) information processing, and 3) personality (Rayneri, Berber, & Wiley, 2006; Sims & Sims, 1995).

Four preferences of student learning styles are: auditory, visual, tactile, and kinesthetic (Rayneri, Berber, & Wiley, 2006). Students who learn best through auditory experiences initially listen to verbal instruction, discussion, or recordings. Visual learners can recall what has been read or observed when asked for information from printed or diagrammatic material. They often can close their eyes and visually recall what they have previously read or seen. This is different from tactile learners who need to underline as they read, take notes when they listen, and keep their hands busy, particularly if they have low auditory preferences. Kinesthetic learners require whole body movement and real life experiences in order to absorb and retain learned material. They learn most when totally involved, for example partaking in acting, drama, designing, and building (Rayneri, Berber, & Wiley, 2006; Sims & Sims, 1995).

Learning style inventories identify which styles of learning students prefer most, but this does not indicate that students cannot learn through the other modes. Some inventories group both tactile and kinesthetic styles together since there are similarities between the two, such as students prefer hands-on and active approaches to learning. Often students may prefer a combination of styles. By understanding students preferred learning styles teachers can cater their lessons to meet the needs of their students (Rayneri, Berber, & Wiley, 2006; Sims & Sims, 1995; Sloan, 2004). From studies conducted at thirteen universities between 1980 to 1990 (as cited in Dunn et al., 2009), conclusions revealed, "…matching students' learning styles with compatible educational interventions positively impacted their academic achievement" (Dunn et al., 2009, p. 138).

Understanding that students learn in different modalities prompted the interest of looking for the impact of written and video help tutorials in online assessments on student achievement. The video help tutorials meet the needs of auditory and visual learners, where the written help tutorials do not meet the needs of learners who prefer auditory experiences.

Building Mathematical Literacy in a Constructivist Era

National concerns have been on the rise regarding reading and mathematical proficiencies among today's adolescents. Standard-based education and performance on standardized testing have been large factors contributing to the pressures for improving students' abilities in mathematics and reading (Moss, 2005). The Educational Testing Service, National Commission on Excellence in Education, and the National Assessment of Educational Progress confirmed students performing less than proficient or at a static rate since the early 1980's. The effects of poor reading and math skills not only result in low-performing schools but impact the job market and economy. When better-educated individuals leave the workforce, they are replaced by those who on average lack in reading and math skills (De Anda & Hernandez, 2007; Jacobs, 2008; Moss, 2005; Oleck, 2007; Shanahan & Shanahan, 2008).

The need to improve literacy and mathematical skills is crucial for producing well-educated contributors to society. Debates over which content-area teachers should be responsible for literacy instruction have been ongoing for years (Draper & Siebert, 2004; Moss, 2005). Such debates must cease, since literacy is involved in all domains of education.

All teachers should hold stock in their role of teaching literacy skills. An important guiding question for this study is, "Can students read in the content area when needed?" which is essential for students to obtain full use of the written help tutorials.

Students' levels of literacy and mathematical literacy could impact the helpfulness of the written help tutorials used in this study. In order for the written help tutorials to be beneficial, students need to be able to read technical mathematical writing. Interviews, survey results, and student online behaviors could provide insight about students' math literacy and achievement. Students' learning style preference could play a role in their decision to use written and video help tutorials within the online quizzes.

Literacy and Mathematics Literacy

Before addressing the concerns with literacy we need to understand what is meant by literacy, sometimes referred to as adolescent literacy. Literacy involves more than reading and writing; it includes purposeful social and cognitive processes that help individuals discover ideas and create meaning. Adolescent literacy also includes analysis, synthesis, organization, and evaluation of reading tasks (Jacobs; 2008; Moss, 2005; Tovani, 2000). Similarly, mathematics literacy involves the capacity to identify, understand and engage in mathematics; including the ability to make sound judgments about the role mathematics plays in ones' present and future life as a constructive, concerned and reflective citizen. (Kramarski & Mizrachi, 2006). Furthermore, NCTM describes being mathematically literate as having an appreciation of the value and beauty of mathematics as well as being able and inclined to value and use quantitative information (NCTM, 1989).

Shanahan and Shanahan (2008) explain a perspective on development of literacy and how students progresses through basic, intermediate, and disciplinary literacy stages. Foundations of literacy lie within learning basic literacy skills, which include decoding and knowledge of high-frequency words that underlie virtually all reading tasks. Intermediate literacy skills are those common to many tasks, including generic comprehension strategies, common word meanings, and basic fluency. Whereas disciplinary literacy involves skills specialized to history, science, mathematics, literature, or other specific subject matter. Progressing through the stages means students are learning more sophisticated but less generalizable skills and routines.

Successful readers of all ages use existing knowledge to make sense of new information by asking questions about the text before, during and after reading. Tovani (2000) said successful readers determine what is important, synthesize information to create new thinking, construct sensory images, and self-monitor their own comprehension. Students struggle when reading if they lack: comprehension strategies necessary to unlock meaning, sufficient background knowledge, the ability to recognize organizational patterns, and the purpose of the selected reading (Tovani, 2000). Mathematical literacy is important for students in this study when accessing and utilizing the written help tutorials. Their ability to decipher the information and apply the read information is important for successfully completing the online assessments. Students with strong mathematical literacy would be known to have logical-mathematical intelligence as described by Gardner (1983, 1991) and may also learn well visually.

Reading and Comprehension

Reading is more than simply moving one's eyes across a page of text; it involves how the reader creates meaning from the text. Reading is highly influenced by the readers' prior knowledge and experience of the information or concepts, along with the kinds of thinking involved during and after they read the text (Draper, 2002). All disciplines within education require students to read, analyze, synthesize, and summarize various levels of texts, creating the need and demand for all students to be successful readers.

Actual comprehension does not occur until construction of meaning is compatible with the author's intended message. Draper (2002) says,

> This depends on the content knowledge of the learner (reader) and the ability of the learner to make sense out of the signs and symbols inherent in the text. This is quite different from the notion that the text somehow carries meaning to the reader (p. 524).

Specifically in mathematics, students will struggle if they lack the mathematical knowledge or understanding of how to use and manipulate signs and symbols. Mathematics teachers can help students improve their math literacy skills and comprehension by providing opportunities that are developmentally appropriate, engaging, and require the use of prior

knowledge to build constructions tying new material with the old (Danielson, 2007; Draper, 2002; Fosnot, 2005; NCTM, 1989, 1991, 2000).

There are many factors related to successfully reading mathematical texts; including the ability to develop meaningful, correct, and applicable definitions. Students need the ability to toggle through words with multiple meanings and select the appropriate meaning for the given context (Adams, 2003; Tovani, 2000). Adams (2003) described another challenging feature of reading and comprehending mathematics is the use of homophones – words with identical pronunciations as well as similar-sounding words. Table 2.2 and

Table 2.3 depict words that may interfere with reading comprehension in mathematics. Students struggle when reading mathematical texts if they connect the incorrect meaning of a word or confuse it with its homonymic or a sound-alike partner (Adams, 2003).

Table 2.2 Homophones (Exact Pronunciation)

Mathematical word	*Everyday word*
Sum	Some
One	Won
Two	To
Whole	Hole
Plain	Plane
Hour	Our
Real	Reel
Chord	Cord
Eight	Ate
Weigh	Way

Reading short passages offer students mathematics in textual and often abstract form. To obtain full meaning from the passage, students must be able to recognize individual concepts as well as the relationships between the concepts (Adams, 2003). Consider the following passage:

> A straightedge and compass are instruments used for construction in geometry. A straightedge is utilized to construct a line, ray, or segment when two points are given. Whereas, given a center point and radius length, a compass is the appropriate tool to use for constructing an arc or circle.

The density of the mathematical vocabulary (i.e. line, ray, segment, arc, radius, and circle) adds to the complexity of the above passage. To comprehend such text students are expected to integrate their linguistic, cognitive, and metacognitive skills (Adams, 2003; Tovani, 2000).

Table 2.3 Sound-alike Words

Mathematical Word	*Everyday Sound-alike Word*
Half	Have
Cents	Sense
Tenths	Tents
Quart	Court
Altitude	Attitude
Sphere	Spear

Word problems or application problems are common forms of mathematical text students frequently read; especially in a classroom with problem-based, student centered instruction. Polya is noted for his four-step problem-solving process most often used when solving application problems. The four steps include (1) reading the problem to identify key terms and questions, (2) understanding the problem through connecting key vocabulary and question to the intended context or setting, (3) solve the problem by selecting appropriate strategies to respond to the problem, and finally (4) look back to check the validity and accuracy of the solution in the context of the problem (Adams, 2003; Van de Walle, 2007).

Adams (2003) and Van de Walle (2007) describe how Polya offers a structured four-step procedure to approach solving application problems, yet many students continue to struggle. Additionally, as students progress through elementary mathematics into middle and higher level mathematical topics, more complex and abstract concepts are introduced. Students need to navigate through relationships of words, numerals, symbols, and variables to be successful problem-solvers especially in an abstract environment (Adams, 2003; NCTM, 1989, 2000; Van de Walle, 2007). Continued practices of reading mathematical texts benefit all learners at any level.

The Digital Age: Assessing Student Learning

The need to design and deliver aspects of a class online, or host a class entirely online is prevalent with more than 1.5 million students nationwide enrolled in online courses across various disciplines (Foster & Carnevale; 2007; Sileo & Sileo; 2008). Education delivered at a distance acknowledges geographic separations between teachers and students, while embracing the needs of emerging technologies and methods of instruction to bridge the gap and provide high-quality learning experiences.

There are several ways teachers assess products or outcomes of learning. Well known forms of assessment include direct observation, written responses, oral responses, self-reports, ratings by others, etc. With the evolution of the internet, online assessments have become a norm when assessing student knowledge.

Online Assessments

Online assessments in systems that include programmed evaluation of student input provide an easy format for quick formative assessments. Grading occurs automatically, which is beneficial for teachers to make swift decisions about daily course content or remediation of material (Ozden, Erturk, & Sanli, 2004; Smith, 2007). Additionally, online assessment systems provide instant feedback to students, affording the opportunity for self-reflection about their academic progress with the learning outcomes of the course. Obtaining immediate scores and feedback has been motivational to students and contributed positively to their achievement on the exam (Ozden et al., 2004; Smith, 2007). Ozden et al. (2004) noted some key reasons to implement online assessments, such as to increase the frequency of assessment, motivating students to learn and encouraging skills practice; to broaden the range of knowledge assessed; to increase feedback to students and lecturers; to extend the range of assessment methods; to increase objectivity and consistency; to reduce marking loads; and to aid administrative efficiency. Online assessments have the potential for transforming learning opportunities by providing effective representations of core ideas in challenging content areas, by informing students and teachers quickly about student achievement, and allowing for immediate modifications in instructional decisions (Means, Roschelle, Penuel, Sabelli, & Haertel, 2003).

Online learning environments have become popular in the university setting. They provide service for any number of students enrolled in a course, saving grading time for the instructor and providing instant feedback to students and teachers. Limited research exists in identifying elements of online assessments. However, the research available in undergraduate courses revealed online assessments are predictors of achievement on formal exams (Bromham & Oprandi, 2006; Smith, 2007). For instance, Smith (2007) found frequent online quizzes to be strongly correlated with written exams in undergraduate geoscience courses at a large university. Bromham and Oprandi (2006) found significant positive correlations with online self-assessment activities and performance on formal assessment tasks within an introductory-level biology course at the University of Sussex.

The infusion of online assessments, like quizzes, into traditional courses that meet face-to-face is relatively new to education. For this study, online quizzes have been used in MATH 320 for two years. Means, Roschelle, Penuel, Sabelli, and Haertel (2003) claim online assessments can provide students with prompt feedback on the correct individual answers they submitted, as well as the percentage of items they have answered correctly. Means et al. say the online systems may or may not improve the quality of assessments, but offer the potential effectiveness of faster feedback to students and reduction in the teachers' record keeping. The online system used in this study provides more instant feedback to students than as described above. Students will quickly be informed if each answer is correct, incorrect, or left unanswered. The students are then provided the opportunity to make changes to incorrect or blank answers, and again are informed of the results. Furthermore, students receive a link to written help tutorials for problems they continued to miss after trying to correct the solution. The written help tutorials will describe in text how to solve the problem they missed. Some of the written help tutorials will contain an extra link to a video help tutorial for students interested in viewing an additional source of explanation for solving a similar problem.

Summary

Teaching and learning theories provide insight to how students learn. Brunner (1966) proclaimed educators should concentrate on teaching methods that urge the development of self-instruction, where students can select their own problems, secure the necessary guidance and stimulation, and find reward. Similar to Bruner's work, constructivism encourages inquiry, problem solving, and constructing knowledge based on interactions with the environment and peers (Draper, 2002; Fosnot, 2005; Marsh & Willis, 2008; Schunk, 2008). Understanding students' multiple intelligences and learning styles can help teachers provide effective instruction. Gardner's (1983) theory of MI's suggested the existence of eight different intellectual competencies that are important for identifying students' abilities in different modalities. Further, students may prefer learning experiences that focus on one learning style, or a combination of the four (auditory, visual, tactile, and kinesthetic). Where Dunn et al. (2009) found that academic achievement was positively impacted from matching students' learning styles with compatible educational experiences.

Proficient levels of mathematical literacy are needed for successful learning of mathematics. Adams (2003) said the mathematical nature of the problem may not be obvious to the reader. Students need literacy skills to decode text so information can be gathered to solve problems (Adams, 2003). Current research pertaining to online assessments is primarily paired with pure online courses (Challis, 2005; Goodfellow & Lea, 2005). Grading occurs automatically, which provide students with immediate feedback. Ozden et al. (2004) discussed students are motivated when obtaining scores instantly, which contributed positively to their achievement on exams. There is a gap in the research concerning the impact of written and video help tutorials in online assessments on student achievement in traditional courses. Filling this research gap became the focus of the study.

CHAPTER 3 - METHODOLOGY

Purpose and Significance of the Study

The study presented herein intends to examine student use of help tutorials within online quizzes in an undergraduate math course. Online quizzes were used to measure the relationship between student selection of help tutorials and student achievement. A survey and student interviews explored reasons for students' selection of help tutorials, their learning preferences, and future career goals. Quantitative and qualitative data were converged to better understand the impact of written and video help tutorials in online quizzes on student achievement.

Online Quiz Environment

Findings about online assessments and students' achievement for a blended course are presented. Students met three times a week on campus for class instruction and completed online quizzes used for analysis in this study. The online quizzes contained open-ended questions where students entered a numerical solution or set of numbers. Upon submission of their answers students were given instant feedback indicating which problems were correct, incorrect, or left unanswered. *Written help tutorials* were paired with incorrect or blank answers, and explained how to complete the problem. Furthermore, targeted problems had an additional link to a *video help tutorial*, which could be found at the bottom of a written help tutorial web page. The video help tutorials verbally explained and pictorially demonstrated how to complete a similar problem.

When students submitted an incorrect answer or left a question unanswered they were allowed two opportunities to input an alternative solution on the quiz. The written and video help tutorials were available after the second attempt to solve the problem. Often students viewed the help tutorials and reentered the online testing environment. A similar quiz was produced each time with the same process, where students received two attempts to correctly complete the quiz. Students had the choice to reenter the system an unlimited number of times to complete similar online quizzes, where the online testing system recorded the highest score in the instructor's grade book.

Students' selection of written and video help tutorials were explored to afford insight in how student achievement was effected by the help tutorials, and under what circumstances did students select help tutorials. Moreover, students provided insight towards what makes written and video help tutorials enticing to view, along with their preferred learning styles through interviews and a survey.

Research Questions

The initial research question guiding the study was: What impact does written and video help tutorials have on online assessment experiences for students?

This question leads to exploring different components of students' online experiences, resulting in the following questions:

1. Under what circumstances do students choose to view written help tutorials?
2. Under what circumstances do students choose to view additional help in the form of a video help tutorial?
3. What elements contribute to the effectiveness of a video help tutorial?
4. Does making video help tutorials available improve student achievement?

Participants and the Setting

The university in which this study took place was located in a North-Eastern Kansas community of about 52,000 people with enrollment of approximately 22,500 undergraduate and graduate students. The participants were students taking MATH 320: *Math for Elementary School Teachers*. The course was designed for students seeking a Bachelors of Science in Elementary Education. However, a few students took this course to fulfill a math requirement for a different degree. According to the university registrar records for Spring 2009, students enrolled in MATH 320 are freshmen, sophomore, and juniors. Three sections of the course were offered that met on campus three times a week, and range from 23 to 35 students per section. At the beginning of the Spring 2009 semester 108 students were enrolled. The ending enrollment consisted of 81 students, 73 females and 8 males.

Each section of the course was taught by a different professor within the Mathematics Department. All professors teaching MATH 320 were male and Caucasian. The first

professor is an American citizen, who has worked for the university for 25 years, and taught the course eight times. The second professor is also an American citizen, however he has only worked for the university one year, and Spring 2009 was his first semester to teach the course. The third professor has lived in the United States for 21 years, where the last 9 years he worked at the university, and taught this course twice.

Protection of Human Subjects

This research complies with all of the requirements established by the University Research Compliance Office on Research Involving Human Subjects. The University Informed Consent Form was given to each interviewed participant to ask their permission for using the data for research purposes (see Appendix A). Participants were asked to sign the Informed Consent Form after they were given the opportunity to ask any questions they had about their rights as participants. Surveys were administered in class by the researcher during the last week of the semester (see Appendix E). Consent by students was obtained through their submission of the survey to the researcher. The use of pseudonyms maintained student anonymity.

Research Design

This study used a mixed method design of quantitative and qualitative methods. Quantitative methods were used to analyze and compare student achievement overtime with online quizzes. As Fraenkel and Wallen (2003) stated, "Correlational studies are carried out either to help explain important human behaviors or to predict likely outcomes" (p. 362). Moreover, surveys about online quiz experiences and learning style preferences provided additional quantitative data that addresses the use of written and video help tutorials, students' learning style preferences, their thoughts about mathematics, and teaching mathematics. Interviews provided qualitative data about students' perceived learning style preferences, and helpfulness of help tutorials accessed within the online quizzes.

Independent (predictor) variables included the selection of written help tutorials, selection of video help tutorials, attempts per problem, and attempts per quiz. Student achievement was the dependent (criterion) variable. Confounding variables consisted of the nature of teaching from different instructors, and their selection of course content.

Development of Video Help Tutorials

The development of video help tutorials for MATH 320 begun in the Fall 2008 semester with targeted online quiz questions. The most frequently missed problems were identified among each of the seven quizzes from the Spring 2007 semester. The researcher used a video camera facing a portable whiteboard. The video recordings contained a similar problem to that of the online quiz. The researcher described how to approach the problem and demonstrated methods and procedures used to acquire the correct solution. Each video help tutorial ranged from three to five minutes in length.

The researcher completed interviews with College Algebra students during the 2008-2009 academic year for another researcher's study that included similar video help tutorials. After completing such interviews, decisions were made to replace the original video help tutorials with shorter videos. One College Algebra student remarked they opened a video to watch, but did not view it because it was too long [approximately 4 minutes in length]. An additional factor that influenced the creation of shorter video help tutorials was from the online entertainment industry. Similar to a television series, *Prom Queen* is an internet series, only available through 90 second episodes on MySpace who received over 15 million views during the original 12 week run (http://www.myspace.com/promqueentv). Observing the overwhelming success of the short videos influenced the reduction of the length to two and a half minutes or less for the video help tutorials in this study.

The videos used for this study were not created with a video camera, but utilized auditory recordings and handwritten work on a Tablet-PC. Each video will began with a screen capture of a similar quiz question. The researcher verbally explained how to solve the problem while writing on the laptop screen with a stylus. The computer digitally recorded the handwritten work to be view by students as they listen to the researcher who discussed the problem solving process. To view each video help tutorial, URL links can be found in Appendix F.

Quantitative Methods

Mills (2003) suggested quantitative research should focus on controlling a small number of variables to determine cause-effect relationships and/or the strength of those relationships. In this study descriptive statistics, Analysis of Variance (ANOVA), and multiple regression analyses were used with numerical data collected from online quizzes.

Survey data gathered were used to better understand selection of help tutorials and learning style preferences. During the last two weeks of the semester the researcher approached each of the three sections of MATH 320. Students were asked to voluntarily complete a 28 item survey (see Appendix E). By turning in the survey students provided consent for the researcher to use the information in the study. Anonymity was kept as students were not asked to write identifying features about themselves on the survey. The intent for administering the survey during class was to gain high levels of participation. Students could have been more obliged to complete a survey if time was devoted in class instead of completing an online survey during their own time. The MATH 320 Survey was created by the researcher. Components were designed based on the research questions and student interviews. Additional question were created based on common inquires to determine preferred learning styles as seen on various learning style inventory tests.

Qualitative Methods

Qualitative methods in this study included interviews with students enrolled in the course. "Qualitative research uses narrative, descriptive approaches to data collection to understand the way things are and what it means from the perspectives of the research participants," (Mills, 2003, p. 4). Preliminary interviews were conducted with College Algebra student volunteers during the 2008-2009 academic year. These students were selected out of convenience due to another study being conducted at the university based on similar course components. Students met in a conference room within the mathematics building where their classes are held. Graduate teaching assistants from the mathematics department and/or the author of this study conducted the preliminary interviews. Students were informed of the purpose of the research and provided with an Informed Consent Form, then agreed to audio record the interview. Students responded to various questions, completed a hand-written survey, and solved selected math problems from a recent exam. At

the completion of their interviews students received a ten dollar honorarium for their participation.

The information obtained from the preliminary interviews guided the direction of the interviews to be conducted for this study. Video help tutorials were redesigned for the Spring 2009 semester. Interview questions evolved to focus on why students chose to view help tutorials, benefits of help tutorials, preferred learning styles, feelings about mathematics, and what it takes to be prepared to teach elementary mathematics.

Near the beginning of the Spring 2009 semester, students were conveniently selected for interviews. Through email invitations, students who had either viewed written help tutorials or written and video help tutorials within the first few online quizzes were invited to partake in an interview. Additional measures were used to gather more student volunteers. The researcher attended each course section, provided an introduction, and brief explanation of the research. Students were encouraged to email the researcher with their availability to complete the 15 minute interview, and received a ten dollar honorarium for their time.

Students who made an appointment with the researcher met in a conference room in the mathematics building where their class was taught. Students were informed of the research purpose, and asked to sign the Informed Consent Form (see Appendix A). A digital recording device was used to record the 15 minute interviews. The researcher followed the Interview Protocol (see Appendix B) where the questions asked had three main ideas: 1) previous college math courses and their feelings about mathematics, 2) experiences with the written and video help tutorials, and 3) future career goals and teaching elementary mathematics.

Data Collection and Instrumentation

Data collection for this research came from three main sources: 1) online assessments, 2) student interviews, and 3) surveys. Online assessments consisted of seven quizzes with 5 to 7 open-ended questions, which addressed recent content from class lecture (see Appendix G). A sample problem from the seventh quiz is as follows:

> If the radius of a sphere increases in size by 8%, then by what percentage does the volume increase? Give your answer to the nearest one percent.
> _____ %

Student interviews were conducted with student volunteers who answered various questions related to their thoughts about mathematics, written and video help tutorials in the online quizzes, and future career goals. A survey about students' online quiz experience and learning style preferences was distributed in class during the last week of the semester, to acquire additional information similar to the interviews. Most survey items used a Likert scale (strongly agree to strongly disagree), with a few items that had categorical scales (e.g., yes/no, selection of type of help tutorials). Sample survey questions depicted the different scales are in Table 3.1. Research questions addressed by each data source are located in Table 3.2.

Table 3.1 Sample Survey Items

27. Consider the following scenario: You miss a problem on an online quiz and were provided with two links labeled "Written Help" and "Video Help". Which link would you select the first time you're seeking help on this problem? *(Please circle one choice.)*	Written Help or Video Help
1. I would select the second form of help if the type I selected first did not fully help me understand the problem or my mistake.	5 4 3 2 1

Table 3.2 Data Sources and Research Questions

RESEARCH QUESTIONS	DATA SOURCES			
	Online Quizzes		Interviews	Surveys
	Student Behavior	Quiz Scores		
	Selection of help tutorials, attempts per problem, and attempts per quiz	Results per problem and per quiz		
What impact does written and video help tutorials have on online assessment experiences for students?	X	X	X	X
Under what circumstances do students choose to view written help tutorials?	X	X	X	X
Under what circumstances do students choose to view additional help in the form of a video help tutorial?	X	X	X	X
What elements contribute to effectiveness of a video help tutorial?			X	
Does making video help tutorials available improve students achievement?	X	X	X	X*

(* Survey item 25 asked students if the video help tutorials were helpful; 47% of students responded Not Applicable, as they had not viewed a video.)

Data Analysis

Interviews

Interviews were conducted during mid-semester by the researcher who transcribed and categorized all data. Color coded schemes were used to identify and group similar and different responses to interview questions. Frequency tables summarized and quantified students' responses. Specific student reactions are quoted to depict responses of small groups.

Participants

Thirty students were invited to participate in an interview Selection of students was based on three criteria: 1) they viewed written help tutorials when a video help tutorial was available, 2) they watched video help tutorial(s) on quiz one or two, or 3) they had the option to watch a video yet opted out. The researcher emailed all 30 students, informed of the interview opportunity, and asked for each to reply with available dates and times to complete the interview. A copy of the email sent to the students can be found in Appendix B. Ten of the students replied and completed the interview.

To obtain more interviewees the researcher attended each course section mid-semester. At that time the research was briefly described as the desire to determine the impact of written and video help tutorials in online assessments on student achievement. Students were encouraged to participate in an interview where they would earn a ten dollar honorarium for about fifteen minutes of their time. The invitation to partake in the interview did not include a stipulation for students to have viewed written or video help tutorials. This resulted in one student who participated that never used the online help tutorials. Students already interviewed made positive statements about the process in class. From the in class invitation to interview six students contacted the researcher, of which five students attended and completed the interview process.

Overall, 15 students completed the interviews, 13 females and two males. Of the 108 students who began taking MATH 320 in Spring 2009, 81 students (78 females and 8 males) were officially enrolled at the end of the semester according to university records. Moreover, 18.5% of total students enrolled in the course participated in the interviews obtaining 16.7%

females and 25% males from the population. It should be noted that more students completed the online quizzes than were enrolled in the course at the end of semester, indicating students dropped the course or there were inconsistent records. The University used two different systems for record keeping, iSIS and K-State Online. The enrollment data retrieved for this study were available from K-State Online, as the researcher had authorization to access that source.

Transcribing and Categorizing Data

The researcher conducted, transcribed, and coded all interview data. Each interview was recorded on a digital voice recorder, downloaded and saved as a digital voice file. The researcher transcribed each interview in electronic documents.

Three groups of students were identified in the interviews. The first group consisted of ten students who utilized the written help tutorials. The second group of 4 students watched one or more video help tutorials. Finally, one student made up the third group, who stated they did not view either type of help tutorial. The online database indicated this student had the opportunity to view one help tutorial prior to the interview.

When transcribing interviews, labels were developed to distinguish between the interviewer and interviewee. The researcher's initials labeled the interviewers questions and statements. Student initials were used to depict their responses to the interviewer. Students were coded based on gender, type of help tutorial used, and a number to represent each individual student based on the type of help they claimed to have used (see Table 3.3).

A "–W" placed behind ten students initials to represent they only viewed written help tutorials. Four students had a "–V" behind their initials to represent they viewed both written and video help tutorials. One student had a "–None" typed behind their initials, to show they did not use either type of help tutorial. Three of the fifteen students interviewed stated they were seeking a concentration in mathematics. An additional label of "–CM" was added behind the –W or –V, to represent the concentration in mathematics. Two of the students had only viewed written help tutorials and one student had used video help tutorials. An example of a transcribed interview can be found in Appendix D.

Table 3.3 Labeling System for Interviews

F = Female *M = Male* *CM = Concentration in Math*		
W = Written Help Tutorial Users	V = Video Help Tutorial Users	N = Non Help Tutorial User
F – W1 F – W2 F – W3 F – W4 F – W5 M – W6 F – W7 F – W8 F – W9 – CM F – W10 – CM	F – V1 – CM F – V2 F – V3 M – V4	F – N1

Surveys

Surveys were administered, collected, and analyzed by the researcher. Descriptive statistics enabled the researcher to meaningfully describe data with numerical indices and in graphical form. Correlation matrices identified relationships among survey items and reduced the set of variables to a smaller number of factors. Cronbach's alpha was computed among grouped survey elements to determine reliability of their groupings. Linear regression models determined correlations among variables. Additionally, ANOVA techniques explored the data for statistical significance.

Online Quizzes

Descriptive statistics were calculated to describe the data. Regression models were used to determine correlations between use of help tutorials and performance on online quizzes. A multiple regression analysis was conducted to determine the correlation between student achievement, the criterion variable, and the predictor variables (selection of written help tutorials, selection of video help tutorials, attempts per problem, and attempts per quiz). ANOVA procedures were conducted to explore data for differences between means.

Reliability and Validity

According to Creswell (1998, 2007, 2009) reliability of a study relates to whether it can be replicated, achieving the same findings. Parallel forms of the online quizzes exist, which data from past semesters revealed students regularly utilized the opportunities to take similar exams multiple times. Thordike (2005) concluded the scores can be correlated from each equivalent quiz to test for reliability. Since the online quizzes contained the same type of questions and level of difficulty they may be considered equivalent. To estimate the reliability of grouped survey items Cronbach's alpha were calculated.

Validity is referred to the appropriateness, correctness, meaningfulness, and usefulness of the specific inferences researchers make based on collected data (Fraenkel & Wallen, 2003, p. 158). Threats to internal validity included student characteristics, location, instrument decay, data collection and testing. The results of correlational studies must be interpreted with a degree of caution because they may suggest causation, although it cannot be established (Fraenkel & Wallen, 2003). Regression equations and validity coefficients were calculated for online quiz and survey data to measure the levels of validity.

An overall research goal was transferability of the study to similar situations. Not only should the study be internally valid and reliable, it should also be applicable in other situations of a similar nature (Creswell, 1998, 2007, 2009; Thorndike, 2005). This study provided transferable analyses to courses that use similar assessments efforts. However, readers should be able to determine for themselves, the applicability to their own situation.

CHAPTER 4 - RESULTS

Introduction

Data collected from a mixed-method study was designed to explore the impact of implementing help tutorials within online quizzes, and students' perspectives about the online help tutorials. Qualitative and quantitative data were collected in three forms. Student interviews provided qualitative insight into the study where surveys and online behaviors, such as quiz scores and use of the help tutorials, were the means of gathering quantitative data.

Qualitative Findings

Interviews

Online Behaviors of Interviewed Students

Online behaviors of students were tracked before and after interviews. During the interviews students indicated if they had viewed written help tutorials, video help tutorials, or neither. Their responses were the foundation for labeling transcriptions and grouping students into three categories: written help tutorial users, video help tutorial users, and non help tutorial users, as seen in the above coding system. When students logged into the online quiz their online behaviors were tracked. The system recorded a variety of data such as start and end dates and times, selection of written help tutorials, download of video help tutorials, number of attempts per quiz, and score earned per quiz. With this knowledge the researcher determined students online behavior did not always match their interview statements about using help tutorials.

Four of the ten students who claimed they had viewed written help tutorial(s) prior to the interview did not have matching online behaviors. However, through conversations with students from past semesters, instructors have indicated students sometimes work together when completing the online quizzes. Therefore it should be noted these four students could have viewed written help tutorials while working with a classmate who was logged into the

system. Two of the four students never had the opportunity to view help tutorials since they received perfect scores on the quizzes prior to the interview. One student stated they only viewed a written help tutorial where the database indicated one video help tutorial was downloaded prior to the interview. Through informal conversations between students and instructors, some students indicated they did not see the video help tutorial after selection, as it appeared in a new window which was overlooked. This could have been the case with the above student. Coding for each student is based on what they indicated during interview (see Table 4.1). Descriptions of students online behavior is found below in Table 4.2.

Table 4.1 Online Behavior of Interviewed Students

Students Interviewed	Online Behavior
W – Written Help Tutorial User V – Video Help Tutorial User N – Non Help Tutorial User CM – Concentration in Math	
F – W1	One opportunity to view written help before the interview, and twice after. Relatively few chances to view a video help tutorial, and never viewed one. Looked at written help every time it was offered, however not often because she rarely missed problems.
F – W2	Did not take Quiz 4, which was due around the time of the interview. Looked at written help tutorials but only attempted each quiz once. Never looked at video help tutorials. Never earned a perfect score.
F – W3	Looked written help tutorials when offered before the interview. Only missed one problem after the interview and looked at written help. Never looked at video help tutorials.
F – W4	Earned perfect scores on all quizzes, therefore never had the opportunity to view help tutorials.
F – W5	Did not look at help before interview, yet had two opportunities. During one opportunity she was one point away from earning a perfect score, but accepted her grade. Looked at written help 11 times after interview. Never looked at video help tutorials.
M – W6	Multiple opportunities all semester to view written and video help. Took advantage of written help often, before and after interview. Viewed one video help tutorial after interview.
F – W7	Did not take Quiz 2. Multiple opportunities to look a written help. Looked at written help before and after interview. Never looked at video help tutorials. Often earned perfect scores on 2nd attempt of taking the quiz.
F – W8	Did not take half of the quizzes. Multiple opportunities look at written help, took advantage of some of them. Looked at one video help tutorial before interview.

F – W9 – CM	Earned perfect scores on quizzes prior to interview, therefore no opportunities to look at any help. Multiple opportunities to view help after interview. Looked at one written help.
F – W10 –CM	Looked at two written help tutorials before the interview and three after. Often earned perfect scores, therefore help was rarely available to view.
F – V1 – CM	Looked at written and video help tutorials both before and after interview. Multiple opportunities to view help throughout semester.
F – V2	Looked at one video before interview. Used written help tutorials a couple of times before and after the interview..
F – V3	Multiple opportunities to view written help before and after interview. Looked at written help before and after interview fairly regularly when it was offered. Looked at videos before and after interview. Only student to go back and review quiz 6 before the final, submit answers and have them go through.
M – V4	Looked at written help 12 times before interview and 14 times after. Looked at 2 videos before interview and 7 videos after.
F – N1	Had one chance to see a written help before interview. Looked at 10 written helps and one video 3 days after the interview.

Once interviews were transcribed, color coded techniques were used to categorize common ideas among student responses per interview question. Direct quotes were used to represent student responses when four students or fewer responded to a question. Table 4.3 displays the interview results with categorized responses.

Table 4.2 Interview Results

Question #1: Describe your feelings towards mathematics at the beginning of the semester as you entered into the course.

RESPONSES N=15	FREQUENCY OF RESPONSES
1. I have always liked math.	3
2. I like math but I may not be the best at it.	3
3. Hesitant or nervous because it's not my strong suit.	2
4. I don't particularly enjoy it but I can do it well.	1
5. I'm out of touch, although I'm ok with math.	1
6. It's easy.	1
7. I feel pretty confident about math.	1
8. The course is different than what I thought. I thought it was going to be more about how to teach.	2
9. My big concern was about understanding the teacher's accent and if they knew how to really teach math.	1

Question #2: In general, how do you usually study for math assessments?

RESPONSES N=15	FREQUENCY OF RESPONSES
1. Complete problems from homework, examples in book, or from class notes.	15
a. Homework problems	8
b. Examples from the text book	3
c. Examples from notes	2
d. Problems (not specified where they got the problems)	2
2. Complete old exams provided online by the instructor.	11
3. Ask questions and work with a friend, tutor, or the instructor.	2
4. Read through the text book.	1

Question #3: Did you study differently for any of the assessments in MATH 320?

RESPONSES N=14	FREQUENCY OF RESPONSES
1. No, not really.	13
2. Yes, I used a friend or tutor.	1

Question #4: How did you study for the online quizzes in MATH 320?

RESPONSES N=15		FREQUENCY OF RESPONSES
1.	I don't study. I just figure it out as I go and use my homework, book, notes, and calculator during the quiz.	9
2.	I did my homework then took the quiz but used my book, notes, and calculator.	2
3.	I briefly review homework, notes, and the book before taking the quiz.	2
4.	Print the quizzes, study questions and then complete it online.	1
5.	I had outside help from a friend or tutor.	1

Question #5: When you miss a problem on an online quiz you have the opportunity to view a written help tutorial. Are you familiar with this type of help?

RESPONSES N=15		FREQUENCY OF RESPONSES
1.	Yes	13
2.	No	2

Question #5a: Why did you choose to view the written help tutorials?

RESPONSES N=13		FREQUENCY OF RESPONSES
1.	So I could understand the problem and figure out how to do it.	6
2.	I was looking for the right way to do it, like a process or directions.	4
3.	I couldn't figure out my mistake and needed more help.	2
4.	Because I didn't know how to do the problem.	1

Question #5b: About how many or how often did you read the written help tutorials?

RESPONSES N=13		FREQUENCY OF RESPONSES
1.	1-3 times overall (for the 2-4 quizzes taken)	4
2.	4-6 times overall (for the 2-4 quizzes taken)	1
3.	1-3 times per quiz	7
4.	Several times per quiz	1

Question #5c: Do you feel the written help tutorials were beneficial?

RESPONSES N=12		FREQUENCY OF RESPONSES
1.	Yes	11
2.	No	0
3.	For some problems	1

Question #5d: Why or why not?

RESPONSES N=11		FREQUENCY OF RESPONSES
1.	It's convenient, straight to the point, gives me direction, and explains how to do the problem.	10
2.	It helps me find my mistakes	4
3.	Some written help was difficult to understand but usually helpful	1

Question #5e: What changes would you suggest to be made to the written help tutorials to make them more beneficial?

RESPONSES N=13		FREQUENCY OF RESPONSES
1.	I'm pleased with how they are.	6
2.	Provide an additional example with different numbers.	3
3.	Explain the step-by-step process in text next to the numbers.	1
4.	Provide hints after submitting the answer to have the opportunity to fix your mistake before the last attempt.	1
5.	I don't have any suggestions.	2

Question #5f: In the future, would you be more or less likely to view written help tutorials for assistance?

RESPONSES N=12		FREQUENCY OF RESPONSES
1.	More likely	6
2.	Same/just as likely	4
3.	I would use them again	2

Question #6: There is additional help available when you miss problem in the online quizzes, in the form of a video. Are you aware of this help?

RESPONSES N=13		FREQUENCY OF RESPONSES
1.	Yes	5
2.	No	8

Question #6a: If you viewed a video, why did you choose to do so?

QUOTED RESPONSES N=3	
1.	"I guess for the visual aspect. It is a view that is more helpful, to help me one step further. I used the video for a graph of something where the video showed how to draw out the picture."
2.	"I actually find the video more helpful because the person is actually doing it step-by-step. The explanations are good and you can see what they are doing."
3.	"I kept on getting the same problem wrong over and over on the first quiz. I got really frustrated and I didn't understand. Then I finally saw a video and it only took me two times after that. I didn't click on the video [the first time because I didn't' see the link]. But then it opened up. So then I used that, went back and I made a minor error, computational. I got it correct the next time."

Question #6b: Do you feel the video help tutorials were beneficial? Why/why not?

QUOTED RESPONSES N=4	
1.	"Some of them. Some of them are different from the problem, or type of the problem. I don't remember an example."
2.	"Yeah. It was like a step-by-step thing and a picture that showed step 1 and step 2 along with the images on the screen was helpful. The visual was right in front of you."
3.	"Yes, I like to hear and see each step."
4.	"I like how simple it was to follow. For that specific problem it didn't give me that answer but a similar problem. I can understand why because you use the video for all of the quizzes so it's different answers."

Question #6c: Talk about the length of time of the videos you've seen. Are they too short, too long, or just right? Or what length of time would you watch a video?

QUOTED RESPONSES N=4	
1.	"I'll watch the whole video to learn how to do the problem. As long as they are 3 minutes or less it's good."
2.	"Obviously I am sure college kids would agree the shorter the better. I am willing to sit though a lengthy video to get the…to learn and understand the concept. At the same time if there is one part I don't understand and the video is a minute long, but I find my information in 20 seconds, I'll close the video. I wouldn't finish it."
3.	"I think they are just right. Each time I have watched them I watched them once and I get it. So for me they work really well."
4.	"It was good. With the play back you can go back and listen to the part you need too."

Question #6d: What changes would you suggest to be made to the video help tutorials to make them more beneficial or would you?

QUOTED RESPONSES N=4	
1.	"More versions available that directly match the problem. But if you're smart like me you can figure them out."
2.	"I only have seen that one video. Far as I can tell it answered my questions."
3.	"I think they are really good."
4.	"No."

Question #7: Is there an amount of time you would or would not view a video if you came across a link?

RESPONSES N=11		FREQUENCY OF RESPONSES
1.	5-10 minutes	1
2.	No longer than 5 minutes	4
3.	3-4 minutes	2
4.	2 minutes	1
5.	1-2 minutes	2
6.	Depends on the problem	1

Question #8: Right now the videos do not show the person in the screen. You can hear the person explaining the problem and see their handwritten work on a recording using a Tablet-PC. Would it bother you that you don't see the person speaking in the video?

RESPONSES N=7		FREQUENCY OF RESPONSES
1.	No	4
2.	I would like to see the person but it doesn't really matter	3

Question #9: Let's pretend the quizzes are set up differently. If you missed a problem and there were two links, one for video help and the other for written help, which would you select the first?

RESPONSES N=9		FREQUENCY OF RESPONSES
1.	Written help	6
2.	Video help	3

Question #10: Do you have a preference of learning by reading text like the written help, or through an auditory and visual approach, like a video?

RESPONSES N=13		FREQUENCY OF RESPONSES
1.	Auditory and visual preference	9
2.	Reading text	2
	a. I like to see how it's worked out but I don't' necessarily need to be told how to do it.	
	b. I like example problems and then give me a problem to solve.	
3.	Combination of auditory, visual, and reading.	1
4.	Combination of auditory, visual, reading, and writing information.	1

Question #11: What do you think you need to know to be an effective elementary math teacher?

RESPONSES N=15		FREQUENCY OF RESPONSES
1.	Know your students, meet their needs, and if they like/dislike math and why.	3
2.	Present material in different ways, like methods of teaching.	8
3.	Need to know basic math, the content you will be teaching and maybe a little bit more. Have a good understanding of the concepts.	7
4.	Know the "how's" and "why's" of math. The reasons behind the math.	3
5.	Understand how to solve problems in multiple ways, and determine if student's solutions are correct and why.	1

Question #12: Do the online quizzes cover information or content that you feel is important to know in order to become an effective elementary teacher? Explain.

RESPONSES N=15		FREQUENCY OF RESPONSES
1.	Yes	11
	a. It highlights the main points. You can make sure you know how to do them so you can teach it.	1
	b. The content is right on the quizzes. The written help tutorials do a good job explaining the material, so as a future teacher I can understand it in a way that I could teach it as well.	1
	c. They are very well rounded and variety of problems.	
	a. They have different problems from what I expect to teach and give us useful techniques.	2 1
2.	Sometimes	2
	a. I think they cover a lot more than what I might teach.	1
	b. It teaches you how to do the problems but not how to teach them.	1
3.	No, the content is more difficult than what you would teach in elementary school.	2

Question #13: What grade levels do you anticipate to teach?

RESPONSES N=15		FREQUENCY OF RESPONSES
1.	Kindergarten	1
2.	Kindergarten through 2nd grade	4
3.	1st through 3rd grade	1
4.	2nd through 3rd grade	4
5.	5th and 6th grade	3
6.	5th through 8th grade	1
7.	No preference, K-6	1

Question #13a: Why do you want to teach in those grades?

RESPONSES N=15		FREQUENCY OF RESPONSES
1.	I like the age group.	2
2.	I have previous experience working with the age group and like it.	4
3.	I want to shape and mold kids.	1
4.	They are still excited to learn and go to school.	1
5.	I had a lot of influential teachers in middle school and want to impact kids.	1
6.	Students are more independent in the older grades and I want to do more teaching and less babysitting.	2

Question #14: How much mathematics do you feel you need to know in order to teach elementary mathematics?

RESPONSES N=15		FREQUENCY OF RESPONSES
1.	Elementary Math	1
2.	Middle School Math	3
3.	High School Math	1
4.	College Math	10

Interview Findings

Fifteen students completed an interview with the researcher, ten of whom had claimed to have only used the written help tutorials, four students viewed video help tutorials, and one student said they did not view either type of help during the online quizzes. Three of the fifteen students are seeking a concentration in mathematics. This section contains quotes from students representing the information provided from Table 4.3.

Of the fifteen students, there were nine category of responses associated with their feelings towards mathematics as they entered the course. Nine students commented with positive remarks, three negative, and three students replied about the course instead of mathematics in general. Positive statements from students included:

> "I like math. I may not be the best person at it but I enjoy doing it."
> *(M – W6)*

> "I really enjoy math. I feel relatively competent in doing it. When I took 320, I was really excited because I thought it was going to be easier compared to the classes I've taken. It has been a lot easier than I ever thought it was. I just really like math."
> *(F – W10 – CM)*

Two students thought the course was going to be about how to teach math, and is different from what they thought and said the following:

> "It's different than I thought. I thought it was going to be more about how to teach the stuff. It seems like a lot of the stuff I won't be teaching elementary kids but they do explain more so why things they are the way they are."
> *(F – W4)*

> "I guess the name of the course threw me off because I thought I would be learning how to teach and maybe different situations you would be put in and how to work through. Now that I'm in the course it is more difficult, more challenging than I thought. I think it is one of the harder classes I've taken here. It's not completely challenging but not what I expected. I was taken-back by the intense vocabulary, and how there are different ways to approach a problem. Those ways are much more complicated than the ways I learned. I didn't know everything, so you have to approach things from a different angle. So I understand why we have to learn the things we do

> but a lot of it is a different way to think. It's thrown me for a loop."
> *(F – V2)*

One student mentioned concern about the instructor instead of their feelings towards mathematics.

> "It wouldn't be too difficult. My big concern was the teacher and the accent and if he understood how to really teach it. Sometimes when I've gone into math classes, they will be used to their way when they grow up and so it conflicts. I wasn't worried about math for elementary education."
> *(F – N1)*

When asked how they usually study for any math assessments all students indicated they prepare by completing problems from homework, examples in the text book, or from class notes. Eleven students also complete old exams provided by the instructor online.

> "Practice old and practice exams definitely. Then going over notes and maybe recopying notes and practice problems."
> *(M – W6)*

> "I am actually really bad at math so I got a tutor to help me study for College Algebra. We worked on different problems and worked through problems. We would go over old tests and stuff."
> *(F – W7)*

> "I go through homework and the book, to make sure I know the concepts and how to work the problems. I will do the practice tests and review in the book."
> *(F – V3)*

When asked if they study differently for the assessments in MATH 320, 93% of students interviewed said no and the remaining said they work with a friend or tutor. With regard to studying for the online quizzes, 60% of students do not study. Yet, they use their homework, book, notes, and calculator while they complete the quiz.

> "Similar. I mean, with those quizzes and being able to do multi-take and stuff like that, I just kind of had my homework and my book with me while I took the quiz. That way I could

> flip through the book when I needed to look something up or understand something else I was doing. I haven't really stressed about the quizzes much as they are fairly easy."
> *(F – W3)*

> "I didn't study for them. I just took the quizzes as many times I needed until I learned it."
> *(F – V1 – CM)*

> "I did my homework then got into the online quiz and took the online quiz. I do ok except I do go back to correct them. It helped out understanding the problems a lot better."
> *(M – V4)*

Students' responses indicated they treated the online quizzes more like homework assignments instead of an exam or test. This was due to the set up of the online quiz system, where students can retake them as many times as desired, and use resources such as book, notes, and a calculator.

Students discussed why they chose to view the written help tutorials. The most common theme from eight students implied they used written help tutorials because they could not figure out their mistakes and wanted to understand how to do the problem.

> "Because I felt like I didn't understand and I wanted to know how to do the problem."
> *(F – W9 – CM)*

> "I just like to have an explanation because most of the time I don't understand how to do it. If I go through that it explains why I'm wrong and I can carry that to do the next problem right."
> *(F – V3)*

Four students implied they were looking for the right way to complete the problem, expecting a process or direction. These students were seeking help in a process and to complete the problem, unlike the students above who were also using the written help tutorials to understand the concepts.

> "Usually I thought I had the right answer but having the explanation of why I was wrong gave me direction to solve it correctly.
> *(F – W1)*

> "I'm just that kind of a learner. It's always been easier for me to see it out. I can go through it rather than viewing it and seeing it briefly. If I can go over the steps more I can get it. *(M – W6)*

Twelve students were asked if they thought the written help tutorials were helpful. Eleven said yes and one said they were only helpful for some problems.

> "For some problems, but others I still didn't understand it completely. It went way over my head but usually they are helpful." *(F – W2)*

When asked to describe why or why not the written help tutorials were helpful ten implied they were convenient, straight to the point, provides direction, and explained how to do the problem. Four students found the written help tutorials helpful to find their mistakes, and one student said some of the tutorials were difficult to understand, but overall they were helpful.

> "Yes. Because it shows you how to get it right. It explains how to work the problem out." *(F – W8)*

> "Yes. I didn't understand what they were asking or the way I wrote it was wrong. So it helped me see what I did wrong." *(F – W9 – CM)*

> "Yes, because if you don't know how to do them, and you don't have time to go to the teacher, it's already there for you to figure it out for yourself." *(F – V1 – CM)*

Students were asked what changes they would like to have made so the written help tutorials were more beneficial. Six students were pleased as with the current written help tutorials, and two students did not have any suggestions.

> "I think how it is setup right now is good. I don't have any changes to suggest. It is very helpful to have the information when you get the problem incorrect." *(F – W5)*

Three students would like to have an additional similar example that included different numbers than the original problem within the written help tutorials. However, students do have access to additional examples. Students may access quizzes multiple times to receive similar problems and their corresponding written help tutorials.

> "More numbers and times to see the actual steps. Obviously you can't give the answer but another example to see it in front of me it usually helps."
> *(F – W2)*

> "Perhaps an additional problem like the one on the quiz. Just so you can get a different perspective, view it and see it a little better that way."
> *(M – W6)*

> "Maybe give another example. I know you gave an explanation for the problem we worked on but to get another example would be extra helpful. Other than that I like them."
> *(F – V3)*

All students asserted they would view the written help tutorials in the future, with ten of the 12 students specifically explaining they would be just as likely or more likely to use the written help tutorials.

Four students viewed at least one video help tutorial prior to the interview. When asked why they chose to watch the video three students replied:

> "I guess for the visual aspect. It is a view that is more helpful, to help me one step further. I use the video for a graph of something where the video showed how to draw out the picture."
> *(F – V2)*

> "I actually find the video more helpful because the person is actually doing it step-by-step. The explanations are good and you can see what they are doing."
> *(F – V3)*

> "I kept on getting the same problem wrong over and over on the first quiz. I got really frustrated and I didn't understand. Then I finally saw a video and it only took me only two times after that. I didn't click on the video [the first time – didn't see it]. But then it opened up. So then I used that, went back and I

made a minor error, computational. I got it correct the next time."
(M – V4)

These students were also asked if they felt the video help tutorial(s) were beneficial and why. They remarked:

"Some of them. Some of them are different from the problem, or type of the problem. I don't remember an example.
(F – V1 – CM)

"Yeah, it was like a step-by-step thing and a picture that showed step 1 and step 2 along with the images on the screen was helpful. The visual was right in front of you."
(F – V2)

"Yes. I like to hear and see each step."
(F – V3)

"I liked how simple it was to follow. For that specific problem it didn't give me that answer but a similar problem. I can understand why because you use the video for all of the quizzes so it's different answers."
(M – V4)

Length of the video help tutorials was of particular interest in this study. Four students who viewed the video help tutorials were asked if they were too short, too long or just right. They responded:

"I'll watch the whole video to learn how to do the problem. As long as they are 3 minutes or less it's good."
(F – V1 – CM)

"Obviously I am sure college kids would agree the short the better. I am willing to sit through a lengthy video to get the, to learn and understand the concept. At the same time if there is one part I don't understand and the video is a minute long, but I find my information in 20 seconds, I'll close the video. I wouldn't finish it. About 2 minutes but it depends on the length of the problems. I feel most of the problems can be solved in less time. But maybe 1 to 2 min."
(F – V2)

> "I think they are just right. Each time I have watched them I watched them once and I get it. So for me they work really well."
> *(F – V3)*

> "It was good. With the play back you can go back and listen to the part you need to."
> *(M – V4)*

All 15 students were asked if there is an amount of time they would or would not view a video for help. Nine of 11 students implied they would watch a video five minutes or less in length. One student would watch a video between 5-10 minutes long, and the final student said it would depend on the problem if they would choose to watch a video.

Students were asked to pretend the quizzes were set up differently. If they missed a problem they would be provided with two links side-by-side, one for written help tutorial and a second link for a video help tutorial. They were asked which link they would select first when seeking out help. Six of nine students believe they would choose the written help first, and three would select the video first.

> "I probably still click on the written help first because it is more concise but if I didn't get the whole picture I would go to the video."
> *(F – W1)*

> "I think I would like the video better. I'm very big on visual and having someone talk it out to me and explain it to me. So I would probably prefer the video, but the written help is still great because it's still there."
> *(F – W5)*

> "Probably the written help but if I couldn't figure it out I would probably watch the video."
> *(F – N1)*

Additionally, students were asked to indicate their learning preference, either as learning through reading text like the written help tutorials, or through auditory and visual approaches, like the video help tutorials. Thirteen students responded with nine who preferred auditory and visual approaches.

> "Listen and watch. Definitely by examples. Like if we do examples in class, I can apply that to quizzes or homework and follow the things like that."
> *(F – W4)*

> "I would probably a verbal explanation. Especially if is interpreting the question or what kind of answer they want. Sometimes a verbal explanation will still get the point across and you can follow it easier."
> *(F – W10 – CM)*

> "I'm more auditory and visual. When it comes to math I like to see the steps first if I have any problems with it."
> *(F – N1)*

Two students stated they prefer to learn through reading.

> "Probably [depends on] the context. I like to see it and how it's worked out. But I don't necessarily need to be told how to do it but I need to see an example, although that would be helpful too."
> *(F – W9 – CM)*

> "I like example problems and then give me a problem to solve."
> *(F – V1 – CM)*

Two students enjoy a combination of methods.

> "It's a combination of the two. I love to have it shown out and see things but then again math is the one thing you can read it and show you in your mind. I always go for the reading first but the combination of the two."
> *(M – W6)*

> "I think PowerPoint really helps me for seeing it and then me writing it down. Whenever I write or type I feel like I comprehend it better. I see it and write it and get it better."
> *(F – V2)*

Another section of the interview included students' thoughts about teaching mathematics in elementary school. When asked what they need to know to be an effective elementary math teacher. All fifteen students answered the question five generalized codes were recorded with three overlying themes; however seven of the students responses overlapped in the themes. The first theme, three students feel they need to know their students, if their students like or dislike math, and how to meet their needs.

> "I think you need to know where the different children come from, if the like or don't like math and why. Be able to present material in a lot of different directions because it doesn't help if your teacher repeats everything the first time, if you didn't understand it that way."
> *(F – W1)*

> "Your students, how they think, and how to interact with them."
> *(M – V4)*

Second, eight students indicated they need to know methods of teaching, and how to present material in different ways.

> "I think I need to open my mind to different styles of learning. I know math, for me has been challenging and I know there are students out there…my mom is a second grade teacher, and she has students that are really frustrated with math. There are students that have to work harder for it than others. So for me, matching all of those levels in my classroom and meeting all of their needs. Make sure everyone is involved and on the same page."
> *(F – W5)*

Third, 11 students claimed they need to know the mathematics, understand the concepts, and be capable of solving problems in multiple ways.

> "You definitely have to know the basis of everything you're teaching. You have to be able to answer those questions of why and how it works. You have to get down to the nitty-gritty of the theorems you're teaching so you can answer those questions."
> *(M – W6)*

> "How to approach different questions you are given. Like from little kids. You need to have a firm foundation how to go about different math, multiplication, division, ways to approach a problem. Different children need different ways and you have to meet their needs. There's many ways to approach problems and knowing and realizing there isn't any one right way. Just because it's easy for doesn't mean it is for them. You need different knowledge of how to do that."
> *(F – V2)*

With regard to the online quizzes, students were asked if the information covered on the quizzes is important to know in order to teach elementary school. Two students said no because the content is more difficult than what they will teach. Additionally, two other students said sometimes because it covers more than what they might teach or the quizzes taught them how to do the problems just not how to teach them. The majority (73%) responded with a definite yes; the quizzes highlight main points, they cover a variety of problems, the content is right on, and they have useful techniques for solving problems.

To conclude the interview students were asked what the highest level of mathematics they need to know to successfully teach elementary mathematics. Of the 15 students, ten implied college math courses, one said high school math, three indicated middle school math, and one stated elementary school mathematics.

Quantitative Findings

Surveys

Development of Survey

Student interviews influenced the development of the survey instrument, which had 28 questions (see Appendix E). When developing the instrument the questions were categorized into four general categories: 1) degree and future career, 2) online work habits and help tutorials, 3) learning styles, and 4) miscellaneous. Table 4.4 displays each survey question with the described four categories.

Table 4.3 Survey Questions and Categories

Category 1 - Degree and Future Career
1. I am seeking a Bachelors of Science in Elementary Education.
2. My degree concentration is mathematics.
3. Circle all the grades you would like to teach in the future.
4. The content I'm learning in this class is valuable for my future career.
7. I am nervous to teach elementary mathematics in the future.
24. I feel confident about teaching math in an elementary school.
28. Circle the highest level of math you feel is necessary to know in order for you to teach elementary math.
Category 2 - Online Work Habits and Help Tutorials
8. I like being able to redo the online quizzes multiple times to obtain a high score.
12. I prefer to watch a video explaining how to solve a problem.
13. If I missed problems on the online quizzes, I would redo the problems until I got them right.
14. If I was stuck on a math problem, I would watch a 1-2 minutes video that explained and showed how to solve the problem.
16. My goal in using the online help tutorials is to understand the problem.
20. The written help tutorials were helpful when I missed a problem on an online quiz.
22. My goal in using the online help tutorials is to correct mistakes in my calculations.
25. The video help tutorials were helpful when I missed a problem on an online quiz.
26. Consider the following scenario: You miss a problem on an online quiz and were provided with two links labeled "Written Help" and "Video Help". Which link would you select the first time you're seeking help on this problem?
27. I would select the second form of help if the type I selected first did not fully help me understand the problem or my mistake.
Category 3 - Learning Styles
9. I can read a math book and figure out how to solve problems most of the time.
11. I learn best when I underline while I'm reading.
15. I learn best through reading material.
17. I learn best when I take notes during class.
19. I learn best through doing hands-on activities.
21. I can often recall information by closing my eyes and picturing what I have read.
23. I learn best through listening and watching.

Category 4 - Miscellaneous	
5.	The online quizzes assess my knowledge over the course material.
6.	I enjoy the mathematics I'm learning in this class.
10.	I hate math.
18.	I try hard in this class.

Implementation of Survey and Participants

The researcher distributed surveys in class throughout the last two weeks of the semester, either during the last five minutes or first five minutes of a class period. At that time an introduction was provided about the researcher and the study. Students were informed that volunteering to complete the survey would contribute to the study, provide information pertinent for evolution of the online assessment system, specifically with the help tutorials. Students provided consent for their completed survey to be used in the study by turning it into the researcher. In order to keep each survey anonymous students did not include their name or any other identifying marks. This method of distribution and collection of surveys was purposeful; to obtain full participation by students in class attendance. Moreover, it was successful as 83 students completed and submitted the survey, comprising 77% of the course population.

Analysis of Survey Data

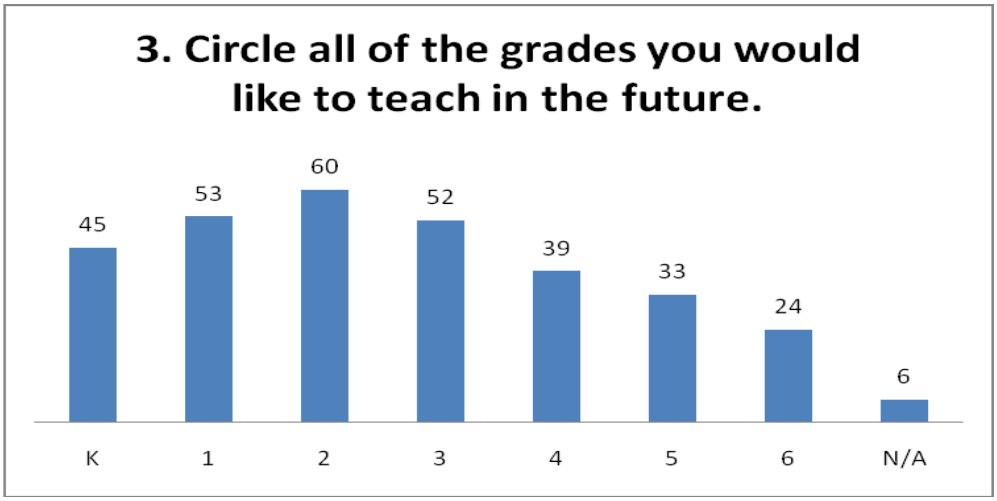
Surveys were administered and collected in the three distinct course sections and combined into one data set. Univariate and descriptive statistics were calculated for each of the 28 items on the survey (see Table 4.5).

Table 4.4 Survey Univariate and Descriptive Statistics

Item	Frequency of Responses									
	Yes 1			No 2			Mode	Median	Mean	Std. Dev.
1. I am seeking a Bachelors of Science in Elementary Education.	66			17			1	1	1.2048	0.4060
2. My degree concentration is mathematics.	10			73			2	2	1.8795	0.3275
3. Circle ***all*** the grades you would like to teach in the future. *(Circle NA for Not Applicable, if you are not an elementary education major.)*	*See Figure 4.1 Results from Survey Question 3*									
	SA 5	A 4	N 3	D 2	SD 1	NA 9				
4. The content I'm learning in this class is valuable for my future career.	24	26	16	12	5		4	4	3.6265	1.2169
5. The online quizzes assess my knowledge over the course material.	18	43	18	3	1		4	4	3.8916	0.8266
6. I enjoy the mathematics I'm learning in this class.	15	19	18	16	15		4	3	3.0361	1.3744
7. I am nervous to teach elementary school mathematics in the future.	4	16	15	31	17		2	2	2.5060	1.1621
8. I like being able to redo the online quizzes multiple times to obtain a high score.	67	9	5	0	1		5	5	4.6627	08593
9. I can read a math book and figure out how to solve problems most of the time.	26	26	24	6	1		5 & 4	4	3.8434	0.9937
10. I hate math.	8	17	13	20	25		1	2	2.5542	1.3638
11. I learn best when I underline while I'm reading.	7	14	33	15	14		3	3	2.8193	1.1597
12. I prefer to watch a video explaining how to solve a problem.	12	17	28	11	13		3	3	2.0759	1.3341
13. If I missed problems on the online quizzes, I would redo the problems until I got them right.	56	17	4	2	3		5	5	4.4217	1.0834
14. If I was stuck on a math problem, I would watch a 1-2 minute video that explained and showed how to solve the problem.	22	18	14	13	16		5	3	3.2048	1.4796
15. I learn best through reading material.	7	20	28	20	8		3	3	2.9759	1.1040
16. My goal in using the online	21	30	21	7	3		4	4	3.6747	1.1274

help tutorials is to understand the problem.										
17. I learn best when I take notes during class.	35	33	7	6	2		5	4	4.1325	1.0048
18. I try hard in this class.	38	25	14	5	1		5	4	4.1325	0.9849
19. I learn best through doing hands-on activities.	40	29	8	3	3		5	4	4.2048	1.0092
20. The written help tutorials were helpful when I missed a problem on an online quiz.	32	28	14	4	5		5	4	3.9398	1.1259
21. I can often recall information by closing my eyes and picturing what I have read.	8	21	27	19	8		3	3	3.0241	1.1259
22. My goal in using the online help tutorials is to correct mistakes in my calculations.	22	37	14	6	4		4	4	3.8072	1.0645
23. I learn best through listening and watching.	19	29	20	11	4		4	4	3.5783	1.1275
24. I feel confident about teaching math in an elementary school.	16	33	24	6	2		4	4	3.5904	1.1047
25. The video help tutorials were helpful when I missed a problem on an online quiz. *(Circle NA for Not Applicable, if you did not view any videos.)*	18	14	8	2	2	39	9	5	6.3494	2.6339
26. Consider the following scenario: You miss a problem on an online quiz and were provided with two links labeled "Written Help" and "Video Help". Which link would you select the first time you're seeking help on this problem? *(Please circle one choice.)*	2			1			1	1	1.3735	0.4867
	Written Help 31			Video Help 52						
27. I would select the second form of help if the type I selected first did not fully help me understand the problem or my mistake.	42	24	9	5	2		SA			
28. Circle the highest level of math you feel is necessary to know in order for you to teach elementary math.	4		3		2	1	4	3	2.7590	1.0886
	College		Middle		High	College				
	11		22		22	27				

Figure 4.1 Results from Survey Question 3



Correlations

Individual correlation matrices were used per course section to identify relationships among students' responses to Likert scale survey items. Data from all three sections was combined to calculate one correlation matrix for the sample population. Many moderate to strong significant correlations were identified at the 0.01 level (see Appendix K).

The original four categories of the survey did not produce significant relationships among the identified survey items. However, there were five new distinct groups identified from the correlation matrix and were labeled as Affect, Persistence, Video, Reading, and Tutorials (see Table 4.6).

Table 4.5 Identified Correlated Survey Question Groups

Group 1 – Affect
4. The content I'm learning in this class is valuable for my future career.
6. I enjoy the mathematics I'm learning in this class.
10. I hate math.
Group 2 – Persistence
8. I like being able to redo the online quizzes multiple times to obtain a high score.
13. If I missed problems on the online quizzes, I would redo the problems until I got them right.
18. I try hard in this class.

Group 3 – Video

12. I prefer to watch a video explaining how to solve a problem.
14. If I was stuck on a math problem, I would watch a 1-2 minutes video that explained and showed how to solve the problem.

Group 4 – Reading

9. I can read a math book and figure out how to solve problems most of the time.
15. I learn best through reading material.
17. I learn best when I take notes during class.

Group 5 –Tutorials

16. My goal in using the online help tutorials is to understand the problem.
20. The written help tutorials were helpful when I missed a problem on an online quiz.
22. My goal in using the online help tutorials is to correct mistakes in my calculations.
27. I would select the second form of help if the type I selected first did not fully help me understand the problem or my mistake.

Cronbach's alpha was calculated among the five groups of survey items to determine coefficients of reliability. An acceptable alpha level was 0.700 or higher (Field, 2005). Of the five groups, the Reading variable did not produce an acceptable alpha output for reliability (see Table 4.6) and it was dismissed as a new variable. Individual survey items were observed for outliers in scatter plots and frequency tables. Three student responses were removed as their responses were very different from the rest. Cronbach's alpha was recalculated for each of the five new variables and acceptable levels were not produced, leaving the original survey data set for analyses.

Table 4.6 Cronbach's Alpha for Grouped Survey Items

Variable	*Cronbach's Alpha*	*Number of Items*
Affect	0.759	3
Persistence	0.771	3
Video	0.768	2
Tutorials	0.750	4
Reading	0.461	3

A new correlation matrix was conducted among the Affect, Persistence, Video, and Tutorials. Moderate to strong significant correlations among variables were identified at the 0.01 level (see Table 4.8).

Table 4.7 Correlation Matrix for Grouped Variables

Correlations

		Affect	Persistence	Video	Tutorials
Affect	Pearson Correlation	1	.149	-.199	.038
	Sig. (2-tailed)		.178	.072	.736
	N	83	83	83	83
Persistence	Pearson Correlation	.149	1	.290**	.532**
	Sig. (2-tailed)	.178		.008	.000
	N	83	83	83	83
Video	Pearson Correlation	-.199	.290**	1	.595**
	Sig. (2-tailed)	.072	.008		.000
	N	83	83	83	83
Tutorials	Pearson Correlation	.038	.532**	.595**	1
	Sig. (2-tailed)	.736	.000	.000	
	N	83	83	83	83

**. Correlation is significant at the 0.01 level (2-tailed).

As seen in the above correlation matrix, strong correlations fail to exist among Affect and the other three variables. Persistence was moderately correlated to Video (0.290) and strongly correlated to Tutorials (0.532). The variable Video was moderately correlated to Persistence (0.290) and strongly correlated to Tutorials (0.595). Furthermore, Tutorials was strongly correlated to Persistence (0.532) and Video (0.595) at the 0.01 level.

A linear regression model was calculated with Video as the dependent variable and Affect, Persistence, and Tutorials as the independent variables (see Table 4.8 to Table 4.10). From Table 4.10 Coefficients of Regression Model, Tutorials were significantly strong at the 0.001 level. Affect depicted moderate significance at the 0.05 level, and described what is left over after accounting for Tutorials.

Table 4.8 Model Summary of Linear Regression

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.635[a]	.403	.381	1.99741	.403	17.805	3	79	.000

a. Predictors: (Constant), Tutorial, Affect, Persistence

Table 4.9 ANOVA from Linear Regression Model

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	213.107	3	71.036	17.805	.000[a]
	Residual	315.182	79	3.990		
	Total	528.289	82			

a. Predictors: (Constant), Tutorials, Affect, Persistence

b. Dependent Variable: Video

Table 4.10 Coefficients of Regression Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	-.213	1.305		-.163	.871	-2.810	2.384		
	Affect	-.173	.069	-.222	-2.521	.014	-.310	-.036	.975	1.025
	Persistence	.002	.108	.002	.023	.982	-.213	.218	.700	1.428
	Tutorial	.454	.077	.602	5.863	.000	.300	.608	.715	1.398

a. Dependent Variable: Video

Summary of Survey Data

Surveys were developed by the researcher and administered to 83 students during the last two weeks of class. Correlation matrices were used to identify relationships among survey items. Five variables, Affect, Persistence, Video, Tutorials, and Reading were created from the correlation matrix. Cronbach's alpha was calculated to determine coefficients of reliability for the five new variables. A significant level ($\alpha > 0.700$) was not obtained for

Reading, therefore the variable was dismissed. A correlation matrix was calculated among Affect, Persistence, Video, and Tutorials. Affect did not produce any significant correlations among the other variables. Persistence was moderately correlated to Video and strongly correlated to Tutorials. Video was moderately correlated to Persistence and strongly correlated to Tutorials. Finally, Tutorials was strongly correlated to both Persistence and Video.

The ANOVA analysis means from Table 4.9 through 4.11 displays the variables Affect, Persistence, and Tutorial as a function of Video. The ANOVA produced a significant regression model at the 0.001 level, with an F statistic of 17.805. The coefficients of the regression model illustrated a strong significance at the 0.001 level for Tutorials with a Beta of 0.454, and a moderate significance at the 0.05 level for Affect with a Beta of -0.173, after accounting for Tutorials. The coefficients in Table 4.11 of the regression model show the greatest impact on whether students like the idea of videos is their attitude toward the online tutorials in general. Students who like the tutorials overall, enjoy the video help tutorials as a part of them. While there is a connection among the video help tutorials and the variable Persistence, it is mediated through Tutorials. Therefore, students who value persistence tend to value Tutorials, of which student then value Videos; however Persistence does not add anything beyond this. Affect was a much smaller factor but does add additional information. Since the beta value is negative, it implies students who dislike math are more likely to value the Videos. All of which is consistent with the idea that video help tutorials appeal to the different learning styles of students.

Online Quizzes

Throughout the semester students in MATH 320 were required to complete seven online quizzes. Each quiz was composed of five to seven open-ended problems. Table 4.12 displays the topics for each online quiz. Scores per quiz were normalized to an equivalent value out of ten points. An assortment of information collected through the online quiz system included: number of times students looked at written and video help tutorials per quiz, average student achievement per quiz, average attempts per quiz, average scores per quiz, etc.

Table 4.11 Quiz Topics

Online Quiz	*Quiz Topic*
Quiz 1	Arithmetic
Quiz 2	Number Theory
Quiz 3	Fractions
Quiz 4	Decimals
Quiz 5	Rations, Proportions, and Percents
Quiz 6	Geometry
Quiz 7	Measurement

Analysis of Online Quiz Data

In order for students to view video help tutorials they incorrectly typed a response or left it blank twice while taking the quiz. Prior to selecting the video help tutorial link the written help tutorial appeared on the screen. Therefore, accessed video help tutorials implied students had the opportunity to read through the written help tutorial associated with the problem.

Online Quiz Attempts

The number of students who began taking each online quiz exceeded the number of students who actually completed each quiz (see Table 4.13). Quiz 6 had the highest percentage of students who began the quiz also finished (98.9%), where Quiz 4 had the least amount of finishers (93.4%). Quiz 6 also appeared to have the highest percentage of students who obtained a perfect score (90.4%) and Quiz 7 had the lowest (57%). On average Quiz 5 was taken 3 times by students, likewise with Quiz 7 taken 3.1 times. Average quiz scores on Quiz 5 and 7 were 9.3 and 8.7 respectively, resulting in the lowest average scores among the seven quizzes. Moreover, the average number of help tutorials accessed on Quiz 5 was 2.1, and 3.8 on Quiz 7.

Table 4.12 Online Quiz Attempts

Quiz #	*# of Students Begun*	*# of Students Finished*	*% of Students Finished Quiz*	*# of Perfect Scores*	*% of Students with Perfect Scores who Finished*	*Average # of Attempts*	*Average Score out of 10*	*Average # of Help Tutorials Accessed*
1	104	100	96.2%	80	80.0%	2.0	9.7	0.9
2	103	98	95.1%	76	77.6%	2.0	9.6	1.0
3	93	89	95.6%	68	76.4%	2.0	9.5	1.2
4	91	85	93.4%	67	78.8%	2.5	9.6	0.7
5	91	89	97.8%	54	60.7%	3.0	9.3	2.1
6	95	94	98.9%	85	90.4%	1.8	9.8	0.8
7	95	93	97.8%	53	57.0%	3.1	8.7	3.8

Video Help Tutorials

Figure 4.2 to Figure 4.8 show the problems per quiz that had a video help tutorial paired with the written help tutorial, the number of students who viewed each video, and the number of views per video. Although the first quiz only had two video help tutorials, 15 students viewed them 21 times, which indicated some students watched the same video more than once (see Figure 4.2). The video help tutorials on the second through sixth quizzes were not viewed that often by students, and some videos were never viewed (see Figure 4.3 through Figure 4.8). The seventh quiz revealed different results. Four of the five available video help tutorials were viewed by 52 students 79 times. Problems 2 and 5 had the most views and repeated looks at the video help tutorial. These problems covered measurement content that of unit conversions and calculating ratios. Reference Appendix G through Appendix J for an example of Quiz 7, written help tutorial example, and video help tutorial example.

Figure 4.2 Quiz 1 Video Views

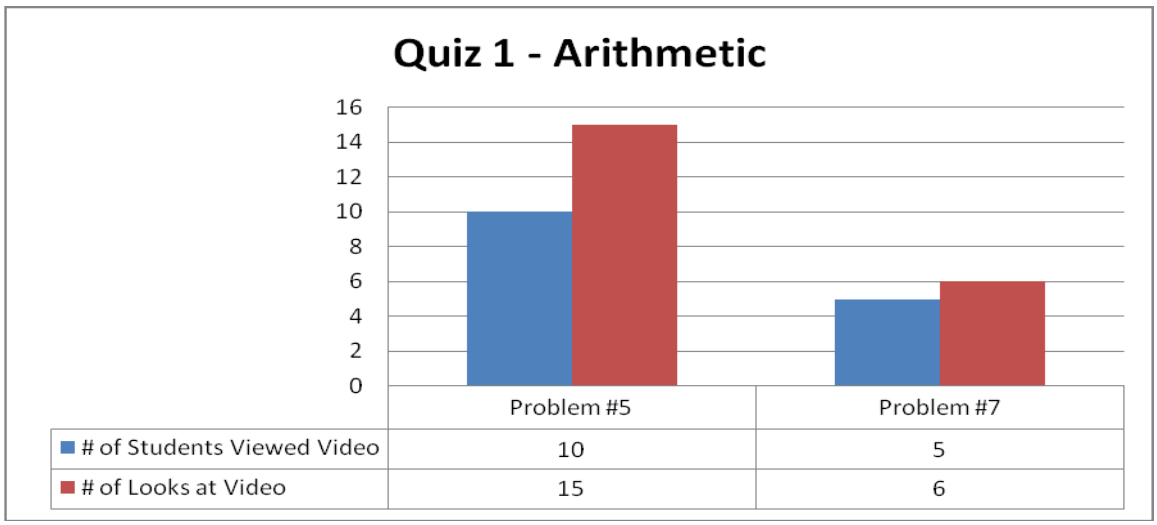


Figure 4.3 Quiz 2 Video Views

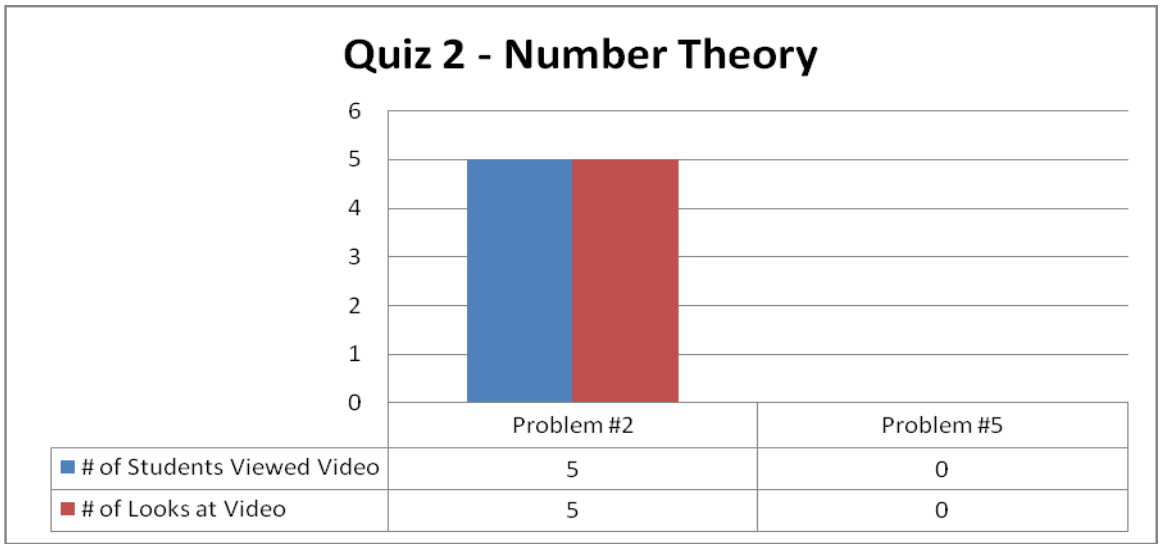
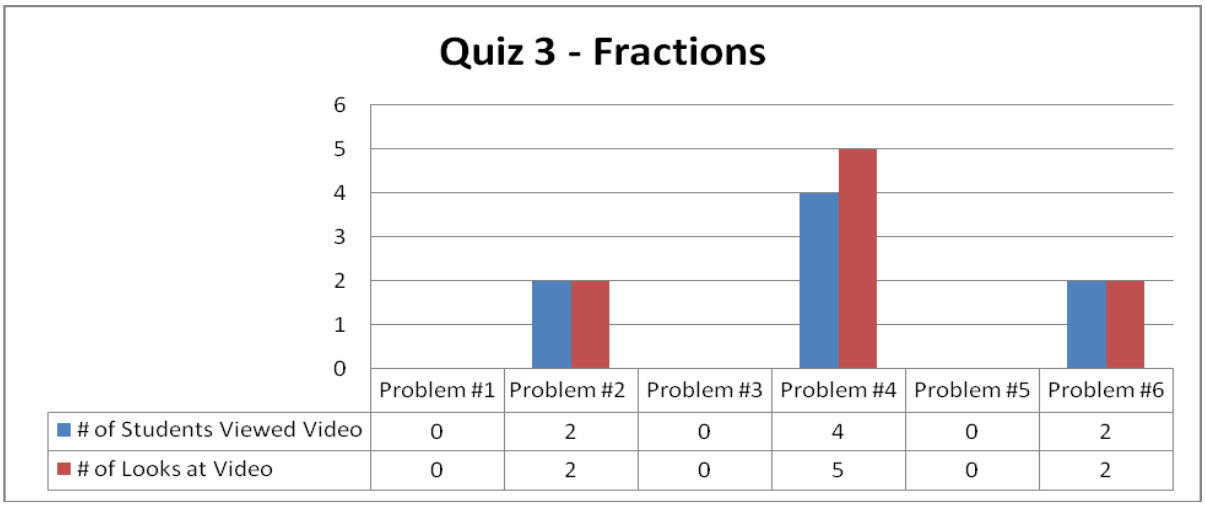
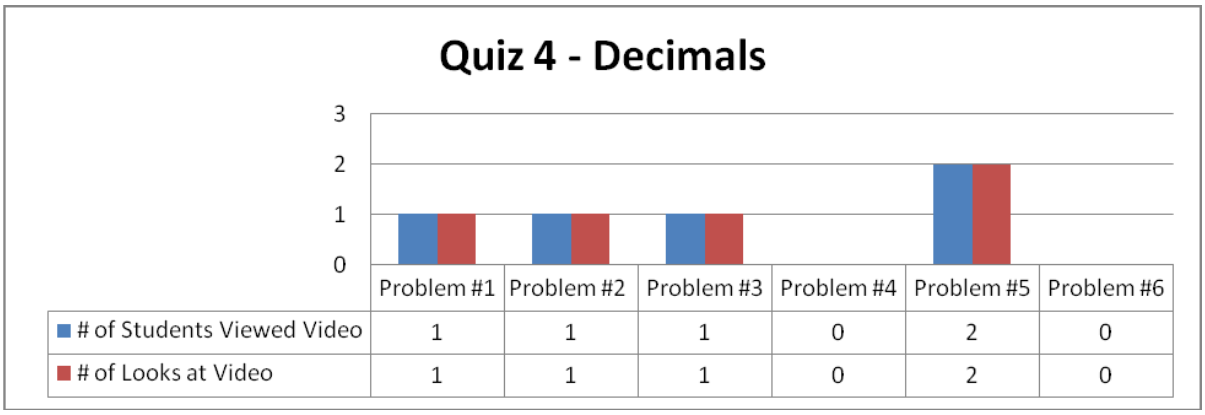


Figure 4.4 Quiz 3 Video Views



	Problem #1	Problem #2	Problem #3	Problem #4	Problem #5	Problem #6
# of Students Viewed Video	0	2	0	4	0	2
# of Looks at Video	0	2	0	5	0	2

Figure 4.5 Quiz 4 Video Views



	Problem #1	Problem #2	Problem #3	Problem #4	Problem #5	Problem #6
# of Students Viewed Video	1	1	1	0	2	0
# of Looks at Video	1	1	1	0	2	0

Figure 4.6 Quiz 5 Video Views

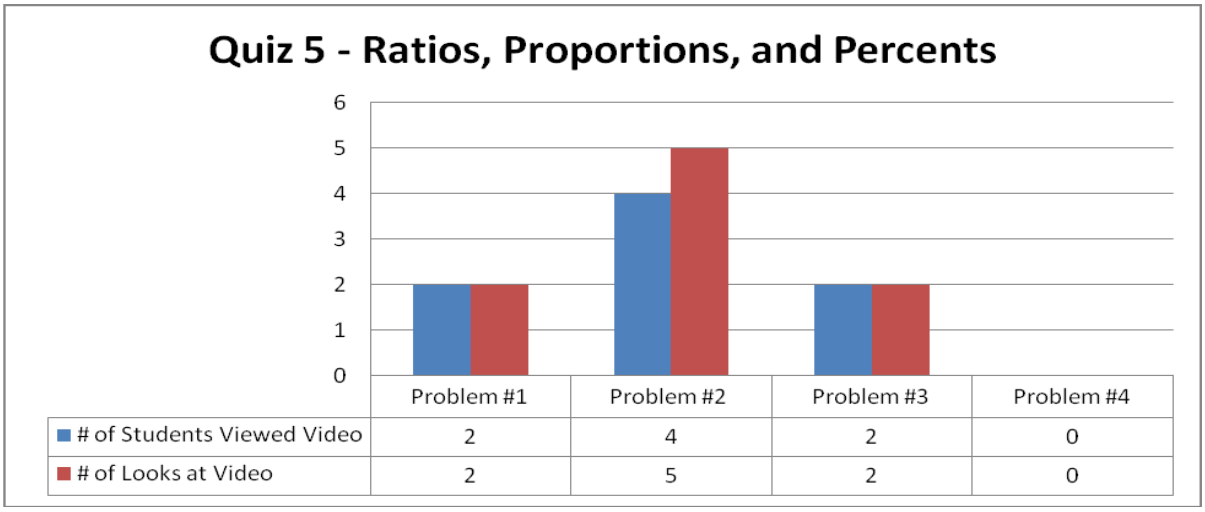


Figure 4.7 Quiz 6 Video Views

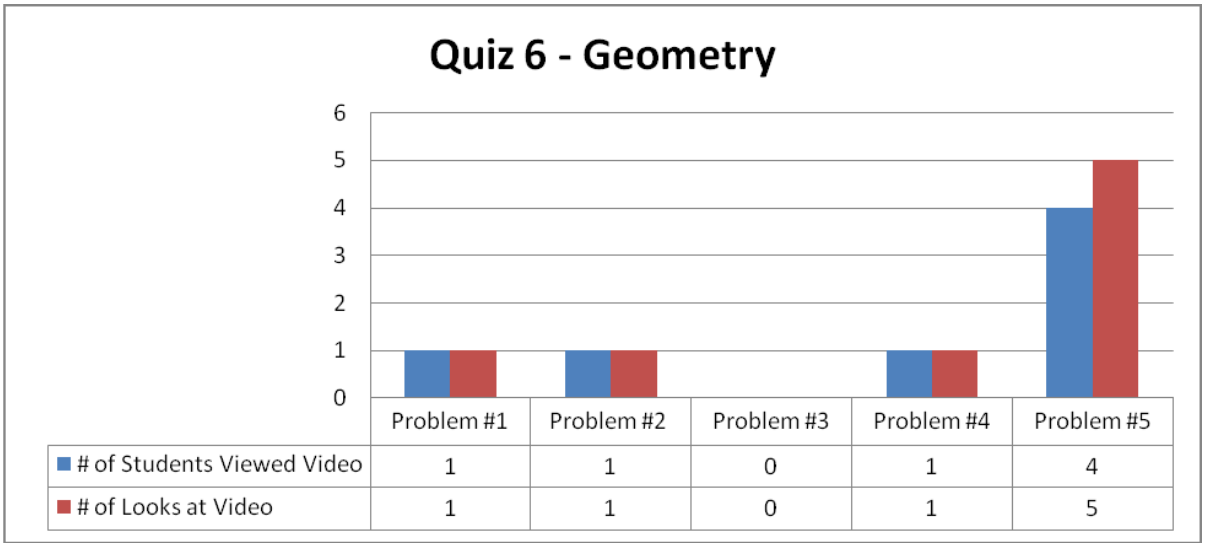
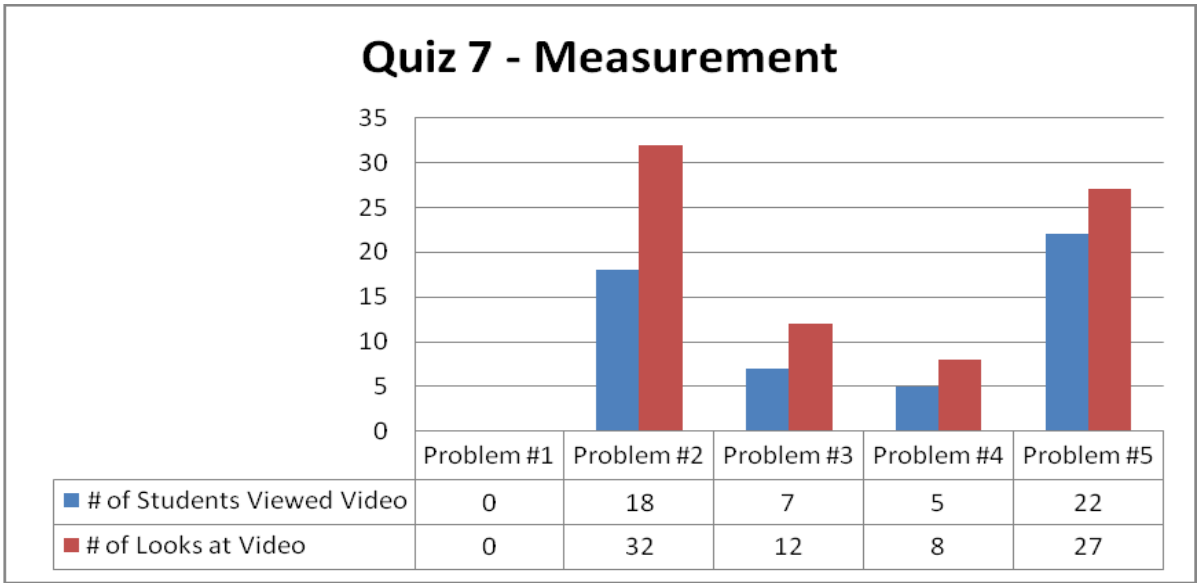


Figure 4.8 Quiz 7 Video Views



	Problem #1	Problem #2	Problem #3	Problem #4	Problem #5
# of Students Viewed Video	0	18	7	5	22
# of Looks at Video	0	32	12	8	27

Quiz 7 Results

The seventh quiz consisted of five problems covering content over measurement. This quiz was of particular interest after identifying students' struggled the most with the content. This was apparent from the number of students who looked at the four video help tutorials, number of attempts taking the quiz, total number of views per video, average number of attempts taking the quiz, and average student score (see Figure 4.8 and Table 4.14).

Of the students who utilized the video help tutorials on Quiz 7, one student attempted the quiz 17 times where another student attempted the quiz 9 times. Eventually both students earned full credit. Nineteen students who watched video help tutorials on Quiz 7 retook the quiz between five to seven times, where ten students made four attempts at the quiz. Additionally, 13 students attempted Quiz 7 three times, and 20 students who viewed the video help tutorials completed the quiz twice. An average score of 8.2 was earned by 28 students who only attempted Quiz 7 once upon using a video help tutorial. Of the 13 students who attempted the quiz three times, the average score earned was the lowest at 7.7, whereas students who attempted the quiz four or more times earned an average score of 9.0 or above (see Table 4.14).

Table 4.13 Number of Attempts on Quiz 7 from Students who Viewed the Video Help Tutorials

# of Attempts on Quiz 7	*# of Students*	*Average Score out of 10*	*Standard Deviation*
1	28	8.2	2.1
2	20	8.8	2
3	13	7.7	2.4
4	10	9.8	0.6
5	7	9.1	1.1
6	4	9	1.2
7	8	9.3	1
9	1	10	
17	1	10	

As stated earlier, students accessed the video help tutorials the most on Problems 2 and 5 within Quiz 7 (see Figure 4.8). Recall, in order for students to view video help tutorials, the written help tutorial for the missed problem appears first. Further data was downloaded from the online system to identify the 18 students who viewed the tutorials 32 times. Table 4.15 describes which students accessed the video help tutorial for Problem 2 on Quiz 7, the date and time of access, how many times the video was selected, and the attempt trial for completing this quiz. Student S1 accessed the video on April 26th and 27th, 2009 during their 4th attempt for taking the quiz. This is possible because students have the option of saving their progress and returning to the system at a later time to complete the quiz.

Two of the 18 students viewed the video help tutorial when they were on their second attempt taking Quiz 7, where the other 14 students accessed the video help tutorial on their 3rd to 10th attempt of taking the quiz. Four students viewed the video twice each and two students watched the video three times each. One student (S18) watched the video help tutorial seven times, of which the first six times of viewing the video was during their fifth attempt at the quiz, then one additional time during their sixth attempt. Table 4.15 depicts students do not chose to view the video help tutorial on their first attempt at taking the quiz, and most students did not access the video help tutorial until their 4th or more attempt to complete the quiz.

Table 4.14 Students Access to Video Help Tutorials on Quiz 7 Problem 2

Student N=18	Date Accessed	Time Accessed	# of Attempt to Take Quiz when Viewing Video
S1	2009-04-26	15:11:36	4
	2009-04-27	15:34:45	4
S2	2009-04-26	18:17:30	4
S3	2009-04-24	19:03:12	5
	2009-04-24	19:21:40	5
S4	2009-04-27	22:48:21	3
S5	2009-04-25	12:15:42	8
	2009-04-25	12:29:22	8
S6	2009-04-23	09:15:02	6
	2009-04-25	11:21:00	8
	2009-04-25	11:21:14	8
S7	2009-04-28	16:25:10	3
S8	2009-04-27	16:35:42	2
S9	2009-04-27	19:15:19	4
	2009-04-27	19:44:51	4
	2009-04-27	19:59:40	4
S10	2009-04-24	14:09:06	3
S11	2009-04-24	14:48:06	3
S12	2009-04-27	13:20:56	4
S13	2009-04-26	17:08:51	10
S14	2009-04-28	14:09:45	5
S15	2009-04-27	09:50:56	2
S16	2009-05-11	11:06:26	5
S17	2009-04-14	22:49:57	6
	2009-04-14	23:04:13	6
S18	2009-04-27	13:26:07	5
	2009-04-27	13:40:16	5
	2009-04-27	13:46:07	5
	2009-04-27	13:56:18	5
	2009-04-27	14:03:41	5
	2009-04-27	14:13:01	5
	2009-04-27	14:32:52	6

Similar analyses were conducted on Problem 5 of Quiz 7 since the video help tutorials were accessed 27 times by 22 students (see Table 4.15). Twenty students watched the video help tutorial one time, one student watched it twice, and one student watched it five times. The student who watched this video help tutorial five times was the same student

(S18) who watched the video help tutorial on problem 2 seven times. Three of the students who accessed the video were on their second attempt for completing the quiz. The remaining 19 students were on their third attempt or more.

Again, the data reveals students do not choose to view the video help tutorial on their first attempt, but more often access the video on their third attempt or more. Table 4.15 displays students who accessed the video help tutorial for Problem 5 in Quiz 7. Fifteen of the 22 students who viewed the video Problem 5 had also viewed the video for Problem 2.

Table 4.15 Students Access to Video Help Tutorials on Quiz 7 Problem 5

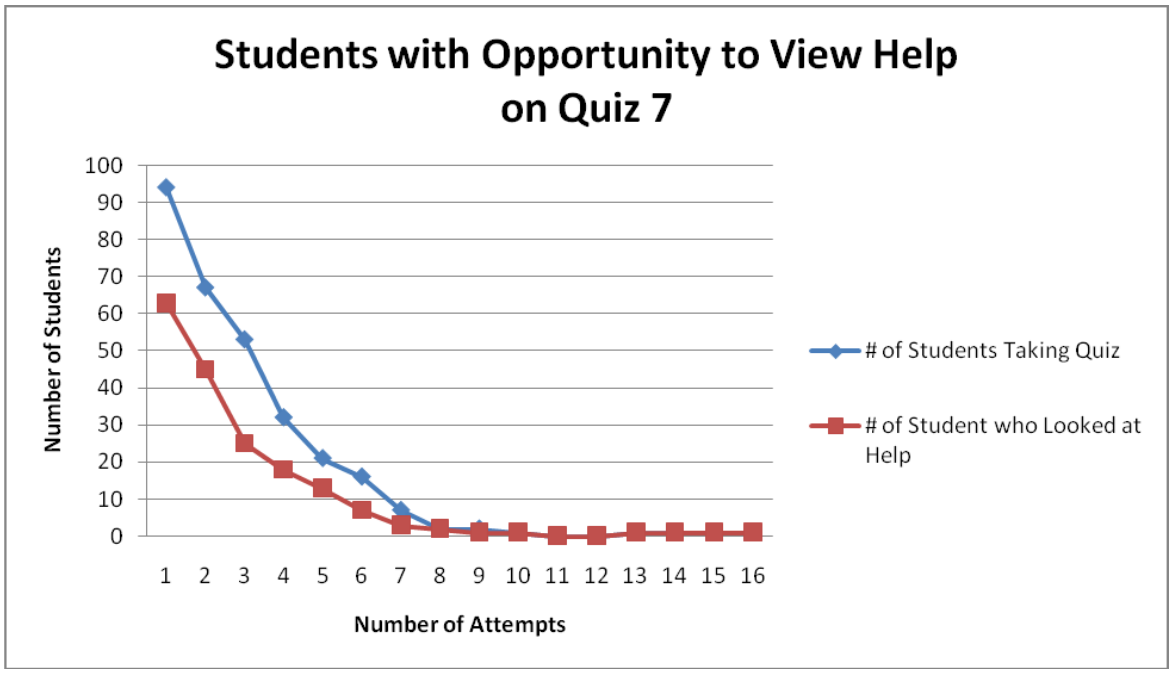
Student N=22	Date Accessed	Time Accessed	# of Attempt to Take Quiz when Viewing Video
S1	2009-04-27	15:43:09	4
S2	2009-04-26	18:24:17	4
S3	2009-04-24 2009-04-24	18:57:22 19:21:52	5 5
S4	2009-04-27	22:44:52	3
S5	2009-04-25	12:23:23	8
S6	2009-04-25	11:25:15	8
S8	2009-04-27	16:43:26	2
S9	2009-04-27	19:22:32	4
S12	2009-04-27	13:36:23	4
S13	2009-04-26	17:10:31	10
S14	2009-04-28	14:20:24	5
S15	2009-04-27	10:03:59	2
S16	2009-04-27	21:58:52	3
S17	2009-04-14	23:00:06	6
S18	2009-04-27 2009-04-27 2009-04-27 2009-04-27 2009-04-27	13:30:09 13:36:55 13:51:17 14:00:25 14:17:24	5 5 5 5 5
S19	2009-04-26	17:26:08	2
S20	2009-04-26	19:50:09	3
S21	2009-04-27	16:00:22	4
S22	2009-04-24	14:11:39	3
S23	2009-04-27	12:56:56	8
S24	2009-04-27	04:15:11	8
S25	2009-04-27	00:58:56	3

It is most common to see that students viewed video help tutorials during their 3rd through 5th attempt. Few students access the video help tutorial after missing a problem on their second attempt, or sixth or more attempt (see Table 4.16). As the number of attempts for taking Quiz 7 increased, the number of students taking the quiz and the number of students who viewed help tutorials decreased (see Table 4.16 and Figure 4.9).

Table 4.16 Students with Opportunity to View Help on Quiz 7

# of Attempts Quiz 7	*# of Students Taking Quiz*	*# of Students who Looked at Help*	*% of Students Looked at Help*
1	94	63	67.0%
2	67	45	67.2%
3	53	25	47.2%
4	32	18	56.3%
5	21	13	61.9%
6	16	7	43.8%
7	7	3	42.9%
8	2	2	100.0%
9	2	1	50.0%
10	1	1	100.0%
11	0	0	
12	0	0	
13	1	1	100.0%
14	1	1	100.0%
15	1	1	100.0%
16	1	1	100.0%

Figure 4.9 Students with Opportunity to View Help on Quiz 7

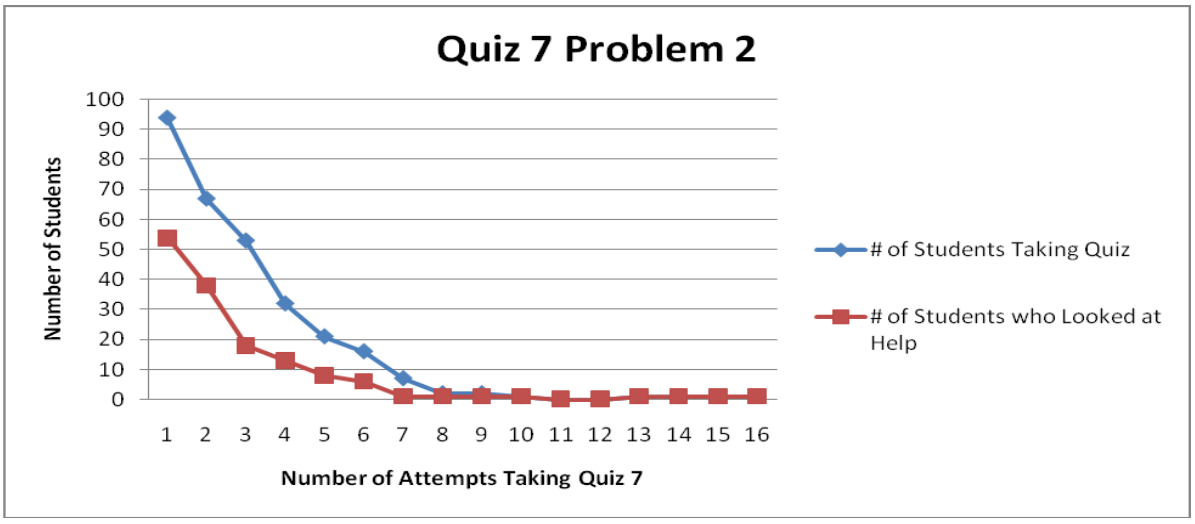


Problems 2 and 5 of Quiz 7 were analyzed further. The number of students taking the quiz decreased on each attempt, as well as the number of students who looked at written help for Problem 2. However, of the 54 students who used the written help tutorial on their first attempt completing the quiz, none watched the video help tutorial. The video help tutorials were not accessed until students' second through tenth attempts taking the quiz.

Table 4.17 Number of Students looked at Written Help and Viewed Videos on Quiz 7 Problem 2

# of Attempt on Quiz 7	*# of Students Taking Quiz*	*# of Students used Written Help on Problem 2*	*# of Videos Viewed on Problem 2*
1	94	54	
2	67	38	2
3	53	18	4
4	32	13	4
5	21	8	4
6	16	6	3
7	7	1	
8	2	1	2
9	2	1	
10	1	1	1
11	0	0	
12	0	0	
13	1	1	
14	1	1	
15	1	1	
16	1	1	

Figure 4.10 Attempts of Taking Quiz 7 Problem 2

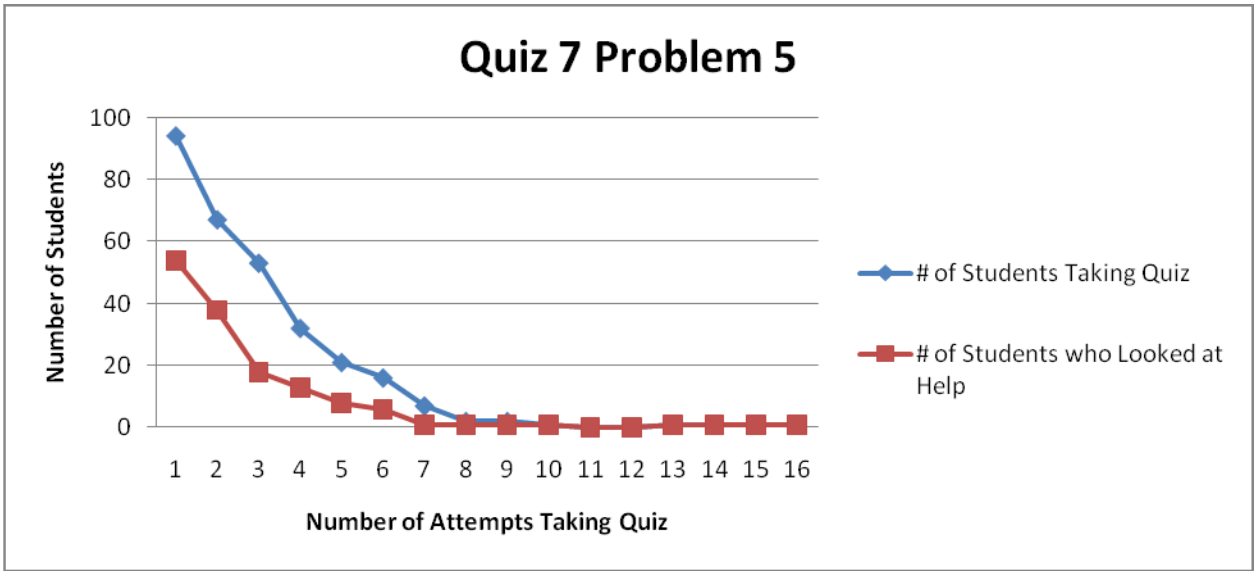


The same number of students used written help tutorials on Problems 2 and 5, and within the same number of attempts of taking Quiz 7. Written help tutorials were most frequently accessed during students first through fourth attempts and video help tutorials were viewed during second through tenth attempts. As the number of attempts for completing Problems 2 and 5 on Quiz 7 occurred, the number of students completing each problem and number of students who looked at help decreased exponentially.

Table 4.18 Number of Students looked at Written Help and Viewed Videos on Quiz 7 Problem 5

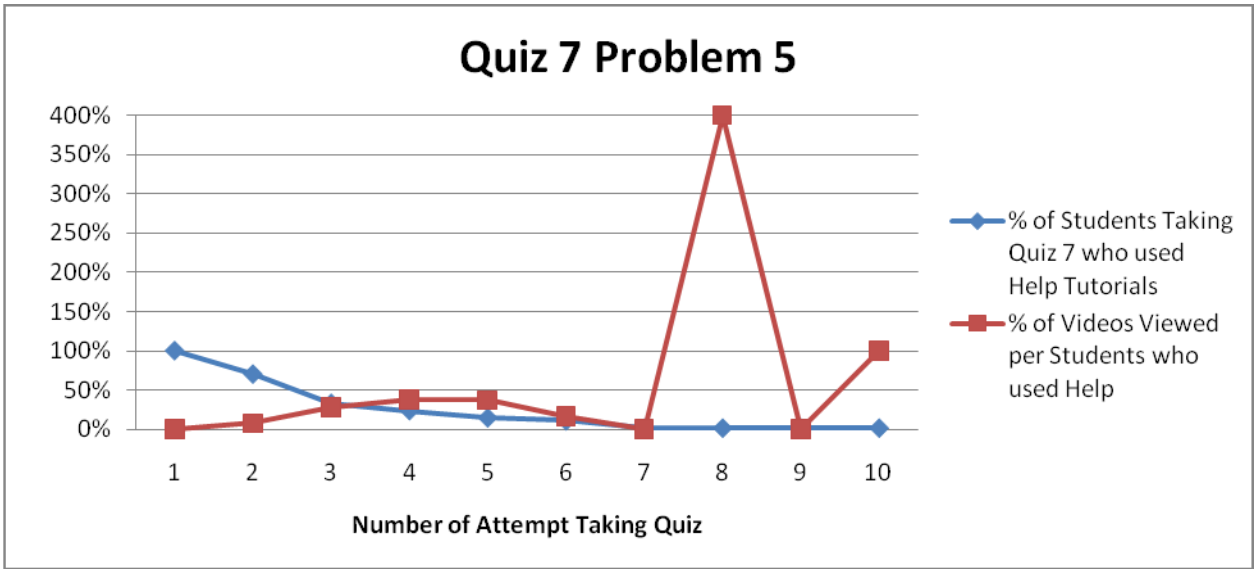
# of Attempt on Quiz 7	*# of Students Taking Quiz*	*# of Students used Written Help on Problem 5*	*# of Videos Viewed on Problem 5*
1	94	54	
2	67	38	3
3	53	18	5
4	32	13	5
5	21	8	3
6	16	6	1
7	7	1	
8	2	1	4
9	2	1	
10	1	1	1
11	0	0	
12	0	0	
13	1	1	
14	1	1	
15	1	1	
16	1	1	

Figure 4.11 Attempts of Taking Quiz 7 Problem 5



The percent of students using help tutorials on Quiz 7 decreased as the number of attempts taking the quiz increased. The percent of video help tutorials used increased on attempts three through five. One student watched a video help tutorial four times on their eighth attempt at taking the quiz, hence the spike within Figure 4.12.

Figure 4.12 Quiz 7 Problem 5: Percent of Video Help Tutorials Viewed



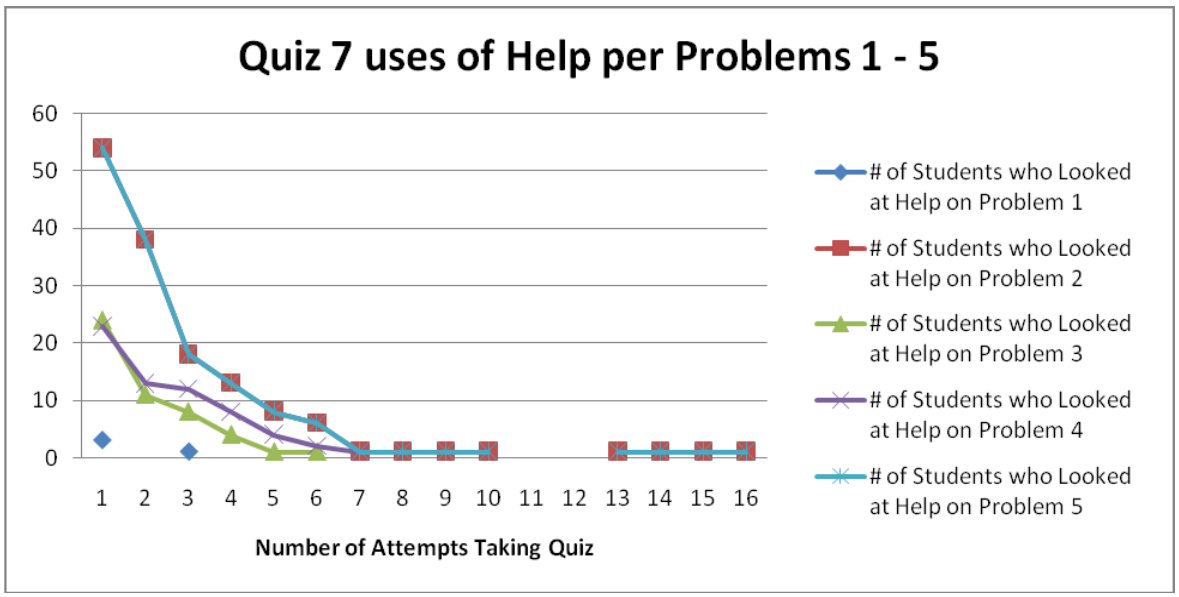
Summary of Quiz 7 Results

Of the 95 students who began to take Quiz 7, 93 students finished. Table 4.19 shows the amount of times help tutorials (written and/or video) were accessed on the five problems, and during what attempt the students took the quiz. As previously discussed, students viewed the most help tutorials on Problems 2 and 5; yet help tutorials for Problems 3 and 4 also received a fair amount of views. The number of students completing multiple attempts of each problem within Quiz 7, and the number of students who used help tutorials declined as the number of attempts increased.

Table 4.19 Quiz 7 uses of Help Tutorials on Problems 1 - 5

# of Attempts on Quiz 7	*# of Students who Looked at Help on Problem 1*	*# of Students who Looked at Help on Problem 2*	*# of Students who Looked at Help on Problem 3*	*# of Students who Looked at Help on Problem 4*	*# of Students who Looked at Help on Problem 5*
1	3	54	24	23	54
2		38	11	13	38
3	1	18	8	12	18
4		13	4	8	13
5		8	1	4	8
6		6	1	2	6
7		1		1	1
8		1			1
9		1			1
10		1		1	1
11					
12					
13		1			1
14		1			1
15		1			1
16		1			1
Total	4	145	49	64	145

Figure 4.13 Quiz 7 uses of Help on Problems 1 – 5



Results of Quiz 5

Student performance on Quiz 5 was not impressive either, with only 60.7% of students who finished the quiz received a perfect score. The average number of attempts taking this quiz was three, about the same as Quiz 7. The average score on Quiz 5 was 9.3 points, 1.6 points greater than scores on Quiz 7 (see Table 4.12).

Similar to results from Quiz 7, the number of students taking Quiz 5 and those who looked at help tutorials decreased as the number of attempts at taking the quiz increased (see Table 4.20 and Figure 4.14). Table 4.20 displays the percent of students taking Quiz 5 who used help tutorials, per attempt at the quiz.

Table 4.20 Students with Opportunity to View Help on Quiz 5

# of Attempts on Quiz 5	*# of Students*	*# of Looks at Help Tutorials*	*% of Students who Looked at Help Tutorials*
1	94	39	41.5%
2	67	29	43.3%
3	53	14	26.4%
4	32	11	34.4%
5	21	5	23.8%
6	16	1	6.3%
7			
8			
9	2	1	50.0%

Figure 4.14 Students with Opportunity to View Help on Quiz 5

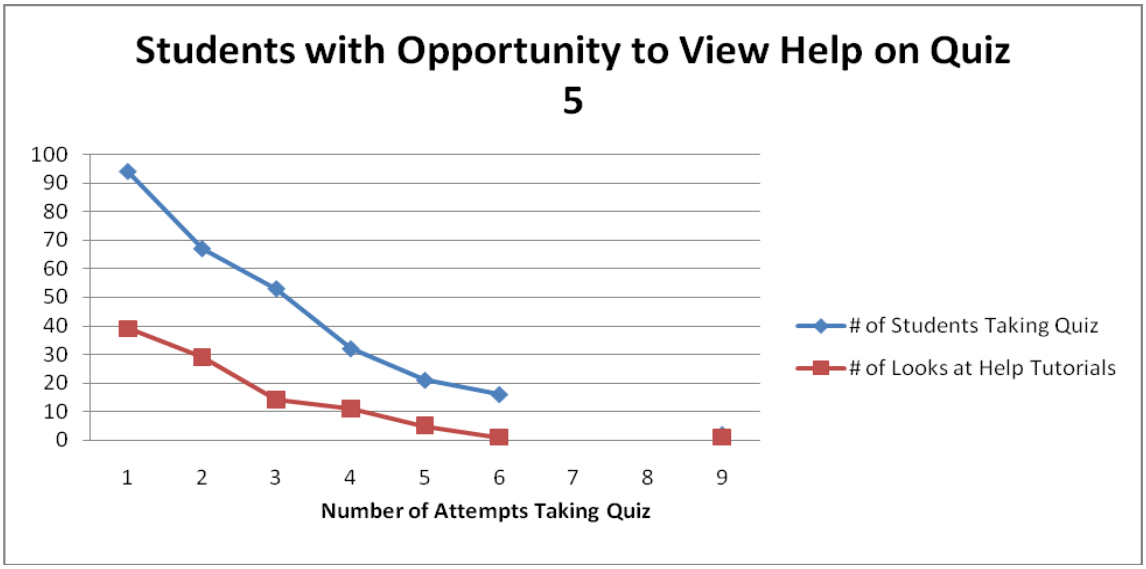
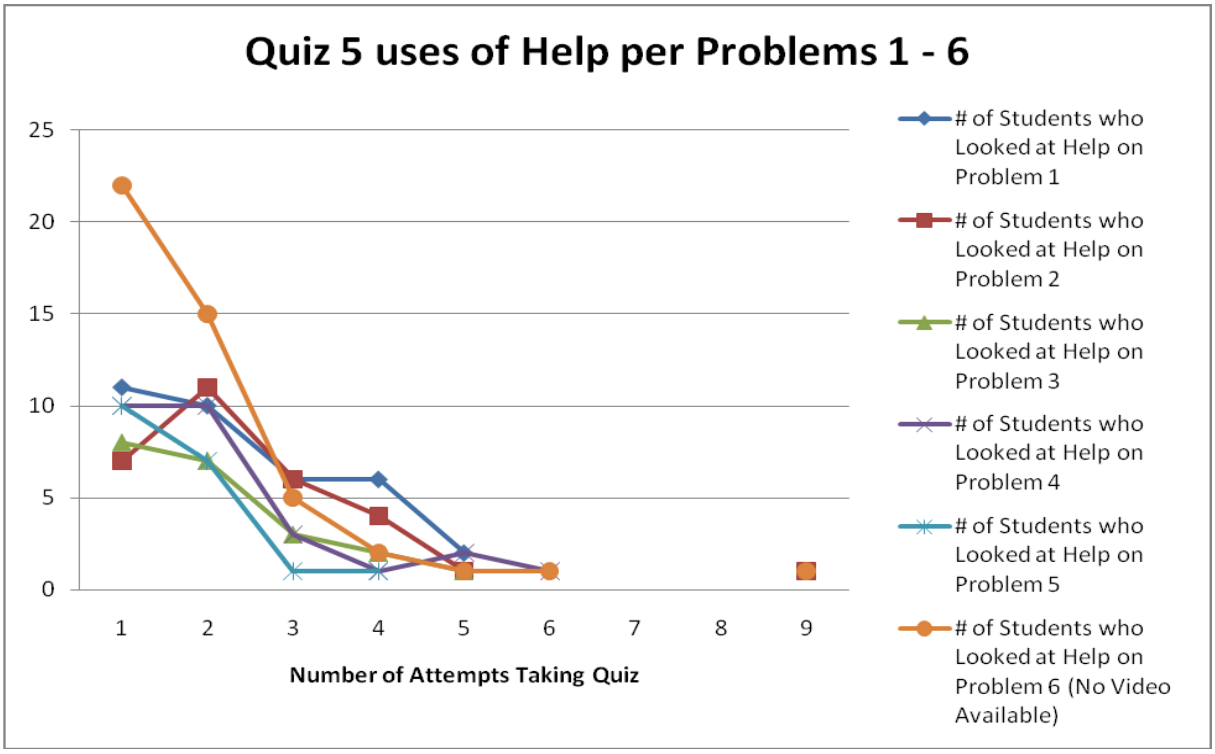


Table 4.22 represents the number of students who viewed help tutorials on each of the six problems within Quiz 5. Notice Problem 6 does not have a video help tutorial available. Therefore, students strictly viewed a written help tutorial for Problem 6, where students who accessed help on Problems 1 through Problem 5 had the opportunity to use both written then video help. Figure 4.15 is a direct representation of Table 4.21 in pictorial form.

Table 4.21 Quiz 5 uses of Help Tutorials on Problems 1 – 6

# of Attempts on Quiz 5	*# of Students who Looked at Help on Problem 1*	*# of Students who Looked at Help on Problem 2*	*# of Students who Looked at Help on Problem 3*	*# of Students who Looked at Help on Problem 4*	*# of Students who Looked at Help on Problem 5*	*# of Students who Looked at Help on Problem 6 (No Video Available)*
1	11	7	8	10	10	22
2	10	11	7	10	7	15
3	6	6	3	3	1	5
4	6	4	2	1	1	2
5	2	1	1	2		1
6				1		1
7						
8						
9		1				1

Figure 4.15 Quiz 5 uses of Help per Problems 1 – 6



Summary of Quiz 5 Results

Problems 1 through 5 on Quiz 5 had both written and video help tutorials, where Problem 6 only had a written help tutorial paired with the problem. More students accessed the help tutorial on Problem 6 within their first two attempts of taking Quiz 5 than any other problem. As student attempts to take the quiz increases, the number of students who viewed help tutorials decreased for each problem. The following sections are a natural progression of investigating how students performed after using the written and video help tutorials.

Student Performance after use of Written Help Tutorials

Students' online behaviors were analyzed to determine how many times students used written help tutorials after they missed a problem. Additionally, data was collected to determine how many students successfully answered the previously missed problem after using the written help tutorial on a future attempt at taking the quiz. The number of times students chose to view written help tutorials was impressive. For example, 95 students begun Quiz 7 of which the written help tutorial for Problem 2 was viewed 174 times (see Table 4.22). This shows a number of students accessed the written help tutorial more than once. Only 51 (29.31%) students correctly answered Problem 2 on a later attempt at completing Quiz 7.

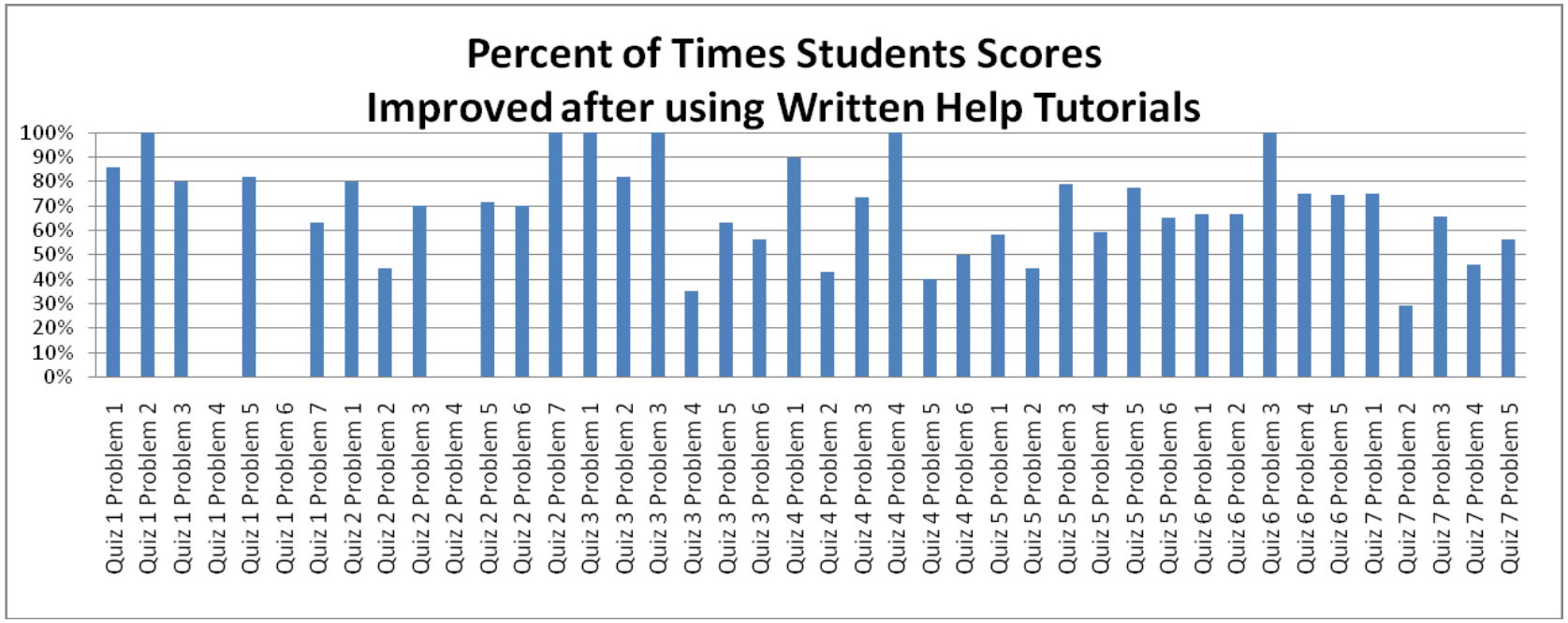
Table 4.22 Student Improvement after the use of Written Help Tutorials

	# of Students who began taking Quiz	*% of Written Help Usage relative to # of Students*	*# of Times Students Looked at Written Help*	*# of Times Students Scores Improved after Looking at Written Help*	*% of Times Students Scores Improved after using Written Help*
Quiz 1 Problem 1	104	6.73%	7	6	85.71%
Quiz 1 Problem 2		1.92%	2	2	100.00%
Quiz 1 Problem 3		4.81%	5	4	80.00%
Quiz 1 Problem 4		0.00%			
Quiz 1 Problem 5		26.92%	28	23	82.14%
Quiz 1 Problem 6		0.00%			
Quiz 1 Problem 7		47.12%	49	31	63.27%
Quiz 2 Problem 1	103	19.42%	20	16	80.00%
Quiz 2 Problem 2		36.89%	38	17	44.74%
Quiz 2 Problem 3		19.42%	20	14	70.00%
Quiz 2 Problem 4		0.00%			
Quiz 2 Problem 5		6.80%	7	5	71.43%
Quiz 2 Problem 6		9.71%	10	7	70.00%
Quiz 2 Problem 7		1.94%	2	2	100.00%
Quiz 3 Problem 1	93	10.75%	10	10	100.00%
Quiz 3 Problem 2		35.48%	33	27	81.82%
Quiz 3 Problem 3		2.15%	2	2	100.00%
Quiz 3 Problem 4		36.56%	34	12	35.29%
Quiz 3 Problem 5		32.26%	30	19	63.33%
Quiz 3 Problem 6		17.20%	16	9	56.25%
Quiz 4 Problem 1	91	10.99%	10	9	90.00%
Quiz 4 Problem 2		15.38%	14	6	42.86%
Quiz 4 Problem 3		20.88%	19	14	73.68%
Quiz 4 Problem 4		1.10%	1	1	100.00%
Quiz 4 Problem 5		21.98%	20	8	40.00%
Quiz 4 Problem 6		2.20%	2	1	50.00%
Quiz 5 Problem 1	91	45.05%	41	24	58.54%
Quiz 5 Problem 2		39.56%	36	16	44.44%
Quiz 5 Problem 3		26.37%	24	19	79.17%
Quiz 5 Problem 4		29.67%	27	16	59.26%
Quiz 5 Problem 5		24.18%	22	17	77.27%
Quiz 5 Problem 6		53.85%	9	32	65.31%
Quiz 6 Problem 1	95	3.16%	3	2	66.67%
Quiz 6 Problem 2		6.32%	6	4	66.67%
Quiz 6 Problem 3		7.37%	7	7	100.00%
Quiz 6 Problem 4		8.42%	8	6	75.00%
Quiz 6 Problem 5		53.68%	51	38	74.51%
Quiz 7 Problem 1	95	4.21%	4	3	75.00%
Quiz 7 Problem 2		183.16%	174	51	29.31%
Quiz 7 Problem 3		57.89%	55	36	65.45%
Quiz 7 Problem 4		84.21%	80	37	46.25%
Quiz 7 Problem 5		76.84%	73	41	56.16%

It is apparent students dilligently chose to view written help tutorials after missing a problem. There are six instances where 100% of the students who accessed the written help, correctly answered the problem on a later attempt at the quiz. Although, those six cases occurred when one to ten students used the written help tutorial.

Of the 42 quiz problems, 26 problems had written help tutorials associated with them. The usage of these helps ranged from 10% to 183% of students (as some students used helps repeatedly). Quiz 7 Problem 2 was the most challenging for students with the help looked at an average of 1.83 times per student taking the quiz. Unfortunately, only 29.31% of students correctly answered the problem on their next attempt. Figure 4.16 displays the percent of times tudents scores improved after using written help tutorials, which ranged from 29% - 100% (also see Table 4.22). It should be observed that the most success occurred among problems where fewer students viewed the help, and then correctly answered the problem on a later attempt. This data supports students' persistence on the online quizzes, as they frequently sought forth help to correctly answer problems.

Figure 4.16 Percent of Times Students Scores Improved after using Written Help Tutorials



(Note: Studens never viewed help tutorials for Problems 4 and 6 on Quiz 1, and Problem 4 on Quiz 2)

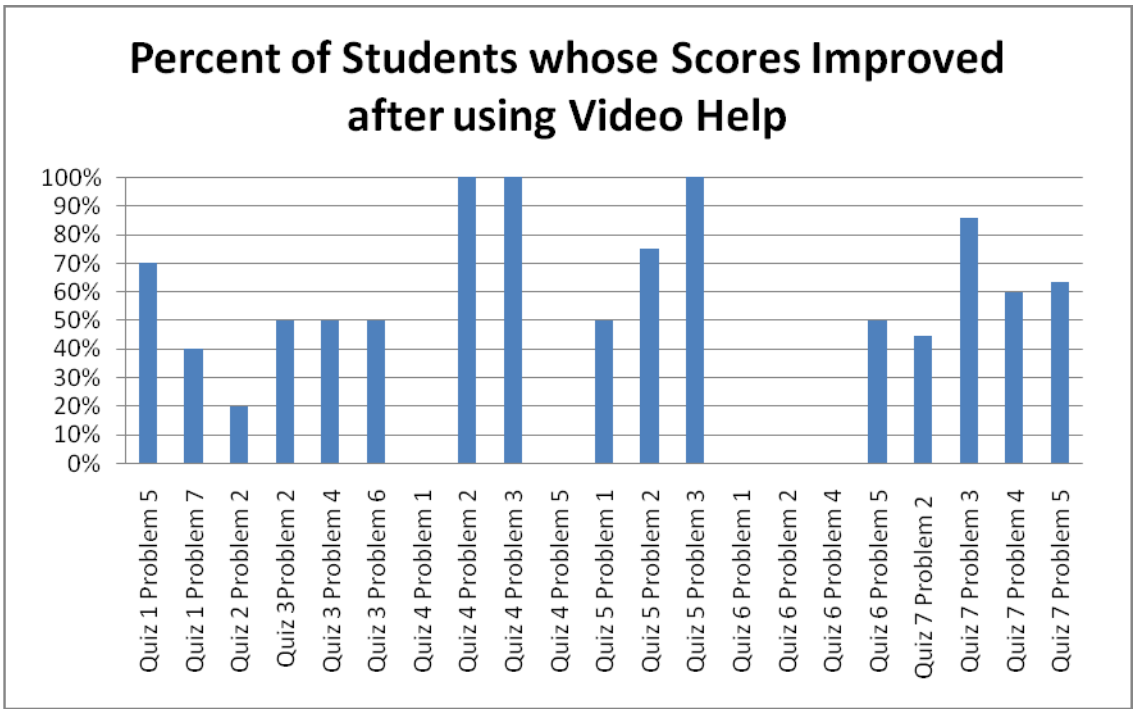
Student Performance after use of Video Help Tutorials

As previously explored a number of students viewed the 21 video help tutorials among the seven quizzes. There were a number of students who viewed 16 of the video help tutorials and then answered the problem correctly on a future attempt of taking the quiz (see Table 4.23). The number of video help tutorials that were viewed was considerably less than those of the written help tutorials. However, the percents of students whose scores improved after using video help tutorials were greater than the written help tutorials.

Table 4.23 Improvement after Viewing Video Help Tutorials

	# of Students who viewed each video	*# of Times Students Scores Improved after using Video Help Tutorials*	*% of Times Students whose Scores Improved after using Video Help Tutorials*
Quiz 1 Problem 5	10	7	70.00%
Quiz 1 Problem 7	5	2	40.00%
Quiz 2 Problem 2	5	1	20.00%
Quiz 3Problem 2	2	1	50.00%
Quiz 3 Problem 4	4	2	50.00%
Quiz 3 Problem 6	2	1	50.00%
Quiz 4 Problem 1	1	0	0.00%
Quiz 4 Problem 2	1	1	100.00%
Quiz 4 Problem 3	1	1	100.00%
Quiz 4 Problem 5	2	0	0.00%
Quiz 5 Problem 1	2	1	50.00%
Quiz 5 Problem 2	4	3	75.00%
Quiz 5 Problem 3	2	2	100.00%
Quiz 6 Problem 1	1	0	0.00%
Quiz 6 Problem 2	1	0	0.00%
Quiz 6 Problem 4	1	0	0.00%
Quiz 6 Problem 5	4	2	50.00%
Quiz 7 Problem 2	18	8	44.44%
Quiz 7 Problem 3	7	6	85.71%
Quiz 7 Problem 4	5	3	60.00%
Quiz 7 Problem 5	22	14	63.64%

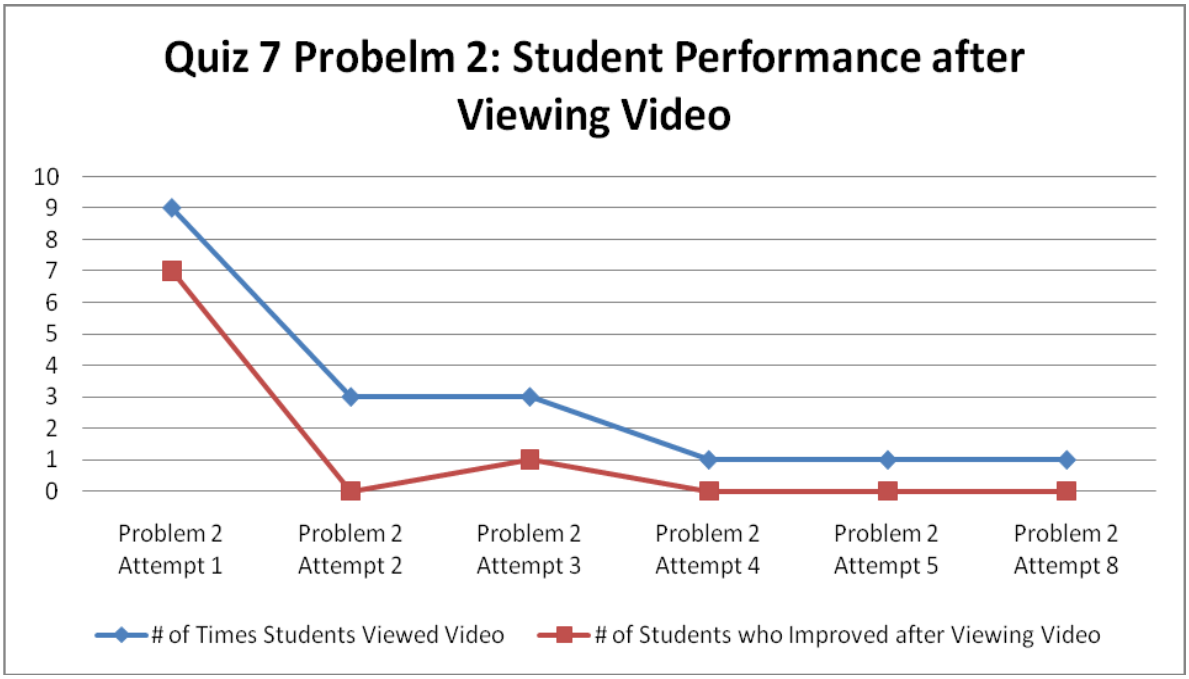
Figure 4.17 Percent of Students whose Scores Improved from using Video Help Tutorials



Problems 2 and 5 from Quiz 7 were the most challenging for students, as previously described in the chapter. Only 44% of the students who viewed the video help tutorial paired with Problem 2 correctly answered the problem on a future attempt of taking the quiz, and 64% of students on Problem 5.

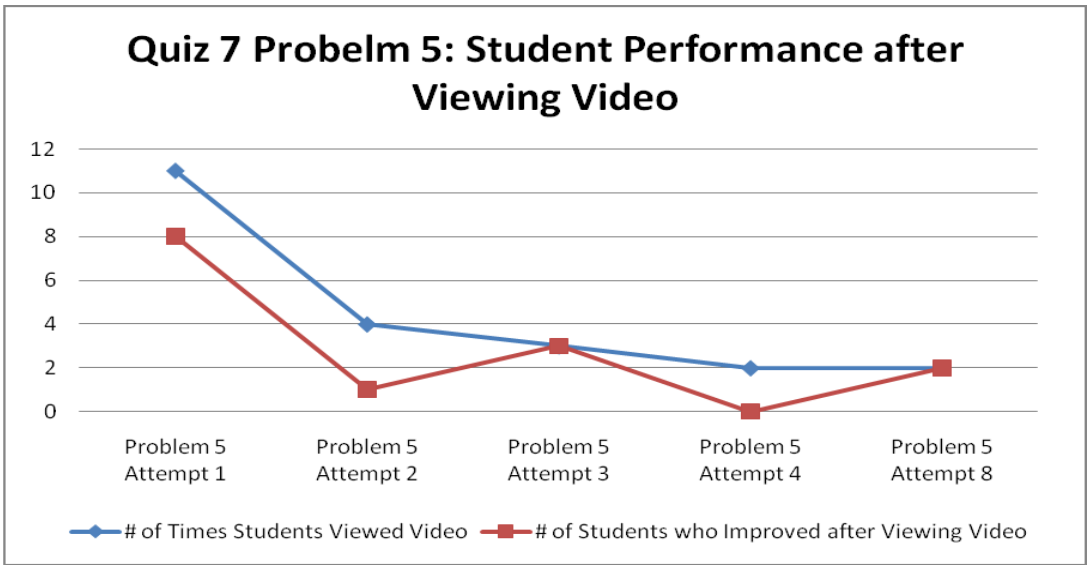
Students chose to attempt quizzes multiple times. It is of interest to explore how students performed on each attempt, after viewing video help tutorials. On Quiz 7 Problem 2, nine students viewed the video help tutorial on their first attempt of taking the quiz. Seven of them correctly answered the problem on their next attempt. Three students watched the video on their third attempt, of which one improved their performance. Correct answers for Problem 2 were not submitted by students who viewed the video on their second, fourth, fifth, and eighth attempts (see Figure 4.18).

Figure 4.18 Quiz 7 Problem 2: Student Performance after Viewing Video



Similar findings may be stated about student performance on Quiz 7 Problem 5. The number of students who accessed the video help tutorial on the first attempt was greater than the other attempts, with a gradual exponential decline of viewers. However, most of the students who watched the video on their first, second, third, or eitghth attempts successfully completed Problem 5 the next time. The two students who watched the video on their fourth attempt of taking the quiz, were not so fortunate to successfully complete the problem on their next attempt (see Figure 4.19).

Figure 4.19 Quiz 7 Problem 5: Student Performance after Viewing Video



Students' performance was explored after they watched a video help tutorial. It revealed many but not all students benefited from this additional feature. The percent of students who benefited from the video help tutorials was greater than those who benefited from the written help tutorials; although the number of views of videos was drastically less than the number of times written help tutorials were viewed.

Comparisons from Spring 2009 and Spring 2008 Courses

The first set of video help tutorials became available in Fall 2008, where the revised shorten videos were available in Spring 2009. Comparisons between Spring 2008 and Spring 2009 semesters were of interest, since the difference between the online quizzes consisted of adding the video help tutorials in Spring 2009. The number of students enrolled was similar among the Spring semesters in '08 and '09, with three sections of the course. However, instructors varied as well as students.

Data was retrieved from the Spring 2008 semester to compare students mean scores among Quiz 5 and 7 (see Table 4.24). However, the video help tutorials were not a component of the online quizzes during Spring 2008. The mean scores from Quiz 5 were the same across both semesters, but Spring 2008 data had a smaller standard deviation. The mean scores from Quiz 7 differed from semesters. The students who did not have access to video

help tutorials in Spring 2008 outperformed students who used video help tutorials in Spring 2009.

Table 4.24 Mean Quiz Scores among 2008 and 2009 Spring Semesters

		# of Students Finished Quiz	*Mean Quiz Score*	*Standard Deviation*
Quiz 5	Spring 2009 with Video	89	9.3	1.5
	Spring 2008 without Video	100	9.3	0.9
Quiz 7	Spring 2009 with Video	93	8.7	1.9
	Spring 2008 without Video	101	9.3	1.7

Summary of Online Quiz Data

The analysis of online quiz data revealed students made multiple attempts at each quiz in order to obtain a high or perfect score. They viewed written help tutorials most often after missing problems on their first through fourth attempts. Students viewed video help tutorials most often on their fourth attempt at the quiz or higher. Student achievement on Quizzes 5 and 7 were lower than the other five quizzes. Quiz 7 had the lowest number of students earning perfect scores, yet a larger number of video help tutorials viewed compared to the other quizzes.

Data was compared between Spring semesters of 2009 and 2008 to investigate student performance with and without video help tutorials. Students from Spring 2008 without video help tutorials earned greater mean scores than student in Spring 2009 where video help tutorials were utilized. However, instructors and students were not the same across the two semesters which created delimitation.

CHAPTER 5 - CONCLUSIONS

Restatement of the Problem

The researcher sought to explore the impact of written and video help tutorials in online quizzes on student achievement in an undergraduate mathematics course. Multiple intelligences and learning styles impact how students learn and therefore should be taken into account by educators when they prepare a course. Mathematical literacy is a critical component required when students are learning mathematics. Moreover, assessment is a significant element in measuring student achievement.

Online assessments can provide students with prompt feedback on the incorrect individual answers they submitted, as well as the percentage of items they have answered correctly. These systems may or may not improve the quality of assessments, but in any event they offer the potential efficiencies of faster feedback to students and reduction in the teachers' record-keeping (Means, Roschelle, Penuel, Sabelli, & Haertel; 2003). The online system used in this study provided more instant feedback to students than the feedback as described above. Students were informed if each answer was correct, incorrect or left unanswered. Then they were provided with the opportunity to make changes to incorrect or blank answers, and then again were informed of the results. Furthermore, students received a link to written help tutorials when they continued to miss a problem after they tried to correct the solution. The written help tutorials described how to solve the problem they missed in text with technical mathematical language. Most of the written help tutorials contained an extra link to a video help tutorial. Students interested in viewing an additional source of explanation for solving a similar problem used this resource.

The results of this study provide this mathematics program with the knowledge of how students perform on online assessments given different online tools in the form of technical written help or video format. Analyses of the use of written and video help tutorials provide insight to their impact within the online quizzes. Additionally, student interviews and a survey data aid in this study to examine students' perceptions of the online quizzes, and the helpfulness of the written and video help tutorials. The results should also offer insight to

professors teaching this course in regards to planning and preparation; in particular, learning generalizations about the student population who takes the course.

Limitations of the Study

As stated in Chapter 1, inherent limitations generally hold in all research. There were four main limitations of this study:

1. The limited number of video tutorials available within online quizzes.
2. The inability to determine the length of time students viewed the videos, or if they actually watched them after the video had begun will also bound data and analysis.
3. The inability to determine if students actually read the written online help tutorials when they were selected.
4. Interviewing a small number of students during the Spring 2009 semester.

The number of video help tutorials available within the online quizzes varied from quiz to quiz as seen in Appendix F - Links to Video Help Tutorials. Frequently missed problems on quizzes from Spring 2008 and Fall 2009 data, were the driving force of determining which video help tutorials to initially create. The first two quizzes only had two video help tutorials. The problems chosen to incorporate video help tutorials were similar in content and desired responses with other problems that only had written help tutorials. Therefore, not all of the problems would have video help tutorials and recall students may only view the video help tutorials if they missed a problem, and selected the written help tutorial for assistance first. The intent for paired problems, one with a video help tutorial and one with only a written help tutorial, was to compare how students performed after viewing the type of help tutorial on the paired problems. Unfortunately, the video help tutorials available in Quiz 1 and Quiz 2 were rarely viewed by students or not viewed at all. For example, the video help tutorial paired with Problem 5 on Quiz 2 never was viewed (see Figure 4.2).

Quiz 3 and Quiz 4 had six problems and six video help tutorials available. Similarly, Quiz 6 and Quiz 7 had five problems with five video help tutorials available. Quiz 5 had six problems and four videos available. A fifth video was created however technical difficulties

occurred, and the video help tutorial was unable to be posted on the internet for viewing. Three video help tutorials were never viewed on Quiz 3, two on Quiz 4, one on Quiz 5, one on Quiz 6, and one on Quiz 7 (see Figure 4.2 to Figure 4.8). Two reasons would describe why these videos were not accessed: 1) students did not miss the problem associated with the video help tutorial; therefore were never provided with the opportunity to view it, and 2) even if students had access to the video help tutorial, they simply chose not to view it for help.

Data from the online quiz system provided the researcher with information pertaining to which video and/or written help tutorials were selected by students. While this was important to the study, it was unclear what the students chose to do after selecting the help tutorials. After selecting the written help tutorial, did students actually read it? Did students reread the written help tutorial? Did students watch the video help tutorial, in full, partially, or at all? Did student take advantage of rewinding or fast forwarding to find information? The answers to these questions were unattainable by the online system used in this study at this time. Students interviewed and surveyed were asked about their experiences with video help tutorials in order to obtain little insight into these questions.

Another limitation to this study was the number of students interviewed. Only 18.5% of the final population of the course was interviewed, 13 females and two males. Obtaining more students would have been desired for this part of the study. However the distribution of students who stated they accessed written and video help tutorials were satisfying, as the interviews were not the main focus of this study.

Summary of Research Methods

Quantitative and qualitative methods were conducted in this study. Quantitative research was conducted using the online quiz system and the survey, developed by the researcher. Qualitative research was conducted through interviews with students. Both research methods were used to examine the effects of implementing written and video help tutorials in online quizzes within an undergraduate mathematics course.

Online quiz data was gathered throughout the Spring 2009 semester with 108 students enrolled at the beginning and 81 remained by the last day of the course. Interviews were conducted with 15 students after they had taken their first two online quizzes, yet before their fourth online quiz. The survey was completed by 83 students in class during the last two weeks of the semester.

The quantitative data were analyzed using univariate and descriptive statistics, correlation matrices, ANOVA, and frequency tables. Qualitative data was collected from personal interviews, coded by the researcher, and organized into patterns for each question to identify common themes.

Summary of Findings

Discussion and summary of the findings are presented in terms of the original research question and sub-questions.

Research question: What impact does written and video help tutorials have on online assessment experiences for students?

Sub-question 1. Under what circumstances do students choose to view written help tutorials?

Sub-question 2. Under what circumstances do students choose to view additional help in the form of a video help tutorial?

Sub-question 3. What elements contribute to the effectiveness of a video help tutorial?

Sub-question 4. Do making video help tutorials available improve student achievement?

A summary and discussion will begin with sub-question 1 through 4. Taken in combination with the descriptions of results in chapter 4, these sub-questions provide an answer to the main research question.

Sub-question 1: *Under what circumstances do students choose to view written help tutorials?*

Interviews revealed students were willing to use written help tutorials after missing a problem on a quiz. Students revealed they were trying to understand the problem, identify a process to solve the problem, and correct a mistake in their calculations.

> "I just like to have an explanation because most of the time I don't understand how to do it. If I go through that it explains why I'm wrong and I can carry that to do the next problem right."
> *(F – V3)*

Students claimed the written help tutorials are convenient, clearly explain how to solve the problem, and they are just as likely or more likely to use them on future quizzes.

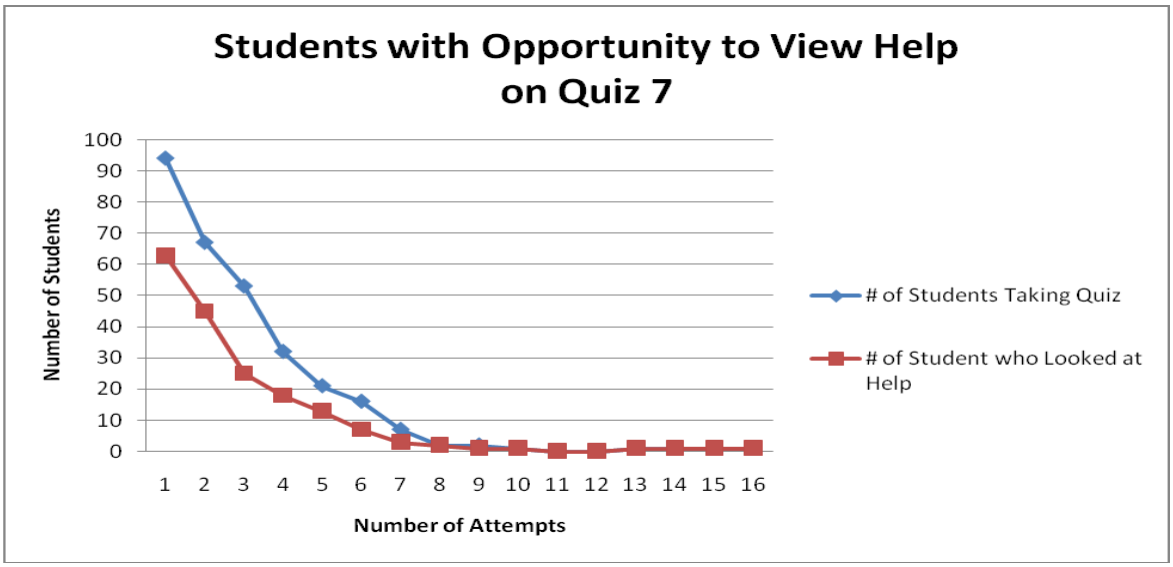
> "Yes. Because it shows you how to get it right. It explains how to work the problem out."
> *(F – W8)*

The survey revealed 88% of participating students would redo problems they missed until they got them right. When asked if the written help tutorials were helpful after missing a problem 72% agreed, 17% were neutral, and 11% disagreed. If students were presented with the opportunity to choose their type of help, written or video, after missing a problem, 37% of students indicated they would select a written help tutorial over a video help tutorial, the first time they missed a problem. Nine of the interviewed students were asked the same question and six claimed they would prefer to use the written help tutorial first, then the video help tutorial if they needed more guidance.

According to students' online behaviors from taking each quiz, the average number of attempts per quiz ranged from two to three. On average, students accessed the written help tutorials once on Quizzes 1, 2, 3, 4, and 6, twice on Quiz 5, and approximately 4 times on Quiz 7. Quiz 7 indicated students struggled with the content more than the other quizzes. Table 4.16 Students with Opportunity to View Help on Quiz 7 and Figure 4.9 showed a large

number of students attempted Quiz 7 multiple times, as well as viewing the written help tutorials often. Of the students on their first and second attempts taking Quiz 7, 67% looked at written help tutorials on each attempt. By the third attempt, 56% of the students who began the quiz were still taking the quiz, and 47% of those students viewed written help tutorials. On students' sixth attempt, 17% of students were still retaking Quiz 7, of which 44% used written help tutorials.

Figure 4.9 Students with Opportunity to View Help on Quiz 7



Findings were consistent among interviews, survey data, and online behaviors. This led to the conclusion that students were motivated to use written help tutorials when they missed problems on a quiz. The written help tutorials met the needs of students with mathematical literacy, reading and comprehension skills. It could be assumed students who benefitted from the written help tutorials also were strong in two of the eight Multiple Intelligences defined by Gardner (1983, 1999), logical-mathematical intelligence and linguistic intelligence. Students' use of written help tutorials can also be attributed to the possibility of earning full credit if they correctly answered all of the problems on any given quiz. Students indicated the written help tutorials were convenient and helpful for determining a procedure to solve the problem they used them.

Sub-question 2. *Under what circumstances do students choose to view additional help in the form of a video help tutorial?*

The survey denoted 63% of students said they would select a video help tutorial over a written help tutorial after missing a problem; and 58% of students strongly agreed or agreed they learn best through listening and watching. However, only 35% strongly agreed or agreed they prefer to watch a video explaining how to solve a problem.

Interviews were conducted with four students who claimed they viewed video help tutorials and 11 students who did not. Three students discussed reasons why they watched the video help tutorials. They voiced positive opinions about how the videos visually showed the step-by-step process and verbal explanation, for example:

> "I actually find the video more helpful because the person is actually doing it step-by-step. The explanations are good and you can see what they are doing."
> *(F – V3)*

Students also remarked the length of the video help tutorials they watched were just the right length and beneficial to use. Positive interview comments were received about the explanations for solving the types of problems, which were presented in a simple, step-by-step approach. Further, interviewees said the video help tutorials included useful pictures or visuals throughout the explanation of how to solve the problem. Survey results presented 53% of student surveyed viewed a video help tutorial by the end of semester. Of those students who viewed a video help tutorial, 73% strongly agreed or agreed that they were helpful when they missed a problem on a quiz. Only 18% responded neutral to the helpfulness of the video help tutorial watched, and 9% disagreed or strongly disagreed, meaning they did not find the video help tutorial beneficial.

Length of a video was a factor that influenced students' use of video help tutorials. Students from the preliminary interviews indicated they preferred videos that were shorter than the 3 to 5 minute video help tutorials they viewed. Success from the online entertainment industry showed 90 second episodes were very popular among viewers (http://www.myspace.com/promqueentv). This prompted the re-creation of the videos used in the Spring 2009 semester. Ten of 11 students interviewed from the Spring 2009 semester stated they would prefer to watch video help tutorials that are five minutes or less in length. Moreover, the survey data revealed 48% of students strongly agreed or agreed they would

watch a 1 to 2 minute video help tutorial that explained and showed how to solve the problem, where 17% were neutral, and 35% disagreed or strongly disagreed. Overall, the shorter the video the more appealing it was for students to view it.

The online student behaviors from Quiz 7 provided proof that students will view video help tutorials when they continue to complete problems incorrectly. In particular, the second and fifth problems on Quiz 7 had the most students who accessed the video help tutorials, some of which watched the same video multiple times. Overall students' online behavior, interviews, and the survey indicated students will use the resources available (video help tutorials) numerous times in order to understand the content to solve the problem correctly. Similar to the discussion of Sub-question 1, students use the resources provided, and their persistence to obtain a high or perfect score on the online quizzes contributed to the use of video help tutorials.

For those students who did not obtain the greatest amount of help from the written help tutorials, they sought help from the video help tutorials. The video help tutorials met the needs of students' different learning styles. Auditory and visual learning style preferences were met through the use of video help tutorials. Students who learn best through auditory experiences initially listen to verbal instruction or recordings (Rayneri, Berber, & Wiley, 2006; Sims & Sims, 1995). It can be assumed students who benefitted from the video help tutorials also were strong in two of the eight Multiple Intelligences defined by Gardner (1983, 1999), spatial intelligence and logical-mathematical intelligence.

Sub-question 3. *What does it take to make an effective video help tutorial?*

The answer to this question was partially addressed above in the discussion of Sub-question 2. Length of video help tutorials was an important factor that impacted students' choice to view video help tutorials. Interviews revealed the step-by-step explanation and visual demonstration of problem solving were key components that made video help tutorials beneficial.

Interpretations may vary about the effectiveness of the video help tutorials based on online student behaviors. For example, the video help tutorials for Quiz 7 Problem 2 was viewed 18 times, and 22 times on Problem 5. A few students watched those two videos multiple times (see Table 4.17 and Table 4.18). It could be said that the video was not helpful

or effective for students who watched the same video over and over. Further data was captured to investigate how students performed after viewing the video help tutorials for those two problems on Quiz 7. Of the 18 students who watched the video for Problem 2 on Quiz 7, 44% of those students correctly answered the problem on a future attempt. Additionally, 64% of the 22 students who viewed the video for Problem 5 on Quiz 7 correctly answered that problem on a future attempt.

Among the seven quizzes there were 21 video help tutorials. There were five video help tutorials that did not seem to be effective, as students who watched the five videos never correctly answered those problems, regardless of how many times they attempted each quiz. Conversely, there were a number of students who correctly answered problems after viewing the other 16 video help tutorials.

Through interviews and the survey students were asked if they have audio and visual learning style preferences. These questions were designed to determine how many students potentially would watch video help tutorials, and benefit from them. However, data could not be obtained to distinguish if students' preferred audio and visual learning styles used video help tutorials after missing a problem, and if they improved their quiz score after viewing video help tutorials.

Sub-question 4. *Do making video help tutorials available improve student achievement?*

The initial purpose of the video help tutorials was to see growth in student achievement, specifically from students who struggle reading and learning from the written help tutorials. Comparison among mean scores between Spring 2008 and Spring 2009 semesters did not indicate video help tutorials improved student achievement when videos were present (reference Table 4.24). Nevertheless, the mean scores did show student achievement was slightly higher during Spring 2008 when video help tutorials were not available.

The number of students who viewed video help tutorials was considerably less than the number of students who used written help tutorials. However, the percentages of students whose scores improved after using video help tutorials were greater than the written help tutorials. For this study, it will be concluded that the video help tutorials were beneficial for some students, but not all. Although the number students who benefited from the video help

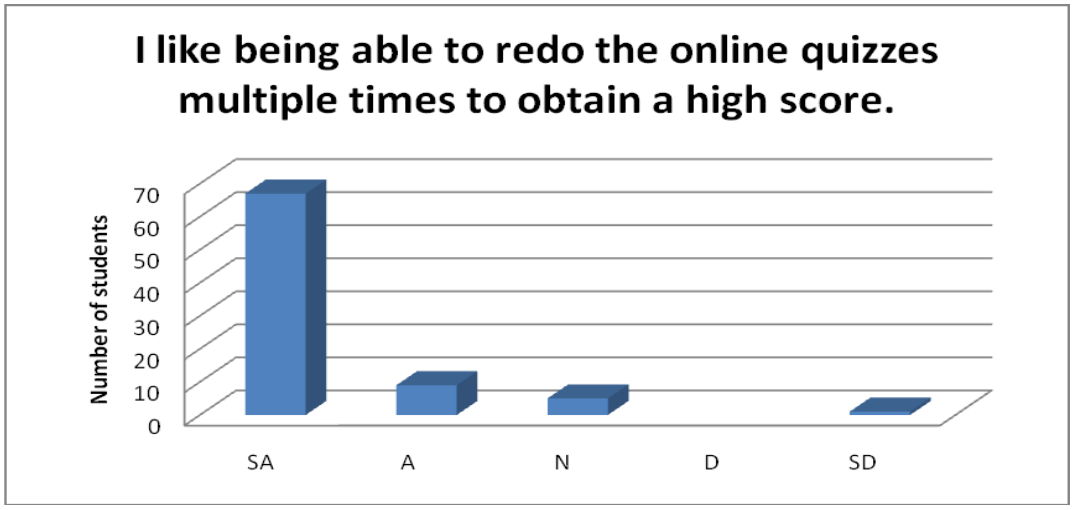
tutorials may be small, any increase in student achievement is desired from both students and educators.

Research question: *What impact does written and video help tutorials have on online assessment experiences for students?*

This study has shown students utilized the written and video help tutorials after missing problems within the online quizzes. The written help tutorials were most popular out of the two types of available help, as they were selected most often. Also, students' indicated through the survey and interviews their preference to select the written help as their first option of help over the video help tutorials if they were provided an option. The minimal use of video help tutorials towards the beginning of the semester could have been attributed to two reasons: 1) the lack of available help tutorials within the first two online quizzes, and 2) the lack of awareness that video help tutorials existed. An increase of video help tutorial use occurred after the researcher attend class sessions during the middle of the semester to obtain interviewees, at which time the researcher discussed their whereabouts within the online quizzes. By the seventh quiz, there was a large increase in student usage of the video help tutorials after students repeatedly missed problems. Unfortunately, few students increased performance after viewing video help tutorials.

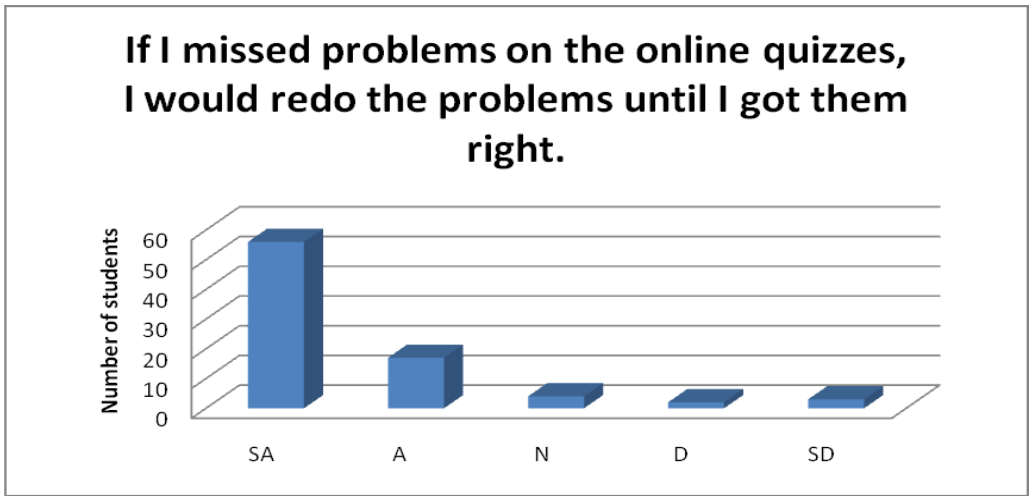
Students' persistence was quite impressive from this study, as many students retook similar quizzes numerous times until they earned a high or perfect score as seen in Chapter 4. The survey supported students' online behaviors as their opinions indicated approximately 93%of students surveyed would continue to retake similar online quizzes to earn a high score (see Figure 5.1).

Figure 5.1 Survey Results of Persistence to Earn High Scores



Additionally, the survey supported students' online behaviors as their opinions indicated 89% of students surveyed would redo the problems they missed until they got them correct (see Figure 5.2).

Figure 5.2 Survey Results of Persistence to Retake Similar Quizzes



Observation of their persistence with online behaviors, comments from interviews, and responses on the survey, draws a conclusion as to students' perception of the online quizzes.

> "… those quizzes and being able to do multi-take and stuff like that, I just kind of had my homework and my book with me while I took the quiz. That way I could flip through the book when I needed to look something up or understand something else I was doing. I haven't really stressed about the quizzes much as they are fairly easy."
> *(F – W3)*

It could be assumed that students consider the online quizzes to be more like homework assignments instead of an assessment of knowledge. Students completed the online quizzes on their own time, were able to use any resources to aid in their problem solving (book, notes, calculator, etc.), and had the accessibility to retake as many quizzes as desired. Such set up is identical to assigned homework from the textbook. Although, answers to the online quizzes are submitted online where textbook homework is turned in during class. Students' problem solving processes are not depicted within the online quizzes, yet are within their handwritten homework.

Discussion of Quiz 7 Content

The analysis of Quiz 7 was particularly of interest to the researcher after discovering students' struggled the most with the quiz content, of measurement. Example questions from Quiz 7 are found in Appendix G. A new question was to be pondered, why did these students struggle with measurement content? Since the researcher was a former Kansas high school mathematics teacher this question led a brief investigation into results of state and national testing of K-12 students.

A brief description of the Measurement Content Standard defined by Kansas State Department of Education Mathematics Standards (2004) is represented in Table 5.1.

Table 5.1 KSDE Math Standard for Measurement (KSDE, 2004)

Standard 3: Geometry – The student uses geometric concepts and procedures in a variety of situations. **Benchmark 2: Measurement and Estimation** – The student demonstrates an understanding of estimation and measurement using standard and non-standard units of measure in a variety of situations.

In the state of Kansas K-12 students are tested in mathematics during 3rd – 8th grades, and once in high school (KSDE, 2005). However, students are only tested over measurement during 3rd through 7th grades.

Tested indicators tend to drive curriculum decisions. Since Kansas students' are not tested over measurement skills in eighth grade or higher, it could be presumed that teachers of those grades do not spend as much time covering measurement content. If that is the case, then the college students in this study displayed lack of measurement content knowledge (as in Quiz 7) due to little exposure in from their junior high and high school education.

National results were of interest to the researcher after discovering students in Kansas are not tested over measurement skills in grades eight and higher. The National Assessment of Educational Progress (NAEP) reported statistics of students progress for grades four and eight (NAEP, 2007). Eighth grade information was of greater interest than fourth grade, since eighth grade students are closer to the age of the college students in this study. NEAP reported in The Nation's Report Card, of the 38 states that participated in the 2007 assessment, also participated in the 1990 and 2005 assessments to allow for comparisons over time (NEAP, 2007). NEAP made the following statements about the changes in eighth grade NEAP mathematics average scores between 2005 and 2007, "The algebra and measurement content areas showed the most and fewest changes in state performance, respectively. …The fewest states made gains in measurement, with increases in nine states and a decline in one state," (NAEP, 2007, pg. 31). Kansas was one of the states illustrated as making no significant gains in average test scores for measurement content. However, nowhere in the document explained that eighth grade students in Kansas were not tested over measurement content; therefore, no possible gains could have been obtained.

In summation, students taking MATH 320 who came from K-12 Kansas schools have not been tested over measurement content since seventh grade. From observing students' lower performance on Quiz 7 over measurement content, and knowledge from K-12 Kansas testing in mathematics, instructors of MATH 320 should be aware their future students could also struggle with measurement content. Considerations for planning and instruction should derive from these analyses.

Recommendations for Practice

From this study it was found students struggle the most with the measurement content; therefore, instructors of MATH 320 should consider spending more time teaching the unit over measurement content. In addition, the instructors could move this unit closer to the beginning of the semester, which would allow more time throughout the semester to revisit measurement concepts and students may apply their measurement content knowledge to other course content areas such as geometry, ratio's, and proportions. More time allotted for practicing measurement concepts will allow for deeper connections among the content.

Near the beginning of each semester the instructors of MATH 320 could model the online quiz taking experience, by logging into the system and displaying a quiz to the students. At such time, the instructor can explain the options of selecting written and video help tutorials within the online quizzes. By demonstrating how and when the tutorials occur in the online quiz system students may be more apt to select video tutorials earlier on in the semester. As this study showed the number of video tutorials viewed increased mid-semester, after which the researcher attended the classes seeking interviewee volunteers and explained the video help tutorials existence. Moreover, as more quizzes were assigned and students missed problems, students were provided with more opportunities to view video help tutorials. By providing students at the beginning of the semester with the knowledge about the video help tutorials, there is a strong chance more videos will be viewed earlier in the semester and even throughout.

Similar recommendations are to be generalized to other instructors of courses that utilize comparable online quiz systems. With the growing popularity of short video clips in the online entertainment industry (YouTube) and social networking (Facebook and MySpace), developers of online courses or instructors should highly consider including short

video tutorials to help students learn basic concepts and course content. The online quizzes in this study provide both formative and summative evaluations, which are important for the learner and teacher and may transfer to other programs as well that utilize alike online testing opportunities.

Recommendations for Future Research

The goal of this research was to determine the impact of implementing written and video help tutorials in online quizzes on student achievement. Online assessments have become popular and easy to implement (Okolo, 2006). They provide students and educators with immediate results of student achievement (Okolo, 2006; Ozden, Erturk, & Sanli, 2004; Smith; 2007). The online assessments in this study are unique; the amount of feedback students receive upon submitting answers, two forms of help available after missing a problem, and the opportunity to retake a similar quiz as many times as they desire, are special qualities of the online quizzes. Often online assessments limit students to multiple choice answers, ability to see correct or incorrect answers, and a final score. Knowledge of which problems were missed and an overall final score provide limiting information to students and educators. Whereas, in this study students took the opportunity to view written and video help tutorials to determine their mistakes and understand how to solve the different problems. Students continued to retake similar quizzes, which allowed more practice with the content, and opportunity to learn and correct mistakes. Instructors can view students' online behaviors and make curriculum decisions based on problems students encountered with the quizzes.

Continuation of this study would be a recommendation for future research. Video help tutorials should be created for the few problems that do not have them available in Quiz 1 and Quiz 2. The professors of each section should clearly explain to students the online quiz system prior to their first attempt at Quiz 1. Such explanation should include demonstration of submitting incorrect or blank answers, then how to access the written and video help tutorials. As seen in this study, once students were aware the video help tutorials existed, they viewed them if needed.

An alteration to the online quiz system could be interesting for future research. Currently, when students miss a problem they are provided with the written help tutorial first, and then a link to access a video help tutorial. By changing the system to display links to the

two types of help they could use, researchers could investigate which type of help tutorials were accessed first and most often. Research could explore the type of help tutorial accessed with preferred learning styles. Additionally, it would be interesting if the online quiz system could track how long students viewed each video help tutorial. Further questions might include: At what point do students stop watching a video help tutorial, and how often do they replay certain parts of the video and why?

Another consideration for future research might include changing the video help tutorials based on students' interview and survey responses. The current videos provide a similar example to the problem students missed, whereas the written help tutorials explain how to solve the specific problem missed. More variations of video help tutorials per problem could be created and analyzed for usage. With multiple video help tutorials per problem, the problem solving explanations could differ, allowing students to view different problem solving strategies. Potentially, the researcher would discover students favor certain problem solving processes over others.

Summary

The goal of this research was to determine the impact of implementing written and video help tutorials within online quizzes in an undergraduate mathematics course. Students received immediate feedback about correct, incorrect, or blank answers to problems within the online quizzes. Students had the opportunity to resubmit answers to incorrect or problems left unanswered. As students continued to miss a problem they were provided a written help tutorial that explained in text how to solve the problem. If students were so inclined they selected additional help, by viewing a video help tutorial.

Our first major finding involved *persistence*. Analysis revealed students are persistent and motivated to retake similar quizzes multiple times until a high or perfect score was obtained. On average students would try two or three attempts and on difficult assignments students would go back as many as 16 times to demonstrate mastery (or at least earn the maximum points). The system allowing multiple retakes may have reduced worries about the possibility of failing and hence increased motivation in line with Bruner (1966).

Our second major finding was the *high use of written help tutorials*. After missing a problem, students selected written help tutorials more often than video help tutorials to

identify mistakes, and understand how to solve the particular problem. In all cases at least 10% of students looked at the help and in one case there were nearly twice as many clicks on the help link as there were students. In interviews students commented favorably on the help system.

However, *the relative value of written and video helps was unclear.* By comparing mean scores between students from a previous semester who did not have access to video help tutorials, it could not be determined students performed better with the videos. The number of students who viewed video help tutorials was considerably less than the number of students who used written help tutorials. However, the percentages of students whose scores improved after using video help tutorials were greater than those who used the written help tutorials. Video help tutorials were beneficial for some students, but not all. Although the number students who benefited from the video help tutorials may be small, any increase in student achievement is desired from both students and educators.

Finally, *content matters.* Quiz 7 covered content over Measurement, which proved most challenging for students. Most of the students used written and video help tutorials on Quiz 7, with a number of students using the same help multiple times. NAEP data shows that this topic is particularly difficult and this seems to have led to greater usage of the help tutorials.

We have demonstrated that students will use and may benefit from an online quiz system with immediate feedback. The students' *sensitivity to length of video* is an issue. Students' comments and behavior indicates they are unlikely to watch a five minute video. The continuing challenge is to design, if possible, an effective video explaining difficult mathematics in only two minutes.

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Appendix A - Informed Consent Forms

KANSAS STATE UNIVERSITY

INFORMED CONSENT TEMPLATE

WAIVER OF INFORMED CONSENT: *There are limited instances where the requirement for a formal informed consent document may be waived or altered by the IRB.*

45 CFR 46 states that " An IRB may waive the requirement for the investigator to obtain a signed consent form for some or all subjects if it finds either:

1) That the only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality. Each subject will be asked whether the subject wants documentation linking the subject with the research, and the subject's wishes will govern; or

2) That the research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context."

PROJECT TITLE: Effects of Video Tutorials in Online Assessments within College Algebra

APPROVAL DATE OF PROJECT: Fall 2008 **EXPIRATION DATE OF PROJECT:** Summer 2010

PRINCIPAL INVESTIGATOR: Dr. Andrew Bennett

CO-INVESTIGATOR(S): Christina Gawik, Rachel Manspeaker

CONTACT NAME AND PHONE FOR ANY PROBLEMS/QUESTIONS:

Dr. Andrew Bennett (785) 532-0562 bennett@math.ksu.edu

IRB CHAIR CONTACT/PHONE INFORMATION*:*

- Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 203 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224.

- Jerry Jaax, Associate Vice Provost for Research Compliance and University Veterinarian, 203 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224.

PURPOSE OF THE RESEARCH:
We are interviewing students in Studio College Algebra to better describe the characteristics of students enrolled in the class. This is prompted by a desire to understand how different students react to certain aspects of the course, how they set about learning the material, and

their level of conceptual understanding. The general goal is to use this information to improve teaching and assessment.

PROCEDURES OR METHODS TO BE USED:
You will be asked approximately 20 questions relating to different aspects of the course, including study preferences, conceptual understanding, and problem solving techniques. Your participation is completely voluntary and your grade will not be affected by your answers in this interview.

LENGTH OF STUDY: This interview should take approximately 20-45 minutes.

RISKS OR DISCOMFORTS ANTICIPATED: There are no foreseeable risks or discomforts.

BENEFITS ANTICIPATED: You will receive $10 for your time for participating in this interview and you may also benefit by improvements in instruction in mathematics and by having a chance to go over the most recent exam an instructor.

EXTENT OF CONFIDENTIALITY: In the event we include any of your comments in a discussion or publication about our findings, your privacy will be maintained by the use of a pseudonym.

TERMS OF PARTICIPATION: I understand this project is research, and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits, or academic standing to which I may otherwise be entitled.

I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.

Participant Name: _____ **Date:** _____

Participant Signature: _____ **Date:** _____

Witness to Signature: _____ **Date:** _____
(Project Staff)

KANSAS STATE UNIVERSITY

INFORMED CONSENT TEMPLATE

PROJECT TITLE: **Effects of Video Tutorials in Online Assessments within College Algebra**

APPROVAL DATE OF PROJECT: **Fall 2008** **EXPIRATION DATE OF PROJECT:** **Summer 2010**

PRINCIPAL INVESTIGATOR: CO-INVESTIGATOR(S): **Dr. Andrew G. Bennett, Rachel Manspeaker, Christina Gawlik**

CONTACT AND PHONE FOR ANY PROBLEMS/QUESTIONS: **(785) 532-0562**
bennett@math.ksu.edu

IRB CHAIR CONTACT/PHONE INFORMATION: **Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 203 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224.**

SPONSOR OF PROJECT: **Kansas State University Center for Quantitative Education**

PURPOSE OF THE RESEARCH:

Assessments have been paired for having comparable performance based on historic data. We are creating video tutorials for certain online assessments. We will not have time to complete videos for all assessments before the course is taught again. Therefore, we are adding video tutorials to one member of selected pairs. We will compare how adding video tutorials to one assessment in each pair changes student performance compared to the assessment using only written feedback. All aspects of student interaction with the online system are automatically logged by the database. We will also include in the database records of student performance in regularly scheduled written assessments that are recorded by the instructor. We will use data mining procedures particularly clustering methods to analyze the data and look for patterns in student performance. We wish to identify which types of assessments benefit from video tutorials and which types of students are most likely to use and benefit from such materials.

We are interviewing students in College Algebra to better describe the characteristics of students enrolled in the class. This is prompted by a desire to understand how different students react to certain aspects of the course, how they set about learning the material, and their level of conceptual understanding. The general goal is to use this information to improve teaching and assessment.

PROCEDURES OR METHODS TO BE USED:

The examination of performances on regularly scheduled assessments will cover all students in the affected courses where instructors use those assessments.

Students will be asked several questions about the College Algebra course. There will be questions about your opinions about the course, your study habits, and the course material. Comments will be tape recorded, and you are encouraged to take notes. Students will also be

asked to complete a short survey about your learning preferences. At the end of the study, they will be given a chance to discuss the most recent exam with the interviewer and will be compensated $10.

ALTERNATIVE PROCEDURES OR TREATMENTS, IF ANY, THAT MIGHT BE ADVANTAGEOUS TO SUBJECT:

N/A

LENGTH OF STUDY: **20 to 45 minutes**

RISKS ANTICIPATED: **None**

BENEFITS ANTICIPATED: **$10 for completing the study.**

EXTENT OF CONFIDENTIALITY: **A pseudonym will be used in any discussion or publications.**

IS COMPENSATION OR MEDICAL TREATMENT AVAILABLE IF INJURY OCCURS: **N/A**

PARENTAL APPROVAL FOR MINORS: **N/A**

TERMS OF PARTICIPATION: I understand this project is research, and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits, or academic standing to which I may otherwise be entitled.

I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.

(Remember that it is a requirement for the P.I. to maintain a signed and dated copy of the same consent form signed and kept by the participant

Participant Name: _____ **Date:** _____

Participant Signature: _____ **Date:** _____

Witness to Signature: _____ **Date:** _____
(Project Staff)

Appendix B - Interview Email Invitation

First Email to Students

Dear Student,

I would like to invite you to share your thoughts about the course MATH 320: Math for Elementary School Teachers. Within this opportunity you will be asked to discuss:

1) Prior experiences and feelings about math and college mathematics courses
2) Experiences with the current online quizzes, in particular the written and video help available within the quizzes
3) Opinions about effective teaching of mathematics
4) Future career goals in teaching elementary education

You will receive a $10 cash honorarium for your participation in the interview which will take about 15 - 35 minutes. The information you provide will contribute to research in mathematics education and provide feedback about your program of study thus far.

Interviews will be scheduled for the week of March 30th – April 3rd. Please email Christina Gawlik at cgawlik@ksu.edu and indicate what days and times would work best with your schedule to complete an interview. I will be looking forward to learning about your thoughts and experiences.

Sincerely,

Christina Gawlik
Ph.D Candidate
Graduate Teaching Assistant & University Supervisor
Department of Elementary Education
cgawlik@ksu.edu

Second Individualized Email to Students

Dear _(Individual Student Name)_,

I sent you an email last week inviting you to participate in a quick interview about aspects of MATH 320 and your program thus far towards becoming an elementary school teacher. I would like to extend that offer again. Your input about MATH 320 is very important! I am looking forward to learning about how you perceive the content taught in this course, the online quizzes over the course material, and your thoughts about teaching math in elementary school.

Please email me with days and times that work best with your schedule, as the interview will only take around 15-35 minutes. Plus, for your time you will get $10 cash on the spot!

Sincerely,

Christina Gawlik
Instructor of EDEL 473: Elementary Math Methods & Clinical Experience
University Student Teacher Supervisor
Department of Elementary Education – Mathematics Education
Office: 214 Bluemont Hall
cgawlik@ksu.edu

Appendix C - Math 320 Interview Protocol

1. *Prepare for the interview at least 5 minutes before the scheduled time. Unlock the conference room (Reta has the key) and leave the door open. Set out the IC Recorder,* ***two copies of the Informed Consent form.***

2. *When the student arrives, introduce yourself and welcome the student by name. Close the door to the conference room. Ask for permission to record the interview. If permission is granted, start the recorder.*

3. *Explain the purpose of the interview*:
   I am interviewing students in Math for Elementary School Teachers to better describe the characteristics of students enrolled in the class. This is prompted by a desire to understand how different students react to certain aspects of the course, how they set about learning the material, and their level of conceptual understanding. The general goal is to use this information to improve teaching and assessment. This interview should take approximately 15-35 minutes. Your participation is completely voluntary and your grade will not be affected by your answers in this interview. You will receive $10 for your time for participating in this interview. In the event we include any of your comments in a discussion or publication about our findings, your privacy will be maintained by the use of a pseudonym. We have two copies of an Informed Consent Form for you to sign, one for our records and one for you to keep.
4. *Have them read and sign the form. If they decline to sign the form, thank them for their time and terminate the interview. Otherwise sign and date the form as witness and then proceed to the questions below.*

5. *Interview Questions. Stay aware of the time and try not to let this section exceed 30 minutes. In the (unusual) event that a student wants to spend more than 30 minutes on this, explain politely that you need to get to some additional questions and promise them they will have a chance to make more comments at the end.*

ALL STUDENTS - Experience & Feelings towards Mathematics

1) What were your most recent math courses taken in college besides MATH 320?
   i) When was the last semester you took one of those courses?
   ii) Where did you take the course?
2) Describe your feelings towards mathematics at the beginning of the semester enter into this course.
3) In general, how do you usually study for math assessments?
   i) Did you study differently for assessments in MATH 320? Explain.
   ii) How did you study for the online assessments in MATH 320?

STUDENTS WHO VIEWED WRITTEN HELP TUTORIALS

4) According to my records you viewed written help tutorials after missing a problem.

a) Why did you choose to view the written help tutorials?
b) About how many or how often did you view those written help tutorials?
c) Do you feel the written help tutorials were beneficial?
    i) Why and/or how were they beneficial?
d) What changes would you suggest to be made to the written tutorials to make them more beneficial?
e) In the future, would you be more or less likely to view written tutorials for assistance on assessments or other course work? Why?

STUDENTS WHO VIEWED VIDEO HELP TUTORIALS

Before asking students these questions explain you are the person who created the videos. There are personal likes and dislikes with the videos however I had to create them under the guidelines provided by my major professor to meet the needs of the research project.

5) According to my records you viewed video help tutorials after missing a problem.
    a) Why did you choose to view the video help tutorials?
    b) Do you feel the video tutorials were beneficial?
        i) Why and/or how were they beneficial?
    c) What changes would you suggest to be made to the video tutorials to make them more beneficial?
    d) In the future, would you be more or less likely to view video tutorials for assistance on assessments or other course work? Why?
6) Do you prefer the viewing the written or the video help tutorials more? Why?

STUDENTS WHO DID NOT VIEW EITHER TYPE OF HELP BUT HAD THE OPPORTUNITY

7) There is help available when you miss problems in the online quizzes.
    a) Are you aware of this help? Did you see the links available on the webpage?
    b) Why didn't you view the help available to you?
    c) What would it take for you to watch a video help tutorial?
        i) Length of video?
        ii) Would you prefer a video with picture of person speaking or hearing a person and seeing an explanation worked out on a Tablet PC?

ALL STUDENTS - Teaching & Career Goals

8) What do you think you need to know to be an effective teacher?
9) Do the online assessments cover information that you feel is important to know in order to become an effective teacher? Explain why/why not.
10) What are your future career goals?
        i) What grade level(s) do you anticipate to teach? Why?
        ii) How much mathematics do you feel you need to know to teach that grade level? (5^{th} grade math? 8^{th} grade math? College Algebra?)

6. *Other comments.*

Are there any comments or questions you would like to make about learning algebra? *Ask follow-up questions or provide answers (if you know the answers) as appropriate.*

7. *Thank the student for participating. Let them know they are always welcome to email any additional comments or suggestions for the course to rbm001@math.ksu.edu.*

8. *Stop the recorder.*

9. *Fill out the receipt. Remember to put the wrap around cover behind the receipt. You need to get the student's address and social security number. Since we are paying the student, we are legally obligated to get their social security number. Be sure they sign the receipt. Once the receipt is signed, given them a $10 bill and thank them again. Place one copy of the receipt in the envelope with the money and leave the other receipt in the receipt book.*

Listen to the interview on the recorder and write up your notes. Transfer the recording to the computer system and erase the IC Recorder.

Appendix D - Example Transcribed Interview

Interviewer: CG
Interviewee: KK-W-CM

CG: I am interviewing students in MATH 320: Math for Elementary School Teachers to better describe the characteristics of students enrolled in the class. This is prompted by a desire to understand how different students react to certain aspects of the online quizzes. The general goal is to use this information to improve teaching and assessment. This interview should take approximately 15-35 minutes. Your participation is completely voluntary and your grade will not be affected by your answers in this interview. You will receive $10 cash for your time participating in this interview. In the event we include any of your comments in a discussion or publication about the findings, your privacy will be maintained by the use of a pseudonym. We have two copies of an Informed Consent Form for you to sign, one for our records and one for you to keep. Will you please sign the form?
CG: Besides MATH 320 what college math courses have you recently completed?
KK-W-CM: College Calculus, Matrix Theory, Math History, Primary Applications of Math, Math 325.
CG: Have you taken all of those at K-State.
KK-W-CM: All but Calculus, I took those at Benedictine College
CG: Do you remember when you took all of those courses?
KK-W-CM: Yes, I took Calculus I my senior year in high school. I took the other ones while in college over the last two years.
CG: Do you have any more math classes you intend on taking?
KK-W-CM: Yes I need to take three more classes in math. I do not know what they are.
CG: Why do you need to take them?
KK-W-CM: My concentration is math ed. So I need them for that.
CG: Ok, describe your feelings towards mathematics at the beginning of the semester as you entered into this course.
KK-W-CM: I really enjoy math. I feel relatively competent in doing it. When I took 320, I was really excited because I thought it was going to be easier compared to the classes I've taken. It has been a lot easier than I ever thought it was. I just really like math
CG: In general, how do you usually study for math assessments?
KK-W-CM: For this class?
CG: In general.
KK-W-CM: Normally the week before I start going over the homework and supplement materials in the text book. If the professor provides online old exams I will go over all of them up to the exam.
CG: Do you study any differently for tests in MATH 320?
KK-W-CM: No.
CG: Did you do anything differently for studying for quizzes or tests in MATH 320?
KK-W-CM: I didn't study for the online quizzes because I did the homework leading up to them, then I would take the quizzes. I didn't do any prep work for them specifically.

CG: When you miss a problem on the online quiz you have the opportunity to view what I'm calling written help tutorial. According to my records you have seen a written help tutorial after missing a problem. Are you are familiar with that help?
KK-W-CM: No, I've never seen them on there.
CG: Have you missed any problems?
KK-W-CM: Yes I missed one and I had to retake it.
CG: When you retook it did you see a link or an explanation on how to work the problem next to it?
KK-W-CM: I think there was but I didn't mess with it. I just decided to retake it.
CG: Were you able to quickly solve the problem missed?
KK-W-CM: Yes I did
CG: Do you remember if your mistake was entering in a wrong number?
KK-W-CM: On that specific problem I did go about it the same method they wanted me to. My answer was a little funny than they wanted when you entered it in.
CG: Was it a rounding problem?
KK-W-CM: I put it in as a decimal but they wanted a rounded number. I didn't catch that. It wasn't explicitly stated that way but I figured it out.
CG: So more about interpretation?
KK-W-CM: Yes
CG: So when you miss a problem you are able to view what are called written help tutorials. They have an explanation from that problem you were working on and you can read through the problems, and I would it consider more to reading a text book to figure an example of how to work a problems. Next to some problems we have added in videos. I'm interested in getting feedback about what type of help you would be most interested in. Would you prefer to read a written explanation or would you prefer a video to help you through a problem?
KK-W-CM: I would probably a verbal explanation. Especially if is interpreting the question or what kind of answer they want. Sometimes a verbal explanation will still get the point across and you can follow it easier.
CG: So more of a video type or auditory?
KK-W-CM: Auditory
CG: The videos I have created don't actually show a picture of me. You can hear me explain how I would work through the problem and you can see my handwritten work using a Tablet PC. So is that something you would prefer to use over the written or reading text.
KK-W-CM: Normally yes especially since you are writing it out step-by-step how to do the problem if I was struggling with the method of solving the problem. I think that would be more beneficial than seeing it written out in text.
CG: Is there a particular length of time you would be willing to watch a video or a length that is too long?
KK-W-CM: If I was stuck trying to solve a particular problem, obviously a video wouldn't go on for 20 minutes probably. I would be willing to sit through it and watch it if I was sincerely confused on what was going on.
CG: What length of time would you not want to watch? What range would you watch?
KK-W-CM: Probably anything under 5 minutes. If it was longer than that I would probably skip around to find the part that is beneficial.
CG: So fast forward looking for visual cues?

KK-W-CM: Yes
CG: Some of the videos I have created are closer to 90 seconds and others are bit over 2 minutes depending on how involved the problem is. Which one would you be more apt to watch?
KK-W-CM: Probably the 90 second video because it should be more concise.
CG: Because you are not seeing my face or picture of the person talking. Would that be a turn off?
KK-W-CM: No it would be fine.
CG: Anything else about a video you would like, or in general with help tutorials, things that are missing that you don't get from the text book when you're trying to help yourself?
KK-W-CM: Like what would I want within the tutorials to help me?
CG: Yes
KK-W-CM: Maybe just simply the methods of solving some of the problems. Some of them are worded differently or they are concepts that we haven't fully explored in class necessarily so it would be easy to be confused on what method to go about it.
CG: What do you think you need to know to be an effective elementary math teacher?
KK-W-CM: I feel like I have most of the concepts so right now what I would want is more ways of teaching the material to the students, so they understand it at their level. It's really easy for us since we got the processes, so in the sense of dumb-ing it down to their level. So more of the methods of teaching.
CG: Do the online assessments cover information or content that you feel is important to know in order to become an effective elementary math teacher?
KK-W-CM: I think so. They are pretty straight forward and they go right with the text book and the stuff in class. I think they are pretty on track.
CG: What are your future career goals? What part of teaching do you want to go into, a specific grade level?
KK-W-CM: I really want to teach 3rd grade and my area is math for my concentration.
CG: Why did you think 3rd grade?
KK-W-CM: It's more to do with the age group and how the children act in the classroom and their attention. AT that point they still know enough and you can do a lot with them with the curriculum. I just think it is a very good age group to work with.
CG: Why did you pick math a concentration?
KK-W-CM: Partly because I really enjoy doing math. I find it second nature to me compared to like English where you have to write papers and stuff. So I thought about what courses I would have to take with different concentrations. Other than that I know a lot of people said most elementary teachers don't choose math or science and those are areas of need, so that was another kind of encouragement to go towards the math.
CG: How much math do you think you need to know in order to teach 3rd grade math? Do you think you need to know college mathematics, high school, middle school, or elementary?
KK-W-CM: I think right now I have more math than I need to know because I've taken so many more advance classes. There is no way that I would bring the math I have learned here into a 3rd grade classroom. I really think that more methods course and more instructional courses about how to teach more concepts would be more beneficial than more math classes to teach in the elementary school.
CG: Since you've taken more math classes, if you were certified to teach at a higher level what's the highest level you think you would be able to teach and why?

KK-W-CM: I would guess I would be able to teach at the high school level. My roommate is secondary math ed and we have taken all of the same math classes. So I think I could teach high school. She has taken a few more math credits because she's required to, but I think with the variety of classes I've taken I think I have enough exposure to do that.
CG: Are there any other comments or questions you would like to make about the course or learning and teaching mathematics.
KK-W-CM: The only thing about the MATH 320 course is that I find it beneficial for a lot of students especially if their concentration is not math. As a person, I think I'm good at math and I've had so many higher levels of it, that it's almost a waste of my time. I understand you take it to be exposed to the material and that is good. I just feel like it is too slow. I understand the purpose but I wish I didn't have to sit through it. I wish I could test out of it. If there is a way I could test out of it and show that I do understand these concepts therefore I don't need to be in the course. I could take a different course.
CG: Have you talked to your instructor to work out a situation like that.
KK-W-CM: No I haven't. I guess I'm just one of those people to know this is how it suppose to be and it's not the end of the world. I'm willing to do it because this is how the program is set up.
CG: Anything you would rather see changed with the course?
KK-W-CM: I think all of the assessments in the course work well. They are very effective like how the other students react to them. How I've done on them I think they are well written and how the instructor has gone through the material and stuff. I think that maybe if there is a way to incorporate the methods. I understand there is a course for math methods, but maybe incorporate how to teach some of the concepts as we go along, and teach them to us. Maybe it would be more interesting if the instructor went about it in a more elementary way of teaching it to us so we can observe and experience that kind of instruction. That might be a little more of a learning tool in the classroom. Like a dual learning experience.
CG: Any other comments?
KK-W-CM: No.

Appendix E - MATH 320 Survey

The information you provide on this survey could contribute to improvements in mathematics instruction and assessments, ultimately benefiting all students. By completing this form and turning it in, you are providing consent to use the information in research being conducted about this course. Your grade will not be affected by the information you provide. Thank you for your time and participation.

Questions may be directed to:

Dr. Andrew Bennett	or	Christina Gawlik
Principal Investigator		Co-investigator and Ph.D Candidate
bennett@math.ksu.edu		cgawlik@ksu.edu

Use the following scale to rate your responses to each statement. ***Circle*** your response.

5 – Strongly Agree	4 – Agree	3 – Neutral	2 – Disagree	1 – Strongly Disagree

1. I am seeking a Bachelors of Science in Elementary Education.	Yes No
2. My degree concentration is mathematics.	Yes No
3. Circle ***all*** the grades you would like to teach in the future. *(Circle NA for Not Applicable, if you are not an elementary education major.)*	K 1 2 3 4 5 6 NA
4. The content I'm learning in this class is valuable for my future career.	5 4 3 2 1
5. The online quizzes assess my knowledge over the course material.	5 4 3 2 1
6. I enjoy the mathematics I'm learning in this class.	5 4 3 2 1
7. I am nervous to teach elementary school mathematics in the future.	5 4 3 2 1
8. I like being able to redo the online quizzes multiple times to obtain a high score.	5 4 3 2 1
9. I can read a math book and figure out how to solve problems most of the time.	5 4 3 2 1
10. I hate math.	5 4 3 2 1
11. I learn best when I underline while I'm reading.	5 4 3 2 1
12. I prefer to watch a video explaining how to solve a problem.	5 4 3 2 1
13. If I missed problems on the online quizzes, I would redo the problems until I got them right.	5 4 3 2 1
14. If I was stuck on a math problem, I would watch a 1-2 minute video that explained and showed how to solve the problem.	5 4 3 2 1
15. I learn best through reading material.	5 4 3 2 1
16. My goal in using the online help tutorials is to understand the problem.	5 4 3 2 1
17. I learn best when I take notes during class.	5 4 3 2 1
18. I try hard in this class.	5 4 3 2 1

19. I learn best through doing hands-on activities.	5 4 3 2 1
20. The written help tutorials were helpful when I missed a problem on an online quiz.	5 4 3 2 1
21. I can often recall information by closing my eyes and picturing what I have read.	5 4 3 2 1
22. My goal in using the online help tutorials is to correct mistakes in my calculations.	5 4 3 2 1
23. I learn best through listening and watching.	5 4 3 2 1
24. I feel confident about teaching math in an elementary school.	5 4 3 2 1
25. The video help tutorials were helpful when I missed a problem on an online quiz. *(Circle NA for Not Applicable, if you did not view any videos.)*	5 4 3 2 1 NA
26. Consider the following scenario: You miss a problem on an online quiz and were provided with two links labeled "Written Help" and "Video Help". Which link would you select the first time you're seeking help on this problem? *(Please circle one choice.)*	Written Help or Video Help
27. I would select the second form of help if the type I selected first did not fully help me understand the problem or my mistake.	5 4 3 2 1
28. Circle the highest level of math you feel is necessary to know in order for you to teach elementary math.	Elementary School Math Middle School Math High School Math College Math

Appendix F - Links to Video Help Tutorials

Quiz 1 – Arithmetic (7 questions, 2 videos)

Problem 5 https://www.math.ksu.edu/math320/quiz/videos/q1n5a/

Problem 7 https://www.math.ksu.edu/math320/quiz/videos/q1n7/

Quiz 2 – Number Theory (7 questions, 2 videos)

Problem 2 https://www.math.ksu.edu/math320/quiz/videos/q2n2/

Problem 5 https://www.math.ksu.edu/math320/quiz/videos/q2n5/

(Original video using a video camera)

Quiz 3 – Fractions (6 questions, 6 videos)

Problem 1 https://www.math.ksu.edu/math320/quiz/videos/q3p1/

Problem 2 https://www.math.ksu.edu/math320/quiz/videos/q3p2/

Problem 3 https://www.math.ksu.edu/math320/quiz/videos/q3p3/

Problem 4 https://www.math.ksu.edu/math320/quiz/videos/q3p4/

Problem 5 https://www.math.ksu.edu/math320/quiz/videos/q3p5/

Problem 6 https://www.math.ksu.edu/math320/quiz/videos/q3p6/

Quiz 4 – Decimals (6 questions, 6 videos)

Problem 1 https://www.math.ksu.edu/math320/quiz/videos/q4p1/

Problem 2 https://www.math.ksu.edu/math320/quiz/videos/q4p2/

Problem 3 https://www.math.ksu.edu/math320/quiz/videos/q4p3/

Problem 4 https://www.math.ksu.edu/math320/quiz/videos/q4p4/

Problem 5 https://www.math.ksu.edu/math320/quiz/videos/q4p5/

Problem 6 https://www.math.ksu.edu/math320/quiz/videos/q4p6/

Quiz 5 – Ratios, Proportions, and Percents (6 questions, 4 videos)

Problem 1 https://www.math.ksu.edu/math320/quiz/videos/q5p1/

Problem 2 https://www.math.ksu.edu/math320/quiz/videos/q5p2/

Problem 3 https://www.math.ksu.edu/math320/quiz/videos/q5p3/

Problem 4 https://www.math.ksu.edu/math320/quiz/videos/q5p4/

Quiz 6 – Geometry (5 questions, 5 videos)

Problem 1 https://www.math.ksu.edu/math320/quiz/videos/q6p1/

Problem 2 https://www.math.ksu.edu/math320/quiz/videos/q6p2/

Problem 3 https://www.math.ksu.edu/math320/quiz/videos/q6p3/

Problem 4 https://www.math.ksu.edu/math320/quiz/videos/q6p4/

Problem 5 https://www.math.ksu.edu/math320/quiz/videos/q6p5/

Quiz 7 – Measurement (5 problems, 5 videos)

Problem 1 https://www.math.ksu.edu/math320/quiz/videos/q7p1/

Problem 2 https://www.math.ksu.edu/math320/quiz/videos/q7p2/

Problem 3 https://www.math.ksu.edu/math320/quiz/videos/q7p3/

Problem 4 https://www.math.ksu.edu/math320/quiz/videos/q7p4/

Problem 5 https://www.math.ksu.edu/math320/quiz/videos/q7p5/

Appendix G - Example Online Quiz

Initial screen as students enter Quiz 7 – Measurement. Students should attempt to solve each problem.

Online Homework Home Logout (without saving)

Math 320 Measurement
Problem Set 1

The deadline for this assignment has passed. You may continue to work problems for practice, but they will not affect your grade.

- Do not bookmark this page. You must sign in through the home page to initialize the problem set properly.
- You are not allowed to use calculators.
- The Gateway quizzes are pass/fail. A score of 100% is passing, but you will have one opportunity to correct any incorrect answers for each attempt.
- You may print out this problem set using your browser's print feature, work on the problems at your leisure, and submit your answers later if you want (you will need to set the paper to "landscape" orientation to fit the graphics on the page).
- You may also save your work without it being graded using the "Save" button at the bottom of the page (this requires your password).
- **Once you submit your answers for grading, you will need to login again through the home page to obtain the new problems.** If you go back and correct the answers to the old problems and try to resubmit them, the grading software will catch you.
- You may attempt this problem set as many times as you want until you pass.

1. How many cars are required to transport 87 friends, if each car can hold 12 friends?

   _____ cars

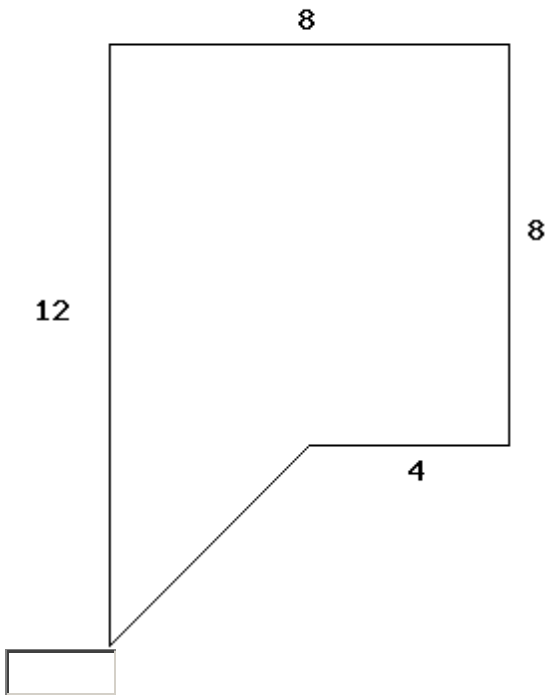
2. If the radius of a sphere increases in size by 8%, then by what percentage does the volume increase?
   Give your answer to the nearest one percent.

   _____ %

3. How many 5/8 ft. long pieces can be cut from a 2 yard length of rope.

   _____ pieces

4. Find the area of the figure below to the nearest tenth.
   You can use 3.14 as an approximation for π if applicable.



5. How many square centimeters is 80 square meters? Estimate your answer to the nearest whole number.

   cm^2

Save Grade

Please report any problems with this page to onlinehw@math.ksu.edu

Appendix H - First Attempt on Quiz 7

Screen snapshot after students attempted questions and told program to grade work. Students are notified of correct, incorrect, and unanswered questions, and have the opportunity to correct or complete missed problems.

Online Homework Home Logout (without saving)

Math 320 Measurement
Problem Set 1

The deadline for this assignment has passed. You may continue to work problems for practice, but they will not affect your grade.

- Do not bookmark this page. You must sign in through the home page to initialize the problem set properly.
- You are not allowed to use calculators.
- The Gateway quizzes are pass/fail. A score of 100% is passing, but you will have one opportunity to correct any incorrect answers for each attempt.
- You may print out this problem set using your browser's print feature, work on the problems at your leisure, and submit your answers later if you want (you will need to set the paper to "landscape" orientation to fit the graphics on the page).
- You may also save your work without it being graded using the "Save" button at the bottom of the page (this requires your password).
- **Once you submit your answers for grading, you will need to login again through the home page to obtain the new problems.** If you go back and correct the answers to the old problems and try to resubmit them, the grading software will catch you.
- You may attempt this problem set as many times as you want until you pass.

1. How many cars are required to transport 87 friends, if each car can hold 12 friends?

   Your answer of 8 cars is **Correct**

2. If the radius of a sphere increases in size by 8%, then by what percentage does the volume increase?
   Give your answer to the nearest one percent.

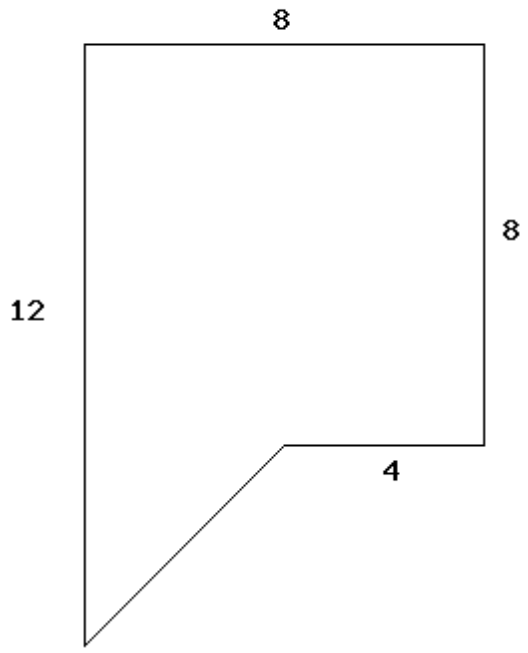
   You did not answer this question.
   [ ] %

3. How many 5/8 ft. long pieces can be cut from a 2 yard length of rope.

   Your answer of 3 pieces is **incorrect**.

   3 pieces

4. Find the area of the figure below to the nearest tenth.
   You can use 3.14 as an approximation for π if applicable.



   Your answer of 104 is **incorrect**.

   104

5. How many square centimeters is 80 square meters? Estimate your answer to the nearest whole number.

   You did not answer this question.

   cm^2

Save Grade

Please report any problems with this page to onlinehw@math.ksu.edu

Appendix I - Second Attempt on Quiz 7

Screen snapshot after students second attempt to complete questions correctly. Links are available for selecting written help tutorials on the problems that were still incorrect or unanswered. Students may take another quiz to obtain a high score on the quiz.

Online Homework Home Logout (without saving)

Math 320 Measurement
Problem Set 1

The deadline for this assignment has passed. You may continue to work problems for practice, but they will not affect your grade.

- Do not bookmark this page. You must sign in through the home page to initialize the problem set properly.
- You are not allowed to use calculators.
- The Gateway quizzes are pass/fail. A score of 100% is passing, but you will have one opportunity to correct any incorrect answers for each attempt.
- You may print out this problem set using your browser's print feature, work on the problems at your leisure, and submit your answers later if you want (you will need to set the paper to "landscape" orientation to fit the graphics on the page).
- You may also save your work without it being graded using the "Save" button at the bottom of the page (this requires your password).
- **Once you submit your answers for grading, you will need to login again through the home page to obtain the new problems.** If you go back and correct the answers to the old problems and try to resubmit them, the grading software will catch you.
- You may attempt this problem set as many times as you want until you pass.

1. How many cars are required to transport 87 friends, if each car can hold 12 friends?

   The answer is 8 cars. Therefore your answer of 8 cars is **Correct**

2. If the radius of a sphere increases in size by 8%, then by what percentage does the volume increase?
   Give your answer to the nearest one percent.

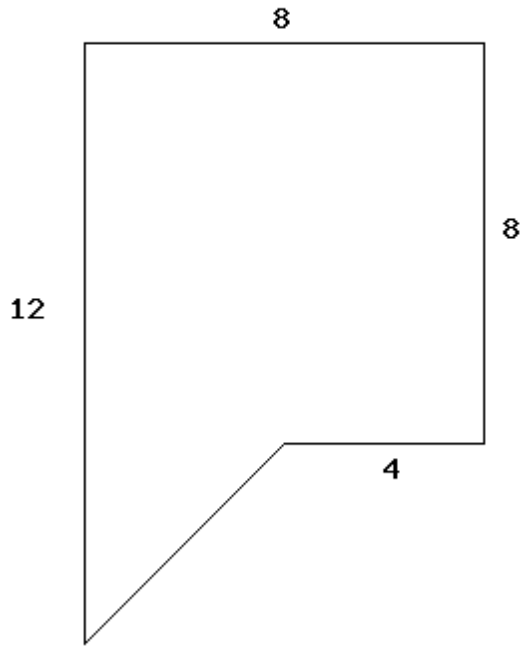
   The answer is 26%. You did not answer this question.
(Click here to see the worked problem.)

3. How many 5/8 ft. long pieces can be cut from a 2 yard length of rope.

   The answer is 9 pieces. Therefore your answer of 3.2 pieces is **incorrect**.

(Click here to see the worked problem.)

4. Find the area of the figure below to the nearest tenth.
   You can use 3.14 as an approximation for π if applicable.



The area of the figure is 72. Therefore your answer of 72 is **Correct**

5. How many square centimeters is 80 square meters? Estimate your answer to the nearest whole number.

The answer is 800000 cm^2. You did not answer this question.
(Click here to see the worked problem.)

Your score this time is 4 out of 10 possible. The deadline has passed for this section, so this attempt is for practice only.

Please report any problems with this page to onlinehw@math.ksu.edu

Appendix J - Written and Video Help Tutorial for Quiz 7

Screen snapshot after students selected the written help tutorial for problem 2 in Quiz 7. Students may select the link to a video help tutorial that will open in a new window.

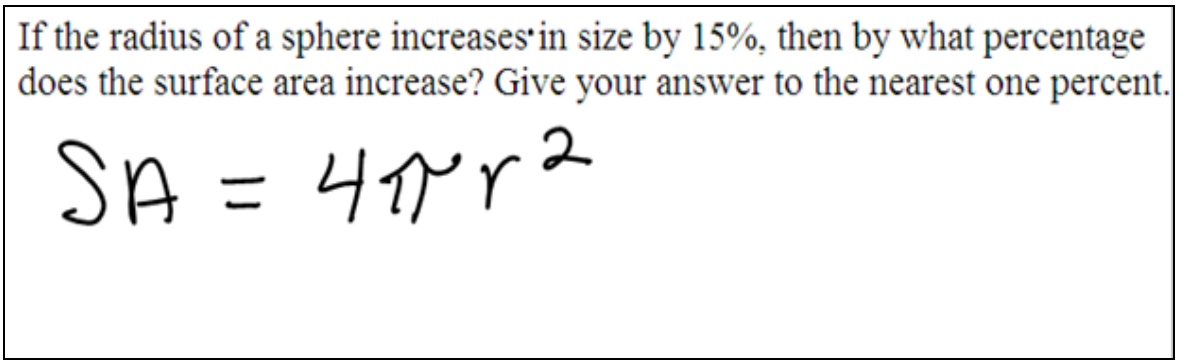
Online Homework Home Logout (without saving)

Solutions for Measurement

2. If the radius of a sphere increases in size by 8%, then by what percentage does the volume increase?
Give your answer to the nearest one percent.

The volume of a sphere is given by the formula $4\cdot\pi\cdot r^3/3$.
Then the 8% increase in the radius of a sphere can be computed as follows:
$4\pi\cdot(1.08r)^3/3 = 1.08^3 \cdot (4\cdot\pi\cdot r^3/3) = 1.259712 \cdot (4\cdot\pi\cdot r^3/3)$.
Therefore the volume increased by (1.259712-1) = 0.259712, which to the nearest one percent is 26%.

For a video explanation of how to solve a similar problem, click the image below (opens in a new window).



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Appendix K - Correlation Matrix for all Likert Scale Survey Items

Correlations

		P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25	P27
P4	Pearson Correlation	1	.262*	.701**	.196	.298**	.334**	-.263*	-.040	-.156	.241*	.043	-.016	.124	.466**	.418**	.301**	.265*	.194	.301**	.337**	.338**	.087	.160
	Sig. (2-tailed)		.017	.000	.076	.006	.002	.016	.721	.159	.028	.699	.887	.265	.000	.000	.006	.016	.080	.006	.002	.002	.435	.149
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P5	Pearson Correlation	.262*	1	.229*	.032	.240*	.128	.151	.234*	.219*	.201	.248*	.037	.289**	.001	.108	.202	.135	.160	.198	.042	.258*	-.044	.256*
	Sig. (2-tailed)	.017		.037	.771	.029	.251	.172	.033	.047	.068	.024	.739	.008	.991	.332	.067	.223	.148	.073	.707	.019	.693	.020
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P6	Pearson Correlation	.701**	.229*	1	.088	.103	.299**	-.570**	-.034	-.239*	.063	-.052	-.015	.000	.306**	.213	.144	.064	.102	.105	.073	.251*	.114	-.004
	Sig. (2-tailed)	.000	.037		.431	.352	.006	.000	.760	.030	.569	.643	.889	.999	.005	.054	.194	.568	.359	.346	.512	.022	.303	.973
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P7	Pearson Correlation	.196	.032	.088	1	.136	-.089	.221*	.069	.165	.080	.095	-.057	.118	.072	.228*	.087	.244*	.000	.277*	.174	-.131	.093	.060

	Sig. (2-tailed)	.076	.771	.431		.219	.424	.045	.537	.135	.471	.393	.609	.289	.515	.038	.432	.026	.999	.011	.115	.238	.403	.589
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P8	Pearson Correlation	.298**	.240*	.103	.136	1	.294**	.172	-.086	.078	.731**	.256*	.094	.376**	.330**	.414**	.488**	.576**	-.105	.395**	.216*	-.019	-.007	.220*
	Sig. (2-tailed)	.006	.029	.352	.219		.007	.120	.437	.484	.000	.019	.397	.000	.002	.000	.000	.000	.345	.000	.049	.865	.953	.045
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P9	Pearson Correlation	.334**	.128	.299**	-.089	.294**	1	-.133	.144	-.224*	-.289**	-.036	.452**	-.024	.202	.121	.118	.293**	.069	.086	.038	.107	-.035	.066
	Sig. (2-tailed)	.002	.251	.006	.424	.007		.230	.193	.042	.008	.747	.000	.828	.067	.275	.290	.007	.536	.437	.731	.333	.755	.553
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P10	Pearson Correlation	-.263*	.151	-.570**	.221*	.172	-.133	1	.095	.322**	.046	.167	.163	.222*	-.094	.135	.156	.210	-.025	.066	.090	-.236*	-.201	.142
	Sig. (2-tailed)	.016	.172	.000	.045	.120	.230		.393	.003	.678	.132	.141	.044	.399	.223	.160	.057	.825	.553	.416	.032	.069	.200
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P11	Pearson Correlation	-.040	.234*	-.034	.069	-.086	.144	.095	1	.360**	-.084	.306**	.235*	.094	-.107	-.107	-.093	.102	.386**	.278*	-.040	-.049	-.039	.191
	Sig. (2-tailed)	.721	.033	.760	.537	.437	.193	.393		.001	.449	.005	.033	.396	.337	.336	.403	.357	.000	.011	.717	.660	.727	.084
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83

P12	Pearson Correlation	-.156	.219*	-.239*	.165	.078	-.224*	.322**	.360**	1	.159	.626**	-.149	.416**	-.234*	.244*	.022	.288**	-.032	.332**	.001	-.164	-.230*	.206
	Sig. (2-tailed)	.159	.047	.030	.135	.484	.042	.003	.001		.151	.000	.178	.000	.033	.026	.845	.008	.773	.002	.991	.138	.036	.061
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P13	Pearson Correlation	.241*	.201	.063	.080	.731**	.289**	.046	-.084	.159	1	.257*	.141	.423**	.311**	.461**	.322**	.465**	-.078	.378**	.317**	.044	.033	.196
	Sig. (2-tailed)	.028	.068	.569	.471	.000	.008	.678	.449	.151		.019	.203	.000	.004	.000	.003	.000	.481	.000	.003	.692	.766	.076
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P14	Pearson Correlation	.043	.248*	-.052	.095	.256*	-.036	.167	.306**	.626**	.257*	1	-.124	.538**	.032	.282**	.208	.455**	.012	.536**	.140	-.149	-.303**	.444**
	Sig. (2-tailed)	.699	.024	.643	.393	.019	.747	.132	.005	.000	.019		.265	.000	.771	.010	.059	.000	.917	.000	.206	.177	.005	.000
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P15	Pearson Correlation	-.016	.037	-.015	-.057	.094	.452**	.163	.235*	-.149	.141	-.124	1	-.006	.014	-.053	-.193	-.030	.108	-.097	-.087	-.108	.066	.102
	Sig. (2-tailed)	.887	.739	.889	.609	.397	.000	.141	.033	.178	.203	.265		.954	.903	.634	.081	.786	.329	.381	.436	.330	.554	.360
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P16	Pearson Correlation	.124	.289**	.000	.118	.376**	-.024	.222*	.094	.416**	.423**	.538**	-.006	1	.121	.336**	.124	.440**	.064	.516**	.092	-.108	-.191	.340**
	Sig. (2-tailed)	.265	.008	.999	.289	.000	.828	.044	.396	.000	.000	.000	.954		.275	.002	.266	.000	.566	.000	.407	.330	.083	.002

	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P17	Pearson Correlation	.466**	.001	.306**	.072	.330**	.202	-.094	-.107	-.234*	.311**	.032	.014	.121	1	.304**	.360**	.240*	.224*	.216	.347**	.045	.053	.189
	Sig. (2-tailed)	.000	.991	.005	.515	.002	.067	.399	.337	.033	.004	.771	.903	.275		.005	.001	.029	.042	.050	.001	.686	.634	.087
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P18	Pearson Correlation	.418**	.108	.213	.228*	.414**	.121	.135	-.107	.244*	.461**	.282**	-.053	.336**	.304**	1	.414**	.322**	.041	.153	.304**	-.017	-.220*	.180
	Sig. (2-tailed)	.000	.332	.054	.038	.000	.275	.223	.336	.026	.000	.010	.634	.002	.005		.000	.003	.712	.168	.005	.881	.045	.104
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P19	Pearson Correlation	.301**	.202	.144	.087	.488**	.118	.156	-.093	.022	.322**	.208	-.193	.124	.360**	.414**	1	.371**	-.069	.242*	.227*	.109	.000	.187
	Sig. (2-tailed)	.006	.067	.194	.432	.000	.290	.160	.403	.845	.003	.059	.081	.266	.001	.000		.001	.537	.028	.039	.327	.998	.091
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P20	Pearson Correlation	.265*	.135	.064	.244*	.576**	.293**	.210	.102	.288**	.465**	.455**	-.030	.440**	.240*	.322**	.371**	1	.020	.663**	.198	-.078	-.082	.256*
	Sig. (2-tailed)	.016	.223	.568	.026	.000	.007	.057	.357	.008	.000	.000	.786	.000	.029	.003	.001		.857	.000	.073	.484	.460	.020
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P21	Pearson Correlation	.194	.160	.102	.000	-.105	.069	-.025	.386**	-.032	-.078	.012	.108	.064	.224*	.041	-.069	.020	1	.095	-.040	-.110	-.019	.007

	Sig. (2-tailed)	.080	.148	.359	.999	.345	.536	.825	.000	.773	.481	.917	.329	.566	.042	.712	.537	.857		.390	.720	.324	.862	.953
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P22	Pearson Correlation	.301**	.198	.105	.277*	.395**	.086	.066	.278*	.332**	.378**	.536**	-.097	.516**	.216	.153	.242*	.663**	.095	1	.277*	.056	-.106	.373**
	Sig. (2-tailed)	.006	.073	.346	.011	.000	.437	.553	.011	.002	.000	.000	.381	.000	.050	.168	.028	.000	.390		.011	.612	.339	.001
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P23	Pearson Correlation	.337**	.042	.073	.174	.216*	.038	.090	-.040	.001	.317**	.140	-.087	.092	.347**	.304**	.227*	.198	-.040	.277*	1	.222*	-.007	.294**
	Sig. (2-tailed)	.002	.707	.512	.115	.049	.731	.416	.717	.991	.003	.206	.436	.407	.001	.005	.039	.073	.720	.011		.044	.948	.007
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P24	Pearson Correlation	.338**	.258*	.251*	-.131	-.019	.107	-.236*	-.049	-.164	.044	-.149	-.108	-.108	.045	-.017	.109	-.078	-.110	.056	.222*	1	.234*	-.007
	Sig. (2-tailed)	.002	.019	.022	.238	.865	.333	.032	.660	.138	.692	.177	.330	.330	.686	.881	.327	.484	.324	.612	.044		.033	.952
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
P25	Pearson Correlation	.087	-.044	.114	.093	-.007	-.035	-.201	-.039	-.230*	.033	-.303**	.066	-.191	.053	-.220*	.000	-.082	-.019	-.106	-.007	.234*	1	-.130
	Sig. (2-tailed)	.435	.693	.303	.403	.953	.755	.069	.727	.036	.766	.005	.554	.083	.634	.045	.998	.460	.862	.339	.948	.033		.240
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83

P27	Pearson Correlation	.160	.256*	-.004	.060	.220*	.066	.142	.191	.206	.196	.444**	.102	.340**	.189	.180	.187	.256*	.007	.373**	.294**	-.007	-.130	1
	Sig. (2-tailed)	.149	.020	.973	.589	.045	.553	.200	.084	.061	.076	.000	.360	.002	.087	.104	.091	.020	.953	.001	.007	.952	.240	
	N	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).