COMPARING THE SUCCESS AND EXPERIENCES OF

DEVELOPMENTAL ALGEBRA I STUDENTS

by

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Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctorate of Education

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ABSTRACT

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Students enrolled during the spring 2011 and summer 2011 semesters taking
developmental Algebra I were invited to participate in a study. Students were required to
complete a researcher-made pretest prior to instruction, complete the course over the
semester, and complete an identical posttest at the end of the course. The online students
voluntarily completed a researcher-made survey. An ANCOVA analysis, using the
pretest scores as a covariate, showed a significant difference between the online and
seated students, as the online students scored significantly higher. The survey showed
online students tended to utilize the captured lectures, with a larger percentage of students
watching the entire lecture. The study discusses the implications of the findings and
makes recommendations for future research.

ACKNOWLEDGEMENTS

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LIST OF ABBREVIATIONS

ASSET   Assessment of Skills for Successful Entry and Transfer

COMPASS   Computer-Adaptive Placement Assessment and Support System

MTE   Mathematics Essentials

QEP   Quality Enhancement Plan

READI   Readiness for Education at a Distance Indicator

SACS   Southern Association of Colleges and Schools

SPSS   Statistical Package for the Social Sciences

CHAPTER ONE: INTRODUCTION

Sixteen years after the Pilgrims arrived at Plymouth, Harvard University was established by the vote of the Great and General Court of Massachusetts Bay Colony. It was the first college established in the United States with just nine students and one field of study. Today, the National Center for Educational Statistics reported in The Condition of Education Report (2008) between 62 and 69% of all high school graduates enroll immediately in college (p. 1). Clearly, times have changed as more and more students are enrolling in college. Moreover, colleges will have to continue to reinvent themselves to meet the needs of an ever-changing student body.

Colleges primarily used traditional teaching techniques in traditional classrooms to instruct students for hundreds of years. However, with rapid advances in technology and a student body that demands learning at their own convenience, it was inevitable that teaching and learning would evolve. Hence, the number of courses being offered online dramatically increased across the United States. In fact, the U.S. Department of Education, National Center for Educational Statistics (2008) reported approximately 97% of public two-year institutions offered distance education classes (p. 1).

With online teaching and learning still in its early stages, studies must be conducted in order for instructors and college administrators to better understand and to perfect the online teaching and learning process. The social cognitive theory and its implications may explain how online students can learn vicariously through others. Online instructors must understand the importance of creating a connected environment in an online setting, while maintaining the perks online learners desire. Creating a less than ideal learning environment, could negatively impact online teaching and learning.

Background

      Being granted admission to a college is a joyous occasion for students; however, many students simultaneously experience high levels of anxiety. To ease the anxiety and ensure students are placed into appropriate level courses, students are required to come to campus and complete placement assessments. These assessments are normally standardized tests in which college administrators use the recommended cutoff scores from the testing company or adjust the scales to determine the introductory level courses in which students need to enroll. At the community college level, many colleges rely on the Computerized Adaptive Placement Assessment and Support Systems (COMPASS) or Assessment of Skills for Successful Entry and Transfer (ASSET) placement tests to determine whether students need additional study in developmental reading, writing, and math prior to their enrollment in college-level courses. Although community college students must have graduated from high school or earned a GED, oftentimes students find themselves needing to enroll in one or more developmental courses.

      Developmental courses do not count toward completion of degrees offered by many community college systems. However, students are required to successfully meet all developmental needs prior to enrolling in college-level courses. Many times students become annoyed because they must spend so much time taking classes that do not count toward the completion of their certificates or associate degrees (Bettinger & Long, 2005). Furthermore, these students find their ability to enroll in various other classes is hindered until they have successfully completed their developmental requirements.

      Community college students represent a unique group of students. Some are first generation college students, have delayed college entry, have dependents, work fulltime

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jobs, and have various other responsibilities (McConnell, 2000). Hence, these students often desire to complete courses online to manage their school work and other responsibilities. In fact, McConnell (2000) pointed out that first generation college students tend to have family members who are less supportive of their academic careers.

Many students have anxiety about enrolling in math classes, so much so that it affects their decision to complete degree requirements. Some students may enroll in online math classes to avoid coming to class and facing embarrassment from their peers and teachers due to their deficient math skills. The frustration students may face trying to complete an online developmental math class may be detrimental to their college success.

Using traditional teaching techniques in online learning environments may be the solution to teaching students math online. Liberty University currently employs traditional teaching techniques in some of their online classes. Many of Liberty's online instructors post vignettes, Point Casts, and the audio from seated classes in Blackboard as a means to supplement instruction. Students must continue to read and gather information independently, but these strategies allow teachers to verbalize the important components of course objectives. Students can conveniently access materials online at their convenience. In fact, some of these technologies allow students to stop, rewind, and fast forward on an as-needed basis.

With community college students needing more developmental classes and the fact that community colleges offer far more online classes than any other type of institution of higher learning, it would only be a natural consequence to perfect the online teaching and learning process. Moreover, Bettinger and Long (2005) stated community colleges must find ways to advance remedial education, as students from all backgrounds

are increasingly needing remediation prior to enrolling in college-level classes. Could community college instructors using traditional teaching techniques provide sound, reliable instruction with the conveniences of online learning for students?

Problem Statement

According to Remedial Education (2003), 76% of two- and four-year institutions receiving Title IV funding had freshman who had to enroll in at least one reading, writing, or mathematics developmental course. In addition, it was reported that public two-year institutions were more likely to provide developmental courses than any other type of institution. In fact, during the fall 2000 semester 42% of students were enrolled in developmental English, writing or mathematics classes at public two-year institutions. Clearly, two-year institutions must be concerned with meeting the needs of students who need to complete developmental classes.

According to the United States Department of Education (2008), 97% of public two-year colleges offered distance education classes during the 2006-2007 school year. This percentage is much higher, when collectively examining the differences between public and private two-year and four-year institutions, where the average is only 66% (U. S. Department of Education, 2008). However, the United States Department of Education (2008) further reported that 22% of full or associate professors at two-year institutions teach online classes and 15.2% of assistant professors, instructors, or lecturers teach online classes (p. 1). Hence, two-year colleges are using highly-qualified faculty members to teach online classes. In addition, many two-year colleges offer classes to students in either a seated or online format. It is up to students and advisors to determine whether or not students are ready to take classes online.

It would only be a natural progression to see that two-year colleges begin offering more developmental classes online. According to Remedial Education (2003), in 2000 public two-year institutions were more likely to offer developmental classes online compared to other types of institutions. The problem is developmental online classes will only increase in demand due to a less prepared student body. In turn, two-year college educators and administrators must find ways to properly provide instruction to this group of students.

Purpose Statement

The purpose of this research project is to contribute to the body of knowledge with regard to teaching and learning developmental Algebra I online. Traditional teaching techniques captured through the program Adobe Connect may provide a reliable source of instruction led by a knowledgeable, trained mathematician while still maintaining the benefits students embrace as online learners. The understanding will assist other online mathematics educators in providing quality instruction to their online students.

Significance of the Study

It is hoped that the results of this study helped to determine whether online instruction is an effective teaching technique to meet the demands of developmental students. Developmental classes are designed to reacquaint students with information they should have already acquired. After successful completion of developmental classes, students should be prepared to pursue college-level work. If it is shown that online students do not perform as well as seated students with regard to Math 3 Algebra I, the college should consider other teaching methods, interactive math programs, or not

offering developmental mathematics classes online. There are many computer software packages available to assist students in learning mathematics such as Hawks, MyMathLab, and WebAssign. Faculty members can then take on more of a facilitator role and not a directed-teaching role.

Since developmental math classes lay the foundation for numerous college-level mathematics classes, colleges cannot afford for developmental students not to understand or retain course content from developmental classes. Some students may become frustrated with taking developmental classes over and over again and not being able to pass. If developmental students barely pass developmental classes and enroll in college-level classes having a minimal understanding, they are inevitably setting themselves up for failure in college-level classes. Developmental classes are extremely important to the future success of many community college students.

On the other hand, if the online students perform equally or better than the seated students, administrators and faculty members should continue to explore the option of offering more developmental classes online. Currently, as an example, fulltime math faculty members at Valley View Community College (pseudonym) do not support having mathematics classes online. If the results are positive for this form of instruction, faculty members should explore offering more online math classes, as many students do value the anytime, anywhere convenience of online learning. When the service district is as large as the one for Valley View Community College, online instruction is a feasible alternative to face-to-face learning.

Since the results of this study showed that students view watching captured class lectures as a significant avenue for them to pass the online class and understand the

course material, other instructors should consider capturing their lecture. Not only would math students have a reliable source of support for solving problems or performing procedures to solve or simplify problems, students studying other subjects could also enjoy the fascinating lectures and life experiences of their professors. Oftentimes online students are given a syllabus, purchase a textbook, and submit course assignments through an online course management system. They are not exposed to the additional knowledge their professors can share with them. Capturing instruction is a happy middle ground in which students can learn at their own pace, and instructors can continue to share their knowledge with their students.

Since capturing instruction is easy and students do readily watch captured class lectures, the possibilities with the process are endless. In the future, all teachers may consider capturing instruction during all class lectures. Students who were absent, late to class, or had to leave early could go to the online course management system and retrieve the information they missed. In addition, if students were preparing for an assessment and were confused or needed an explanation again, they could retrieve the lecture they needed to review.

In the foreseeable future, online teaching and learning is going to continue to expand. As many working adults desire to increase their credentials and move up the career ladder, online learning is the only option for many. Institutions of higher learning must be committed to exploring and improving online learning. The results of this study could greatly impact the teaching of developmental math classes online. With developmental classes being referred to as gate-keeper courses, colleges must ensure students pass developmental classes and not delay entry into college-level classes.

Research Questions

Students who are required to take developmental classes have demonstrated that they are not quite ready for college-level classes. In fact, according to A Quest for Quality in Online Instruction (2007), it was reported "developmental students face challenges in addition to the regular issues of online education" (p. 38). Consequently, this study examined the following questions:

(1) Do online developmental students achieve at comparable rates with students in seated developmental classes?

(2) Do online students utilize the online lectures provided by the instructor from a seated class?

(3) Do online students experience satisfaction while completing this online math class?

(4) Do developmental online students recommend inclusion of seated lectures for this course and other online courses?

Research Hypothesis in Null Form

In an attempt to seek an answer to the first research question, the null hypothesis is as follows:

1. Scores - H_0 stated there is no difference between the posttest scores of students in the seated Math 3 Developmental Algebra I compared to the scores of students in the online Math 3 Developmental Algebra I.

Identification of Variables

Upon beginning their first semester at Valley View Community College, students are required to complete the COMPASS or ASSET placement test to determine which, if

any, developmental classes they need to enroll in prior to enrolling in college-level classes. Furthermore, students interested in enrolling in online classes must have completed the READI Assessment and be deemed suitable candidates for online learning. Hence, students in the seated Math 3 Algebra I would have to score within the range for Algebra I, would have successfully completed Math 2 Basic Arithmetic with a 75 or higher average, or would be repeating the course after a failed attempt. Students enrolled in the online Math 3 Algebra I would have had to score within the range for Algebra I, would have successfully completed Math 2 Basic Arithmetic with a 75 or higher average, or would be repeating the course after a failed attempt. In addition, they would have a score from the READI assessment that indicates they are well suited for online learning. This assessment determines whether students are potential candidates for online learning. The dependent variables in this study are the posttest scores after students have completed developmental Algebra I and their responses to their viewing behaviors.

Research Plan

Qualitative and quantitative methods were employed to seek answers to the research questions in this study. Students of Valley View Community College sought advising services from their academic advisor or college counselor. Their placement test scores, previous academic performance, and READI assessment scores assisted all parties involved in developing an appropriate class schedule. Participants of this study were enrolled in Math 3 Algebra I during the spring 2011 semester or the summer 2011 semester. Students registering for the seated Algebra I class during the spring and summer 2011 semesters served as a control group, while students registering for the online Algebra I class during the spring and summer 2011 semesters served as the

experimental group. Students in the experimental and control groups completed a pretest

during the first week of the semester to ensure they were properly placed into the correct

course and to measure their initial mathematical proficiency. All students received

instruction for the entire semester. The online students were provided the instruction

captured from a prior seated course as a means of reliable instruction. At the end of the

course, all students were required to complete an identical posttest that served as their

exam and a final measure of their academic gain. Lastly, the online students were

provided an announcement in Blackboard to voluntarily complete a survey with regard to

their viewing practices of the lectures provided by their instructor and their desire to

recommend such practices in the future.

Students were placed into their courses through the registration process. Hence,

a quasi-experimental research design was utilized. Furthermore, it would have not been

acceptable to place students into classes for which they were not academically prepared

or motivated to complete.

Due to the quasi-experimental research design, ANCOVA was employed to

determine if there were any initial differences in the mathematical proficiency between

the online and seated students. This analysis then adjusted for those differences before

determining if one group outperformed the other on the posttest. According to Matching

Statistics with the Research Design (n.d.), ANCOVA analysis is best suited when

researchers have two or more groups that were not assimilated through random

assignment, desire to measure the dependent variable before and after participants are

subject to the treatment, and after the treatment there is at least one observation. Lastly,

students in the online class were offered an opportunity to complete a 15-question Likert-

scale survey and an open-ended question on their personal experience while completing the online Algebra I course. The methodology of this study is described in more depth in Chapter 3 of this dissertation.

Definitions

   ASSET. This is a pencil-and-paper placement test published by American College Test (ACT) that is used by many postsecondary institutions to measure the general education level of incoming students to access their needs with regard to developmental education. This test is not adaptive and students must complete the entire assessment.

   COMPASS. This placement test is also published by ACT, but it is computer adaptive. If students answer questions incorrectly the subsequent questions become easier, while if students answer question correctly the subsequent questions become more difficult.

   Developmental classes. Developmental classes are designed to assist students in developing a significant skill base to build upon prior to completing college-level work in general or a certain subject area. The terms developmental and remedial are often used interchangeably.

   MTH 2. Math 2 Arithmetic is described as a 1-5 credit course that covers arithmetic principles and computations including whole numbers, fractions, decimals, percent, measurement, graph interpretation, geometric forms, and applications. It develops the mathematical proficiency necessary for selected curriculum entrance. Credits are not applicable toward graduation.

MTH 3. Math 3 Algebra I is described as a 1-5 credit course that covers the topics of Algebra I, including real numbers, equations and inequalities, exponents, polynomials, Cartesian coordinate systems, rational expressions, and applications. It develops the mathematical proficiency necessary for selected curriculum entrance. Credits are not applicable toward graduation. The prerequisites include a placement recommendation for MTH 3 and Arithmetic or equivalent.

MTH 4. Math 4 Algebra II expands upon the topics of Algebra I, including rational expressions, radicals and exponents, quadratic equations, systems of equations, and applications. It develops the mathematical proficiency necessary for selected curriculum entrance. Credits are not applicable toward graduation. The prerequisites include a placement recommendation for MTH 4 and Algebra I or equivalent.

READI Assessment. This online assessment tests students' skills and knowledge about self-motivation, time-management skills, self-discipline, on-screen reading rate and recall, persistence, availability of time, ability to use a laptop, printer, software, and the Internet, and typing speed and accuracy through completion of a 105-question assessment. The results are stored within a database with students, advisors, and student services having access to scores.

Social cognitive theory. This social learning theory was suggested by Albert Bandura with a focus on the mental state of students and the use of observational learning. To engage students in observational learning, teachers must consider the attention, retention, reproduction and motivation of students, while building self-efficacy (Cherry, 2012). Self-efficacy is a key component of the social cognitive theory, as students must believe in their abilities to succeed.

Successfully completing a developmental course. Earning an overall average of 75 or higher in a developmental course is considered successfully completing the course and allows students to enroll in the next developmental course or enroll in the first college-level mathematics course prescribed for their degree or certificate.

CHAPTER TWO: REVIEW OF THE LITERATURE

As technology continues to advance and as companies desire to employ more educated workers, colleges and universities will have no choice but to expand their distance learning opportunities to meet the needs of a changing student body. It is clear there has been an increased demand for distance education over the past 10 years. Another current trend colleges are experiencing is an increased need for remedial or developmental classes to meet the needs of students coming to college without an adequate skill base. By exploring data related to online education, characteristics of community college students, demands of developmental mathematics students, and effective online teaching pedagogy, future trends will likely reveal that it is only a natural consequence that online developmental classes would be offered. The key to maximizing the effects of education is dependent on ensuring instruction and course design to adequately meet the needs of students. In addition, social cognitive learning theory suggests that online students can learn through modeling and vicariously through the learning experiences of the students in the seated class.

Theoretical Framework

Miller and Dollard developed a social learning theory in 1941. Later, Bandura and Alters realized this model was missing key elements, so added the components of observational learning and vicarious reinforcement. After continued research, in 1977 Bandura added yet another component, self-efficacy, and in 1986 changed the name to social cognitive theory to distinguish it from other social learning theories that were still emerging at the time.

Bandura's social cognitive theory of motivation states that people will avoid certain activities instead of having to experience failure and frustration as they have in the past. However, setting low expectations for students and emphasizing their low achievement is of little value to students (McCabe, 2006). Instead teachers should aim to provide verbal feedback to students to instill in them that they possess the skills to complete any assignment. Pajares (2002) stated that teachers will weaken the self-efficacy of students through negative appraisals far more easily than strengthening students' self-efficacy through positive encouragement. Simply stated, students' performance is closely linked to how capable they believe they are of completing the tasks at hand.

With students selecting activities they feel they will be successful in completing, math teachers in particular must understand why some students may choose to delay enrollment in math classes or to demonstrate being less engaged in any given activity. However, if students feel as if they will be successful, they will put more effort into completing tasks, and thus will likely achieve more. Through self-regulation, all students will be able to set goals and judge their performance against their classmates. Students who judge themselves to be falling behind their classmates may, through self-regulation techniques, find ways to improve their behavior (LaRose, 2000).

Learning vicariously is one of four ways students can acquire knowledge about their abilities and develop greater self-efficacy. Vicarious experiences can be defined as "observations and comparison to others' actions or skills" (McCabe, 2006, p. 255). Moreover, this ideology can be directly applied to the topic of online students learning vicariously by observing and comparing themselves to the seated students. McCabe

(2006) suggested that when online students observe the similarities between themselves and the seated students, they take on the mindset that "if they can do it, so can I" (p. 255). In addition, McCabe suggested using such verbal cues as "watch me as I;" "did you see what I did;" "notice how I;" "listen while I;" and "try to remember what I am about to do;" are all excellent ways for students to learn vicariously (p. 254). Verbal praise can also assist online students, as they may imagine if they were in the seated class how they would receive the same verbal praise for similar efforts. Furthermore, online students may feel more connected to the group of seated students if they are able to hear the teacher call students by name (Larose, 2000).

Modeling is another key component of social cognitive theory. Students learning through modeling must pay attention to the behavior, remember what they observed, have the ability to replicate the behavior, and be motivated to learn (LaRose, 2000). In an online learning environment, students can not only model the behavior of the seated students, they can also model the behavior of the teacher. Hence, online students can model the behavior they hear about from an outstanding class leader or mimic the actions of the teacher. Students in online learning environments may experience less frustration when they have the ability to model the actions of others. For example, Eades and Moore (2007) suggested note-taking in developmental mathematics results in positive effects such as reducing math anxiety, promoting active learning, and assisting in comprehension.

LaRose and Whitten (2000) conducted a study with three online introductory-level college courses to test the effect of the presence of the instructor on student learning. One online class was taught using text and graphics only, the second online

class was taught by allowing online students to listen to the audio from a seated class, and the third online class was taught by video using a "talking head" approach. The results showed the audio-only course to have the highest teacher immediacy and the most social incentives for students to complete course requirements. LaRose and Whitten recommended that online teachers "bring live classroom instruction to the Web" as a means in which to "tap a wider range of immediacy behaviors" (p. 333). Being committed to exploring and developing the best online learning environment should be a top priority for online instructors.

Review of the Literature

With a demanding student body and daily advances in technology, the teaching and learning process will continue to evolve with regard to online instruction. As many students enter college with an inadequate learning base to begin college-level work, it is clear that best practices among developmental educators must be identified. This study examined whether online students can learn vicariously through the use of captured lectures from a seated class. The review of the literature examines the characteristics of community college learners, previous experiences in online classes, and research in support and opposition of using traditional teaching methods in online learning environments.

Increased demand for online instruction. According to the Sloan Consortium, during the fall 2006 term, approximately 3.5 million students enrolled in at least one online course, which was a 10% increase from the previous year (Online Nation, n.d.). The Sloan Consortium also reported 69% of educational leaders in higher education believe online learning will continue to grow over the next several years, and 83% of

higher education institutions that already offer online learning will see an increase in the demand for online learning (Online Nation, n. d.). Moreover, according to the U.S. Department of Education, National Center for Educational Statistics (2008), approximately 97% of public two-year institutions offered distance education classes. Examining the percentages from other education institutions, it is clear that two-year institutions are more likely than any other type of educational institution to offer distance education classes. Hence, community college administrators and instructors must be dedicated to improving the instructional process.

Characteristics of community college students. Enrollment at community colleges within the United States has continued to grow over the years. Most students who choose to attend community college are first-generation college students from families where neither the mother nor father has earned a college degree. These students travel an unusually different road in obtaining their education. They can be characterized as having a lack of a family support system, feeling incapable of completing college assignments, and believing they may not be well suited for college-level learning (Striplin, 1999).

According to McConnell (2000), first generation college students tend to be older females who have delayed their enrollment in college, live in low-income households, are married with dependents, and work off-campus (p.76). McConnell also reported that first generation college students tend to enter college with a need for remedial classes in reading and math. In fact, this group of students is more likely to drop out of college during their first semester of study and not complete a degree program (McConnell). In order to retain these students, community colleges must make these students feel

connected and part of the community college environment (Striplin, 1999). Failing to meet the needs of this group of students could negatively impact budgets for the college.

According to Berkner et al. (2004), it is reported "forty-seven percent of all undergraduates enrolled in public two-year institutions in 2003-04 received some type of financial aid" (p. 6). With almost half of students receiving financial aid, there may be a lack of money to provide the necessary tools required for online learning. In fact, some financially strapped students of Southside Virginia Community College opted to take online classes instead of seated classes due to the expense of driving to campus (Hurt, 2008).

Readiness of online community college learners. Completion rates for online learners are significantly lower than traditional seated class students. According to Milam, Voorhees, and Bedard-Voorhees (2004), many students simply do not consider that they must take on more of the teacher role, the high demands of online instructors, their personal learning style, the technical skills needed, and the time required to complete assignments. Specifically, the Virginia Community College System states that student motivation favorably impacts course completion. Hence, colleges must take necessary actions to ensure community college students are suited to such a learning environment.

Valley View Community College uses the Readiness for Education at a Distance Indicator (READI) to determine whether students are candidates to enroll in online classes. The READI assessment tests students' skills and knowledge about self-motivation, time-management skills, self-discipline, on-screen reading rate and recall, persistence, availability of time, ability to use a laptop, printer, software, and the Internet,

and typing speed and accuracy through completion of a 105-question assessment (About READI, 2009, p. 1). Both the students and the college are provided an individual, easy to read printout of the results for all students. In addition, READI provides remediation for students who are deficient in any of the targeted areas yet still desire to enroll in online classes.

There are many skills online students must develop prior to enrolling in online classes. Gahungu, Dereshiwsky, and Moan (2006) conducted a study of 25 out of the 58 instructors at Chicago State University teaching online classes and found that over 50% of the teachers suggested their students needed to develop basic computer skills such as emailing and attachments, the operation of such programs as Word and Excel, and the use of discussion boards.

Having a reliable computer with a reliable Internet connection is a problem for some community college students in rural areas in the United States. According to Hurt (2008), the Internet infrastructure "poses serious problems for online learning and teaching" (p. 8). Southside Virginia Community College is located and serves students from 10 rural counties in Virginia, many with a limited Internet infrastructure. Many of the online instructors choose not to use technology in their online courses, due to the fact that most students would not be able to open and view such documents (Hurt). In fact, one of the instructors cited that some of his students could still not send an email attachment during the last week of his 16-week course (Hurt).

Although Hargittai and Shafer (2006) studied the online skills of 100 people in Mercury County, New Jersey, a place where residents are more educated than the national average, many interesting facts were taken from the study, which required

participants to complete 10 online tasks. The initial survey revealed that 58% of the

participants self-assessed their Internet skills as fair. In addition, there was no task that

95 participants could complete without a limit on time. Overall, younger participants,

participants with more education, and participants with computer access at work were

able to find the content online. Moreover, the online abilities of females and males did

not differ, but women reported having a lower self-assessment of their online abilities.

Hence, Hargittai & Shafer believe women would be less likely to enroll in online classes.

Therefore, college recruiters, admission personnel, and advisers must encourage females

that they do have the ability to take and be successful in online classes.

Developmental college classes. Meeting the needs of students who are

underprepared for college is a challenge faced by most colleges. Colleges have had to

implement developmental or remedial classes for students in reading, writing, and math

so they are able to obtain the skills necessary for advanced study.   Developmental classes

do not carry college-level credit, but are designed for students to rebuild their skills to be

successful in college-level for-credit classes. It is recommended students pass all of their

developmental classes before pursuing college-level classes. In fact, most college-level

classes have numerous prerequisites, which often include successful completion of

developmental classes. It can be alarming for students to find out that they will have to

spend a semester or longer taking developmental classes that do not fulfill program

requirements and that could potentially negatively impact their financial aid.

According to data from the National Center for Education Statistics, 76% of

students enrolled in Title IV degree-granting two- or four-year colleges were taking at

least one remedial college class in reading, writing, or math (Remedial, 2003, p. 1). In

fact, colleges classified as being public two-year colleges were more likely to have remedial classes than any other type of institution. The report noted that 28% of all freshmen for the 2000 school year were enrolled in one or more remedial course. The demand for remedial mathematics classes was the greatest (Remedial, 2003). Trenholm (2006) reiterated this phenomenon by reporting that developmental mathematics classes "will likely remain strong for years to come" (p. 53). It was also reported that 42% of incoming freshmen at public two-year institutions were required to take at least one remedial course (Remedial, 2003). Clearly, some students accepted into college may not have the necessary skills to complete college-level work. Colleges are requiring students to take developmental or remedial classes in hopes that they acquire the skills to be successful in college.

Bailey, Dong, and Cho (2009) studied the characteristics of developmental education students. Bailey et al. determined full-time students were less likely to need developmental education courses, while students in vocational curricula were more inclined to need developmental education courses (p. 20). Female students tended to progress through developmental math classes more quickly than males, and older students experienced lower rates of passing upper-level developmental classes. A cumulative review of the statistical analysis indicated that African American male students in vocational curricula had the lowest rate of fully completing all developmental education sequences.

Remedial classes in colleges have also seen an increased use of technology. In 1995 only 3% of colleges were using distance education to teach remedial classes. However, by the fall of 2000 it was reported 13% of colleges were using distance

education for remedial courses, and 25% of public two-year institutions were teaching remedial courses online (Remedial, 2003). This study also showed almost one-third of colleges used computers in remedial courses for hands-on instruction.

The U.S. Department of Education (2002) reported during the 1999-2000 school year that 40.5% of students in public two-year institutions had taken remedial courses. Moreover, 75.6% reported they had taken remedial mathematics classes. African American students reported the highest need for remedial math classes (Profile, 2002). Upon further analysis of the data, the profile of students who reported having to take remedial courses was highest for married people with no dependents who were 40 or older(Profile) . Thus, from this data institutions may categorize the types of students who are more likely to need remedial services.

Bailey and Cho (2010) reported the alarming statistics on the dismal success rate of developmental students. They found that 28% of students recommended for developmental education did not enroll in developmental classes, 30% of students failed or withdrew from at least one of their developmental classes, 10% dropped out prior to failing their developmental classes, and only 31% actually completed their developmental education classes with the requirement grade (p. 2). More startling is the fact that only 16% of students who successfully completed their developmental classes enrolled in a college-level course within three years.

Sheldon and Durdella (2010) compared the success rates of students taking developmental classes within the regular length of the semester to the success rates of students taking developmental classes within a compressed length. Utilizing data from a large suburban community college in California, Sheldon and Durdella were able to

determine, regardless of gender, ethnicity, age, or GPA, that students in compressed

courses experienced greater rates of success. Other findings suggest developmental

students need courses that are offered longer than the traditional time allotted for

learning, but these students are skillful enough to successfully master material in a short

time frame when the information is more intense and presented in a more compressed

format (Sheldon & Durdella). With numerous variables not studied, Sheldon and

Durdella suggested future research to focus on the ability of students to retain

information from compressed courses, to follow students through a sequence of

developmental courses, and to determine if compressed courses required a higher degree

of obligation and impetus from students.

   With the complexities and length of time some students devote to developmental

education, Bailey and Cho (2010) suggested that developmental education needed

reforming. One suggestion was the use of Accelerated Learning Programs where

students who were on the borderline of needing developmental courses enroll in

mainstream college-level courses and work with the same professor after class to meet

their needs. Another suggestion was the Integrated Basic Education and Skill Training

initiative in which students who were headed toward specific occupations should enroll in

courses that integrated basic education skills with occupational classes. The last

suggestion was for community colleges to investigate the use of learning communities in

which students who needed developmental courses would take the same set of courses

together as a cohort with integrated curricula and collaborating instructors.

   Some people associate a stigma to having to enroll in developmental courses.

However, according to Hall and Ponton (2005), they described, "teachers of

developmental mathematics courses as holding the key for college success" (p. 28).

Their study focused on the self-efficacy of freshman enrolled in developmental

mathematics courses. They reported that enrolling in developmental mathematics

courses was directly related to students' success in completing a college degree. The

researchers also pointed out that the "fastest growing segment of higher education is the

number of non-traditional-aged learners" (Hall & Ponton, 2005, p. 30). Thus, instructors

should tailor instruction to the needs of all students.

Ashby, Sadera, and McNary (2011) studied students completing an Intermediate

Algebra course during the summer and fall semesters at a Mid-Atlantic Community

College. This course was offered in a face-to-face format with classes meeting two or

three days a week for a total of three hours; an online format; and in a hybrid format with

classes meeting once a week. The face-to-face class lectures were traditionally based,

while the hybrid class instruction was limited in the quantity and scope of instruction.

The online students were provided a lecture with audio that imitated traditional lecture-

based instruction, a transcript, a handout, practice problems, and answer keys.

Comparing the pass rate between the three groups, 63% of students in the face-to-face

class obtained an overall passing grade for the class, 69% of students in the hybrid class

obtained an overall passing grade for the class, and 85% of students in the online class

obtained an overall passing grade (Ashby et al., 2011, p. 136). Hence, online students

seemed to pass at much higher rates compared to other forms of instruction.

There should be no price tag associated with remedial classes at the college level.

Florida's Legislature determined between 2004 and 2005 that $118.3 million were spent

on remedial education within the Florida Community College System (Levin &

Calcagno, 2007). Moreover, legislators brought to the forefront that the state had already spent money on these services, as students learned remedial education concepts in middle school and high school. McCabe (1998) stated that he could not remember any span of five years in which there was not some party who opposed developmental college programs. Moreover, he called developmental community college classes a "bargain" compared to the amount of money needed to support an inmate and their family due to a lack of education and job training (McCabe, 1998, p. 4). Certainly the United States cannot afford to allow this group of students to fall by the wayside due to their insufficient skill base.

Bailey (2009) referred to the placement testing process as a form of higher education high-stakes testing. Students are assessed once, with their future college enrollment dependent upon that one score. Moreover, colleges differ in their opinion of cut-off scores for placement into various developmental classes. Bailey pointed out that students with similar placement test scores may vary greatly according to their academic knowledge due to various factors such as length of time out of school or not having completed any prior classes with the subject material. Moreover, students deemed in need of developmental education are not required by some colleges to actually enroll in the courses. In fact, Bailey stated that less than half of students who are shown to be in need of developmental classes actually complete the entire recommended course sequence.

With an annual cost of developmental education remediation to be between $1.9 and $2.3 billion per school year, developmental education weighs heavily into the budgets of colleges (Bailey, 2009, p. 2). Furthermore, it is reported less than 25% of

students in community colleges who take developmental courses graduate within eight years, compared to almost 40% of students who do not enroll in developmental education (Bailey, 2009, p. 2). Attewell et al. (2006) reported that two-year colleges are more likely to place students with comparable academic skills and backgrounds into remedial classes than are four-year colleges. Even more astonishing is the fact that students at two-year colleges who took two or more developmental math classes were 3% less likely to graduate from college than students who took one or no developmental math classes (Attewell et al.). This may be linked to the findings of Attewell et al. (2006), stating that only 30% of developmental math students passed the course the first time. Trenholm (2006) reported between 40 and 50% of students pass developmental classes during their first enrollment. Recently, developmental classes in general have been referred to as gatekeeper courses, as many educational leaders recognize them as quality control courses (Attewell et al., 2006).

Spann (2000) suggested if one-third of students enrolled in developmental classes were to earn a bachelor's degree, they could potentially produce $74 billion in federal taxes and $13 billion in state and local taxes (p. 2). In addition, Kisker and Oulcalt (2005) pointed out that developmental students are more likely to transfer to four-year colleges than non-developmental students. Levin and Calcagno (2007) discussed the large number of states that have restricted or prohibited remedial education at public four-year institutions due to the cost savings at two-year institutions in which adjunct faculty members could teach over-enrolled developmental courses at a much reduced pay rate. It should be noted, colleges that have more than 70% of developmental classes taught by adjunct faculty members tend to have unacceptable pass rates. Hence,

educational institutions must embrace the philosophy of doing more with less while still maintaining quality control.

Paul Nolting is a national expert on the learning problems associated with developmental mathematics and was interviewed by researcher Boylan (2011). Boylan noted through the interview the complexities associated with the various tiers of developmental mathematics and thus the higher probability that students would be placed into developmental math courses over developmental reading or writing courses. Anxiety becomes a vital factor in developmental mathematics, as students experience more anxiety while completing their initial placement test, yielding lower scores and avoidance behaviors experienced once placed into the appropriate course (Boylan). Due to the sheer probability of students passing developmental mathematics set at 50%, the probability that students would pass three developmental math classes the first time to enter college-level courses is reduced to 12% (Boylan). Although it is becoming more socially acceptable to fail a mathematics course, Boylan stated the probability that students passing developmental mathematics classes they have already failed becomes even slimmer and in turn raises the question of the number of times students will fail developmental math courses prior to deciding to withdraw from college altogether (p. 21).

The mathematics departments at community colleges and universities cannot hold the sole key to the success of students. Instead, math faculty members must unite with student services to find ways to combat the anxiety associated with completing mathematics classes. Boylan (2011) reported students with anxiety experience rapid heartbeat, sweaty palms, shallow breathing, and persistent procrastination with

completion of homework or attending class. These symptoms can overcome mathematics students to the point where one student said her test anxiety was so great that she could not bear to stay in the room any longer.

B**est practices in developmental mathematics education.** A wise saying states that a person never gets a second attempt to make a first impression. This is true of developmental education, as Boylan (2002) related how the experiences of students in developmental courses shape the attitudes they have toward higher education and the institution in which they are attending. Completion rates for developmental courses, grades in developmental courses, grades obtained in post developmental education courses, retention rates, and student satisfaction together form the industry standard in assessing the success of developmental education (Boylan).

Offering professional development opportunities for faculty and staff working with developmental students is essential to the progression of services (Boylan, 2002). Developmental students have already demonstrated their inability to learn under traditional methods, or these methods have not provided long-lasting, meaningful experiences (Boylan). Hence, professional development may open new avenues to explore various instructional models. Some of these models include using self-scoring instruments that provide immediate feedback, discussing learning problems, making referrals, providing social reinforcement, and developing skill sets conducive to distance learning (Boylan). Best practices teaching models include an increased use of technology, integration of the classroom and lab time, offering a multitude of delivery methods, project-based instruction, proper assessment and placement, and professional development for developmental education faculty (Bonham & Boylan, 2011, p. 3). With

regard to redesigned models, new models have been coined supplemental, replacement, emporium, fully online, buffet, and linked workshops (Bonham & Boylan, 2011, p. 4).

Phillip (2011) reported that community colleges have been sluggish with regard to increasing the number of developmental courses offered online, as the state of Virginia offers only three to four percent of online courses as developmental courses, due to the fact that students taking online remedial courses are less likely to be successful in college-level courses. Foothill College in California reported that students who earned an A in a low-level math course had an 80% pass rate in the next math class; students earning a B had a 50% success rate in the next math class; and students earning a C had between a 15% and 20% pass rate in the next math class (Phillip, 2011, p. 2). Phillip explored developmental education further and stated that successful developmental education programs should be tailored to fill in the gaps for students rather than force them to repeat material they had already mastered. These best practices will only continue to expand in the future as more research and sharing among researchers is conducted.

Online mathematics achievement. According to Wadsworth, Husman, Duggan, and Pennington (2007), colleges and universities are beginning to offer developmental classes online to cater to a greater student body and to reduce the teaching load of faculty members. However, Wadsworth et al. , question whether this caliber of student is ready for online instruction, as they have demonstrated how they failed to adequately learn course material the first time they encountered it. In addition, Wadsworth et al. believe developmental students may lack the required amount of motivation to complete the challenging assignments of online learning. They conducted a study where there were

511 students enrolled in online developmental mathematics classes at a large southeastern public university. The researchers offered all the students an opportunity to participate in the study for extra credit. Although only 89 students chose to participate, limiting the ability to generalize the results, the researchers concluded that learning strategies and self-efficacy were the most critical factors in determining student achievement among those taking online developmental classes.

According to Perez and Foshay (2002), faculty members who were teaching developmental math classes online for the first time were very successful, as they were very self-motivated to find ways to incorporate technology and utilize computer-based instruction. However, Offenholley (2006) stated that one of the drawbacks to online mathematics instruction was the lack of mathematical symbols in course-management systems, leading to both student and teacher frustration. Jacobson (2006) reported online math students become frustrated when entering in answers to their assigned problems, as few students had knowledge of Equation Editor and those who had, reported it be "complex, inconsistent, and hard to learn" (p. 8). Moreover, students who completed a survey on their online experience expressed their dissatisfaction with the computer marking their questions wrong when they were indeed right (Jacobson). The only difference in their submission and the correct answer was text formatting. Without the necessary technology in place, teachers and students alike struggle to communicate during the process.

Not only do students struggle to communicate mathematical concepts online, many college students suffer from math anxiety. Taylor and Mohr (2001) conducted surveys and telephone interviews with 215 students taking an online math class, with

59% of males and 50% of females reporting math anxiety (p. 7). Throughout the course of study, 92% of the students indicated they developed an increase in their self-confidence to complete future math courses (Taylor & Mohr). Moreover, of those who completed the course requirements, 80% of the females passed the class and 94% of the males passed the class (Taylor & Mohr, 2001, p. 8). This information is misleading when one considers that 50% of the initial students did not complete course requirements or the final exam (Taylor & Mohr). Although it is wonderful to see that so many students were able to overcome their anxiety and build self-confidence, this study reported that an overwhelming number of students did not complete the course.

Ryan (2002) reported a study of students from California Polytechnic State University that revealed of the 271 students in a seated Pre-Calculus class, those who completed Intermediate Algebra in an online, interactive course format earned 49% more As, Bs, and Cs than students who took the Intermediate Algebra in a traditional seated class format. The findings here clearly support online learning of developmental math concepts, as this group of students could use those developmental skills and be successful in college-level mathematics classes.

Gundy, Hope, Morton, and Kline (2006) conducted a study during the fall 2002 semester and spring 2003 semester at a predominantly White university in the north-eastern part of the United States. There were four statistics classes studied, with a total of 175 participants. Students who received treatment A were required to utilize Blackboard to obtain class material, but sending class emails or participating in online discussions was voluntary. Students who received treatment B did not have access to Blackboard and everything that was online for group A was copied for students in this group. Students

who received treatment C were required to turn in assignments through Blackboard and participate in class discussion groups. Gundy et al. concluded that the math anxiety of students utilizing Blackboard reduced during the course of the class. Students reported that being able to communicate with their classmates in a non-one-on-one environment raised their self-esteem; they were able to communicate with classmates without feeling dumb or inadequate.

Havill, Hashim, and Alalawi (2004) conducted a study of women at Zayed University enrolled in a developmental math class that used traditional teaching techniques but incorporated the computer into practice. Through a 10-question questionnaire, the researchers were able to determine many interesting patterns among the responses of the women. The results of the study showed 63% of the participants thought that completing their homework on the computer was better than completing homework within the textbook (Havill, Hashim, & Alalawi). In addition, participants reported that working on homework assignments on the computer allowed them to work together in groups more than other techniques. Eighty-two percent of participants stated that being able to practice math problems anywhere, anytime on their laptop helped them tremendously (Havill, Hashim, & Alalawi, 2004, p. 47). Also, more students reported that they liked being able to complete their practice problems and test questions online at their own speed. Moreover, 53% of participants stated that if the course was online it might work, and 37% said it would not work without a teacher (Havill, Hashim, & Alalawi, 2004, p. 47). This study suggests that students are cautious about taking online mathematics classes.

Zavarella and Ignash (2009) examined students at a large, multi-campus community college in Florida who were taking a developmental math class either in a traditional lecture-based format, hybrid format, or distance learning format. The statistical analysis of the data showed students taking the developmental math class in the hybrid or distance learning formats experienced higher drop-out rates of 42% and 39% respectfully, compared to the 20% drop-out rate of traditional lecture-based instruction (Zavarella & Ignash). Students in the online class completed a survey on their experience, which allowed the researchers to conclude that students perceived traditional lecture-based instruction to be more complex than computer-based instruction, and computer-based instruction would require less time (Zavarella & Ignash).

Zhu and Polianskaia (2007) investigated the success rates of traditional lecture-based mathematics classrooms to computer-mediated classrooms at Victoria College from 1996-2005. Their 10-year research project showed male students under the age of 35 experienced greater success rates in traditional lecture-based classes, and students fared better in traditional lecture-based instruction than computer-mediated instruction. Likewise, a comparison of the scores of students in these math classes showed students performed better in traditional lecture-based classes than computer-mediated classes (Zhu & Polianskaia).

In response to the highly qualified teacher constraint of No Child Left Behind, O'Dwyer, Carey, and Kleiman (2007) studied the effectiveness of using online instruction with eighth and ninth grade Algebra I students. School systems in the state who were eligible had to prove their inability to provide certified Algebra I teachers in order to participate in the study. Six school systems participated by creating 18 classes,

with each class having a live instructor who had expressed interest in becoming a certified Algebra I teacher with a total of 257 students.   Instruction was delivered online using video feeds, emails, and various Internet tools.

 The 25-question pretest and posttest involved in this study were not identical, but the scores were compared to the scores from students learning in traditional classrooms to determine if the groups of students scored comparably to one another (O'Dwyer et al., 2007). Results showed that the online students outscored the face-to-face students on 18 of the 25 questions. The online students were then asked to complete a survey on their experience in the new online Algebra I course. They reported the most enjoyable part of the class was being able to use technology to learn mathematics, while stating the most difficult part of the class was getting all the assignments submitted by their due dates. This was due to the fact the online format required more independent work. With a shortfall of certified instructors and the demand for numerous course offerings, K-12 learning environments may continue to seek the instructional services of online instructors.

Online learning in the Virginia Community College System. In an attempt to become more student-centered and promote faculty development and student success, the Virginia Community College System released its distance learning strategic plan in 2001. To study the effectiveness of this plan and its outcomes on the student body, Jaggars and Xu (2010) set out to explore the patterns and performance among online learners within the state. Armed with previous research stating the compatibility of online learning to seated learning, and the difficulties that less prepared students encounter when functioning in online learning environments, they studied students who began their

education endeavors during the fall or summer 2004 semesters and tracked them for four years. A second group of students who started in 2008 were also tracked, but unlike the first cohort they were not tracked for four years. Cumulatively, online learners tended to be White female students aged 25 or older who received federal aid and had stronger academic abilities (Jaggars & Xu, 2010, p. 5). Online enrollment in mathematics classes was generally higher than online enrollment in English classes. Moreover, students were more inclined to enroll in online classes during the summer semesters, as more than half of the students who took online courses during the summer semesters took all of their courses online.

With regard to developmental classes within the Virginia Community College System, students who completed developmental classes in a face-to-face learning environment entered gate-keeper courses at a 46% rate compared to the 26% rate experienced by students who completed their developmental math classes online (Jaggars & Xu, 2010, p. 14). In addition, students who did not perform well in online courses made the switch to face-to-face classes to such a degree that 45% of failing online students enrolled in all face-to-face classes the following semester. However as students proceeded through their programs, they preferred online courses or online courses were more readily available.

The Virginia Community College System offers face-to-face classes, hybrid classes, and online classes. Comparing completion rates, face-to-face classes saw the greatest success rates, hybrid classes experienced a completion rate nine points lower than face-to-face classes, and online classes experienced a completion rate 12 points lower than face-to-face classes (Jaggars & Xu, 2010). This also affected the probability

that students would return the following semester. Jaggars and Xu found that students who only completed face-to-face classes had a 75% chance of returning the following semester, while students who took one online class had a 73% chance of returning the following semester (p. 23). Jaggars and Xu further suggested online instructors may be importing traditional pedagogy and materials to the web.

Increased demands on teachers. Although many instructors initially believe teaching online is easier than teaching seated classes, once they have taught online, they quickly retract their initial opinion. Hurt (2008) studied 11 full-time faculty members at Southside Virginia Community College and found that not one of them rated online instruction superior to traditional instruction. According to Boettcher (2004), an appropriate number of hours for online students to study course material for a three credit class was 135 hours. With regard to teacher preparation, Boettcher stated that five years ago average online instructors would spend 18 hours per one hour of regular instruction preparing to teach online. However, since many online instructors currently have more training and experience, on average they now spend 10 hours per one hour of instruction preparing to teach online. Clearly, online instructors must invest an enormous amount of time in preparing online courses.

Furthermore, the costs associated with losing trained online faculty members are costly for colleges and universities. Bolliger and Wasilik (2009) pointed to the research by Hogan and McKnight (2007), who noted that online instructors suffer from above average emotional burnout, high levels of depersonalization, and low levels of personal accomplishment (p. 114). Obviously, administrators must pay attention to the side-effects experienced by online teachers as well as students.

Pagliari, Batts, and McFadden (2009) surveyed faculty members at two-year institutions within the North Carolina Community College system to determine the amount of training online teachers were receiving. With such rapid increases in technology, Pagliari et al. astonishingly found that 40.7% of online teachers did not attend any off-campus training and 44.4% of online teachers did not attend any on-campus training in the previous year (p. 6). Nevertheless, online faculty members cited timely feedback, supporting students through online communication, and using discussion boards to facilitate interaction as the top three best practices among online teachers (Pagliari et al.. College administrators must be dedicated to finding ways to train online faculty members even if it requires little to no additional monetary spending. Peer discussions and mentorships allow faculty members to discuss issues at hand without any financial burden to the college.

Many online students desire the "anytime, anywhere" convenience online learning offers. In return they "require constant attention" from their instructors (Thompson, Falloon, & Simmons, 2001, p. 4). Stumpf, McCrimon, and Davis (2005) reported findings from Falloon (2003) that stated students panic when they have contacted their instructor and have not received a response within 24 hours. Students also feel more comfortable sharing private information through emails with instructors than other forms of communication (Gahungu, Dereshiwsky, & Moan, 2006). Thus, online instructors should expect to see a large influx of emails to sort through and respond to in a timely fashion. This contradicts the myth that online teaching and learning is fast and stress-free (Qing & Akins, 2005).

Barrett, Bower, and Donovan (2007) extended an invitation to all part-time and full-time online teachers in Florida's Community College system in an attempt to understand their teaching philosophies, due to the fact community college instructors are more likely than any other type of instructor to teach online classes. Using the Principles of Adult Learning Scale (PALS) assessment to gage the model of teaching these instructors were implementing, Barrett et al. found instructors were using more of a teacher-centered model. This contradicted the literature that stated community college online instructors were using a learner-centered model (Barrett et al.). The findings could be attributed to the possibility of these instructors not being aware of or not implementing current findings on the subject. Community college instructors must implement best practices both in the classroom and in online learning environments.

Due to the extent faculty members were being asked to turn their seated classes into online classes and wanting to learn more about faculty members transferring their teaching skills to a new medium, Smith, Ferguson, and Caris (2003) set out to survey online faculty members in the state of New York. Many faculty members praised online learning, as it allowed them to formulate better responses to student questions and ensured they completed communication expectations and descriptions of assignment (Smith et al.). However, online mathematics teachers seemed to be more concerned with their dissatisfaction teaching online, due to the inability to communicate with students. Teachers were frustrated at the lack of technology available to readily communicate and input formulas and equations into online course management systems (Smith et al.). The two-way communication with students was so burdensome, one faculty member commented "If this doesn't change, it will eventually be the reason why I give up

teaching mathematics on the Internet" (Smith et al., 2003, p. 48). Participants suggested

online course management systems implement somewhat of an online chalkboard where

they could easily write formulas or complete problems.

Trained online faculty members can also become frustrated with the sheer volume

of students enrolling in online classes. It has been projected by 2015 as much as 20% of

enrollment in the California Community College System will stem from online

enrollments (Hale, 2007). Hale examined the online teaching loads of faculty members

within the Yuba Community College District in California. Tenured faculty members

were first given the opportunity to develop and teach online classes with a set cap of 30

students, as more than 30 students in an online class affected the enrollment in face-to-

face classes (Hale). Initially faculty members were provided a stipend for every 20

additional seats taken in the class, with up to 70 seats being taken. However, this practice

was deemed unfair as this policy was not implemented with face-to-face classes.

Teachers who chose to allow over-enrollment in online classes were no longer receiving

stipends. Online teachers must determine the appropriate number of seats to make

available in online classes and hold true to their ability to effectively teach such a large

group.

The typical developmental instructor. Many institutions of learning in the

southern part of the United States are accredited through The Southern Association of

Colleges and Schools (SACS). According to the policies set forth by SACS, instructors

of developmental mathematics courses need only possess a Bachelor's degree in

mathematics. However, instructors of college-level mathematics courses must possess a

Master's degree with a minimum of 18 hours in mathematics. There is clearly a vast

difference in the required educational credentials of developmental and college-level courses. According to Fike and Fike (2007), more than 60% of developmental classes are taught by adjunct or part-time faculty. With part-time faculty usually not having an office, not holding office hours, and not having an office telephone number, it can become difficult for them to meet the needs of their students. In fact, Fike and Fike reported that students who enrolled in a higher percentage of classes under part-time instructors were less likely to complete their degree requirements.

Fike and Fike (2007) conducted a study of students enrolled in Intermediate Algebra in Texas to determine whether or not the employment status of teachers affected student achievement. Demographically, fewer than 10% of the participants were of an ethnicity other than White; hence the results of this study may be limited to colleges with the same demographics. Fike and Fike determined through use of bivariate analysis, students enrolled in Intermediate Algebra completed the course with higher grades if the instructor had a Master's degree. Prior educational research, however, suggested that students taking classes under part-time faculty were more likely to complete courses with higher averages.

Kisker and Oulcalt (2005) surveyed 1,531 instructors within the United States about the courses they were instructing. Only 3.7% of the instructors surveyed reported teaching both developmental and honors classes during the previous school year (p. 6). However, 21.9% had taught developmental courses, but not honors courses (Kisker & Oulcalt, 2005, p. 6). In addition, Native American and African American instructors were more likely to teach developmental courses than any other ethnicity (Kisker & Oulcalt, 2005, p. 7). Kisker and Oulcalt were able to characterize developmental

instructors as more likely to have come from a high school teaching position and less likely to be involved with grant writing and publishing. Developmental faculty members tended not to have experience teaching the most advanced classes and students. Furthermore, they tended to spend more time preparing to teach and less time researching current trends.

Petrides & Nodine (2005) noted with such a rapid increase in online developmental education whether or not colleges have ensured the effectiveness of the teaching process. With a multitude of developmental classes being taught by adjunct faculty members, they may not have had the ability to seek the services of the college's fulltime technologist and attend professional developmental opportunities. In addition, Petrides and Nodine advised college instructors that the question of technology had been redirected to "how, how much, and how best to use it" (p. 46).

Clearly, developmental educators must be current on the latest, research-based technologically driven pedagogy. In fact, the Association of Mathematics Teachers at Two-Year Colleges believes developmental mathematics teachers need specialized training in developmental mathematics, technical mathematics, teaching preparation, intensive math background, and statistics (p. 6). These teachers are preparing students for the next prescribed mathematics course and should understand where these students have been and where they will be going in the future.

Preferred online learning techniques. It cannot be underestimated the importance of online learners participating in some type of orientation for online courses. As online orientation is said to be the second greatest factor in predicting the success of online learning, Harrell (2008) suggested online orientation should be interactive, explain

to students the types of assignments for which they will be responsible, and cover institutional policies (p. 38). Orientation, whether face-to-face or online, has the ability to build a sense of community and ward off the feeling of isolation online learners experience.

According to Perez and Foshay (2002), students of developmental online classes preferred having knowledge of tutorials for the subject, flexibility to be self-paced, and interactive feedback (p. 3). Furthermore, students desired to attend an initial orientation class to familiarize themselves with the course infrastructure. To encourage students to be more motivated and self-confident in their abilities, Hodges (2007) referred to the findings of Visser, Plomp, Amirault, and Kuiper (2002), who suggested emailing students to encourage them each week.

Many instructors require the use of discussion boards for their online students. This process allows students to be less isolated while studying online. According to Offenholley (2006), one online mathematics teacher used online discussion boards to encourage her students to think through higher-order thinking questions, a means in which to monitor student progress, and encourage peer collaboration (p. 8).

In addition, Sahin (2007) analyzed the results of 917 online surveys to determine the likes and dislikes of online learners. Sahin reported students desired to link course concepts to their personal experiences and desired to use their own learning strategies, problems, and solutions in the online learning environment (p. 5). Moreover, Sahin stated that online instructors should strive to include real life examples related to course content, personal experiences, and instructional support to online learners (p. 6). If instructors fail to provide the atmosphere that online learners desire, instructors will have

poor student performance. Smith (2002) suggested that mathematics instructors should periodically rethink mathematics curricula, as the available tool set and intended audience is ever-changing (p. 12).

Mupinga, Nora, & Yaw (2006) reported online learners had certain expectations while completing their courses online. Students expected communication from their professors and feedback from emails and submission receipts within 24 hours. Moreover, they expected grading to be done almost instantaneously or at least within two business days of the due date (Mupinga et al.). In an effort to ensure instruction was comparable with traditional learning, 36% of online learners expected to complete group work with students who were on campus. Therefore, online students desire their learning process to be equal to the learning process they would experience on campus.

Examining the experiences of online teachers at Harrisburg Area Community College, Chow and Shutters (2002) added insight into effective and ineffective online teaching strategies. Chow and Shutters suggested colleges create a Frequently Asked Questions document to alleviate 90% of initial emails at the start of online courses. Further along into online courses, Chow and Shutters advocated sending students reminders of assignment due dates and progress reports after each test. Chow and Shutters decisively believed in the importance of maintaining open lines of communication.

Looking to examine the working habits of online community college learners, Hastings (2000) administered a survey to 23 Monroe Community College classes of students taking health, physical education, and golf management online. Students reported spending more time on Thursdays and Sundays completing online work

compared to spending the least amount of time on Fridays and Saturdays. In fact, the

most popular time frame for working was from 10-12 a.m.. When students were asked if

they thought they had learned as much taking the online class as they would have if they

had taken a traditional class, 58.8% responded yes, with the best learning activity of the

class as projects. Participants felt that the greatest advantage of taking online classes was

the ability to schedule their own time to complete assignments.

      Preferred seated learning techniques. Stillson and Nag (2009) conducted

research with students completing a seated remedial algebra course at a university using

ALEKS and MathXL during instruction. At the end of the course, a survey was given to

measure the learning experiences of the students. Students admitted the need for both

lecture and practice over the duration of the course by 82.4% and 90.7% over the two

semesters the study reviewed. Moreover, students reported the lecture, textbook, and

online work were the most influential pieces in assisting them to master course material

by 55.9% and 57.4%. While completing the course, students valued being able to

improve their scores by repeating assignments and being able to immediately review

feedback provided by MathXL. Although about half of the students completed the

course, the instructor noted that many students thought they would not have to work hard

to pass the class and some students allowed their previous poor performance in

mathematics classrooms to impact their performance in the course by giving up prior to

starting the course. On the other hand, students who wrote all the steps while completing

problems experienced greater rates of success than students who did not show all of their

work, and students who attended lectures and practiced problems tended to succeed at

higher rates.

Undoubtedly, libraries have experienced changes over the last three decades as technology has grown by leaps and bounds. Betne & Castronguay (2008) examined library usage of mathematics students in a face-to-face mathematics class at LaGuardia Community College to find that 81.5% of students did not use websites for math-related assignments. Moreover, of those who did use the websites for math-related assignments, 50% of the students were using Blackboard and the textbooks' online companions as instructed by their instructors. Shockingly, only 3.4% of students read math-related magazines or journals. These results suggest that math students may not be using the multitude of resources available to them in libraries and on the web.

Cheating. Academic cheating is an issue that both online and seated instructors face. In the classroom, cheaters oftentimes give themselves away by their eye contact or abnormal movements. However, in an online environment, instructors have to question whether or not students themselves are completing course assignments. With regard to testing, most seated tests are designed to be closed-book tests, while online tests are designed to be open-book (Trenholm, 2007). Trenholm reported that work conducted by Bauman (2002) concluded that students who would never be tempted to cheat in a seated class were more unable to control the desire to cheat in an online class. Although Qing and Akins (2005) stated that a myth of online teaching and learning is the simplicity of cheating online, one would have to wonder how to tell if online math students have been cheating when all that is required of them is to access material with a password.

As testing is normally a large percentage of overall course averages, finding ways to reduce cheating on tests is imperative to ensure students have mastered course objectives. Trenholm (2007) suggested that instructors use an algorithmic test generator

to generate tests if at all possible. This process would ensure that all students had different versions of any given test, and would make sharing of answers and work next to impossible. However, not all subjects and course objectives can be measured by algorithm-based test questions.

Dr. Joseph Winslow, a professor at Coastal Carolina University, performed a study in 2001 in which he encouraged his students to "discover as many different ways possible to use technology to cheat on their assignments" (Winslow, 2001, p.202). He reported 61% of the students in the class continued to take the assigned quiz until they got the desired grade they wanted; 26% of the students saved the quiz to a disk; and 21% of the students emailed the quiz to a classmate. Twenty percent of the students in the class used instant messaging to pass along the correct answers to their classmates while taking the quiz themselves. Moreover, 80% of the students in the class found at least one way to cheat during the assignment. After reporting such startling results, Winslow gave suggestions to reduce online cheating, such as taking away navigation buttons from the screen, limiting the time available to take the quiz, requiring students to provide identification prior to testing, and taking away the "right clicking" abilities of students (Winslow, 2001, p. 203).

Retention. Many colleges and universities focus their attention on the recruitment of potential students and pay little attention to retaining those students from semester to semester. Fike and Fike (2008) examined the retention rates of a community college in Texas over a four-year period. Results indicated students who dropped classes during their first fall semester tended to have decreased retention rates the following semester. Furthermore, students completing developmental mathematics with passing grades had a

higher retention rate than students who did not complete developmental classes, and students who did not enroll in developmental mathematics classes had lower retention rates than students who enrolled and failed the course. In addition, students who completed developmental English classes and passed had higher retention rates than students who did not successfully complete developmental English. With a large majority of students needing to take developmental classes at community colleges and the large sum of funding tied to developmental education, community colleges must devote time and energy to implementing best practices.

Aragon and Johnson (2008) attempted to determine characteristics of students more apt to drop online classes. By researching 305 students at a rural community college in the midwestern part of the United States, Aragon and Johnson found no statistical differences among age, ethnicity, or financial aid eligibility. However, females tended to complete online classes at higher rates than males, and students who completed online courses tended to be enrolled in more credit hours. The most frequent reasons students abandoned online courses were due to the limitations on personal time, poor course design, and lack of communication with instructors (Aragon & Johnson, 2008, p. 151). All of these areas can be addressed and circumvented by the implementation of best online teaching practices.

According to Stuart (2009), higher education has been praised for enrollment numbers, but they are not praised for the successful adventures of students undertaking remedial education. Enrollment numbers and the need for remedial education will only continue to increase, as the job market demands better trained employees in all fields of study. Among Stuart's suggestions to increase retention were remediation on how to

study, note taking skills, and time management immediately upon enrolling in college (p. 5). Stuart noted that students needing developmental English or mathematics should complete these courses prior to starting their first year studies or during their first year of college, as those students who do are 69% more likely to graduate. These students do not enter college without any skills, but typically rather have gaps in their knowledge, and teachers must find ways to fill those gaps while avoiding instructional practices from high school.

With the ever-rising cost of gasoline, rural community colleges are facing yet another obstacle regarding retention. Sander (2008) quantified the cost of driving to campuses, as some students were driving 30 to 60 miles one way to nearby campus locations. This equates to 10 or more dollars per week in gasoline costs compared to the previous year. This fact has forced a countless number of students to cram as many classes as possible into as few days as possible. Some students have not been able to overcome their problems with rising gasoline prices and have had to drop out of college or turn to online classes to complete their degrees. Conversely, students in rural areas have what Sanders called spotty Internet access, and the most remote locations suffer the greatest from the digital divide, as they have no Internet access. With no foreseeable solution for soaring gasoline prices or Internet issues, there is no relief in sight for this group of students.

Research supporting traditional teaching techniques in online learning environments. According to Evans and Champion (2007), students in face-to-face classes enjoyed the benefits of traditional learning due to the guidance and verbal directions given in class, which seems to be lacking in the online teaching and learning

arena. Even though there are programs that allow teachers to embed lectures into

PowerPoint slideshows, this is not a learning option for students with dial-up Internet.

The Internet tends to time out or drop when attempting to download such enormous files,

which leads to frustration among online students (Evans & Champion). Reviews of

Camtasia and Snagit, a program that allows teachers to capture PowerPoint presentations

with lectures and live-screen captures in a highly compressed file stored on a server, has

been described as a package that has the ability to "bring the student and teacher together

across the miles, creating a kind of cyber-synergism" (Evans & Champion, 2007, p. 80).

This new combination has the ability to "add a twist to instruction that can bring new life

to online courses," as the merits and quality of online instruction are increasingly being

investigated (Evans & Champion, 2007, p. 82).

Smith, Smith, Kansas, and Boone (2000) studied the academic performance of 58

pre-service elementary teachers taking a technology integration course. The instructor

for the course used the same PowerPoint presentations for the seated and online classes.

However, during instruction her lecture was audio recorded and later transcribed and

disseminated to the online students, so they could read verbatim what was presented in

the seated class (Smith et al.). After analyzing the course outcomes using Statistical

Package for the Social Sciences (SPSS), it was determined that the online class and

seated class performed as well as one another on the pretest and posttest. Hence, it may

be said that lecture may be effective in both an online learning environment and a

traditional classroom learning environment.

With regard to technology and mathematical instruction, Hodge-Harrin (1997)

compared the results of three modes of instruction with Introductory and Intermediate

Algebra at a four-year college. The first group of students was taught in a traditional

setting using traditional methods, the second group of students was taught in a traditional

setting using traditional methods with the inclusion of a remote site of students, and the

third group of students received the instruction at the remote site. Using ANCOVA, it

was found there was no significant differences in student achievement between any one

of the three groups of students (Hodge-Harrin). Hence, one could infer that the concept

of lecture to distance students may be an effective means of instruction. In fact,

according to Offenholley (2006), "In the future we're going to see more streaming media.

We're going to see the instructor be able to have an audio post and students will be able

to respond by speaking into a microphone" (p. 8).

Clearly, many technological advances such as streaming video, tablet PCs, and

programs such as Breeze can assist in using traditional teaching techniques in online

learning environments. According to Whiteman (2002), adult age community college

students want to be treated as customers. Moreover, when their computer failed to

deliver instructor-made lectures and discussions, they desired to have someone to call for

assistance (Whiteman). Colleges and instructors must ensure their infrastructure can

support students with useful technical assistance hours. This can easily be accomplished

by setting up an appropriate help desk for students.

Research against using traditional teaching techniques in online learning

environments. Although there is research available addressing online teaching and

learning of developmental mathematics, there is virtually no research on the effects of

using traditional teaching techniques with developmental online Algebra students. Some

researchers suggest that traditional teaching techniques used in online learning

environments are not effective. According to Thompson, Falloon, and Simmons (2001), instructors who use traditional teaching techniques such as lectures in online environments have lower retention rates. In a face-to-face learning environment, Brewer and Burgess (2005) suggested that lectures could be too long and fail to encourage students to engage in reflective thinking. In addition, Brewer and Burgess stated that traditional lectures are not an effective way to motivate students to continue to come to class throughout the semester, but may be effective when the teacher has demonstrated a high level of content knowledge. Levin and Calcagno (2007) conveyed the notion that students remain persistent in higher education by not only quality instruction, but also by their integration into the social and academic life of the college.

Thompson, Falloon, and Simmons (2001) suggested that instructors create a student-centered environment, in which there is frequent communication between the teacher and the students (p. 1). Harbeck (2001) pointed to the research of Bonk and Cummings (1998) that "cautions instructors against trying to duplicate the traditional classroom in the online learning environment" (p. 26). However, it is important to note that they were discussing weekly quizzes and not lecture. Furthermore, Tallent-Runnels et al. (2006), questioned whether "online classroom culture should be similar to or different from face-to-face-classrooms" (p. 104). There are still many questions surrounding what types of traditional teaching techniques work in online learning environments.

Petrides & Nodine (2005) recalled how traditional courses are centered around lectures and end-of-semester exams, while online instruction should be centered around "encouraging contact with faculty, developing cooperation among students, using active

learning techniques, encouraging prompt feedback, emphasizing time on task, communicating high expectations, and respecting diverse talents" (p. 46). Bonham & Boylan (2011) reemphasized the importance of students spending more time doing math rather than passively listening to someone talk. Online teachers must comprehend their new position as facilitators during the learning process for online students, and not dictate the learning process by lecturing.

Jacobson (2006) reviewed the experiences of seated students who completed their homework online. Through an analysis of the survey responses from students, Jacobson suggested less emphasis should be placed on videos that instruct students on how to work mathematical problems. This raises the question if students will utilize the instructional videos as a means to seek answers for their shortcomings.

Zhu & Polianskaia (2007) suggested through the research of Kinney (2001) that students select seated courses and online courses due to their preferred learning style. Students who register for seated classes enjoy learning through observation and by having the ability to ask questions of the instructor. In contrast, online students register for online classes due to their desire to use multimedia to aid in the instructional process over observing the lectures; desire to learn through more visual multimedia than by copying notes from the chalkboard; desire to learn independently; and want to control their own learning pace (p. 65). Consequently, online learners desire more independence and control over the learning process than seated learners.

Milliron (2010) suggested the argument between online teaching/learning and traditional teaching/learning should cease between higher education instructors and

educational leaders. Milliron referred to online courses, hybrid courses, mobile learning, game-based learning, and social networking as the "newest and rowdiest children in the family of higher-education resources" (p. 30). With the increased number of non-traditional college students, he believes remedial education is like the Bermuda Triangle due to the lost opportunities of failing students, the wasted money on failed courses, and the deferred dreams of these students. He suggested that colleges add online sections or blended sections of courses to allow students the opportunity to succeed, but has seen many online instructors displace lectures for other instructional opportunities. Moreover, he admitted to the need for research on the effective mixture of online and face-to-face teaching strategies.

Condie and Livingston (2007) described the traditional classroom as being full of passive recipients of knowledge directed from teachers, and suggested that utilizing new teaching strategies will turn students into "active creators of knowledge" (p. 339). With teachers holding the lock and key to educational change, teachers must have confidence in their abilities to deliver course content using technology and new pedagogical skills. Condie and Livingston noted that teachers tend to continue to implement tried and tested teaching methodologies and are hesitant to implement new technology while maintaining their online courses. Would using traditional teaching techniques in an online learning environment continue to provide students with the same old ineffective instruction with teachers tranquilly operating in their comfort zone? Would various other forms of web-enhanced instruction appeal to a new generation of learners forcing teachers to deal with the distresses of exploring a new frontier?

Summary

After reviewing the literature surrounding online learning and developmental classes, it becomes obvious that inevitably colleges will continue to increase the number of developmental online classes offered. Many students are deciding to continue their education, only to find out through placement tests they have deficient reading, writing, and/or math skills. As developmental students make up a large percentage of the student body at community colleges, it is imperative that instructional strategies be effective. Without rigorously studying developmental concepts, these students will not be able to continue to take college-level classes and pursue college degrees.

The research clearly indicates that many colleges are already offering online developmental classes, and some research suggests that traditional teaching techniques do not work well with online learning. However, mathematics is a complex field of study, where students may be unable to successfully read and study a textbook to fully master the course objectives. Hence, this study examined whether traditional face-to-face lecture is beneficial for online developmental Algebra I learners. Social cognitive theory suggests students can vicariously learn through observing and modeling the behaviors of others. The results of this study could assist developmental instructors at community colleges in developing the most effective learning environment for developmental online learners. Although developmental courses carry no weight in credit hours for degree completion and students should have already mastered course objectives, community colleges cannot afford to ignore the learning needs of this group of students.

Moreover, there seems to be a gap in the literature describing best practices for online teaching and learning of developmental Algebra I students. In addition, there seems to be nonexistent research on whether traditional teaching techniques are effective in online learning developmental math learning environments. The findings of this research will provide helpful insight and build onto the body of literature on the subject. Researchers cannot ignore the fact that online teachers need training on effective research-based templates and techniques to follow as the use of online education continues to expand.

CHAPTER THREE: METHODOLOGY

Introduction

An analysis of the enrollment information with regard to online learning environments makes it clear there has been an explosion in the number of colleges offering online classes and degrees. In fact, the U.S. Department of Education, National Center for Educational Statistics (2008), reported approximately 97% of public two-year institutions offer distance education classes (p. 1). Another current trend colleges are experiencing is an increased need for remedial or developmental classes to meet the needs of students coming to college without an adequate skill base. Hence, it is a natural consequence for community colleges to begin offering online developmental classes. Developmental students are just beginning their college career and have many unique characteristics. Therefore, these phenomena have led college instructors and administrators to ponder whether traditional teaching techniques would be effective in online learning environments for students enrolled in Math 3 Algebra I.

Research Design

Data for this research study were collected during the spring 2011 and summer 2011 semesters. Students from online and seated Math 3 Algebra I courses offered through Valley View Community College (pseudonym) were invited to participate. Hence, a quasi-experimental design was employed, as testing through the READI assessment determined whether students were good candidates for online learning, and discussions with academic advisors created intact groups. Students were placed into either of the Math 3 Algebra I class formats according to guidance received from their academic advisor or other college officials. Students not deemed as ready for online learning through the READI assessment were not allowed to register for the online class.

Research questions and hypothesis.

The research questions were as follows:

(1) Do online developmental students achieve at comparable rates with students in seated developmental classes?

(2) Do online students utilize the online lectures provided by the instructor from a seated class?

(3) Do online developmental students experience satisfaction while participating in a Math 3 Algebra I online math class?

(4) Do online developmental students recommend inclusion of seated lectures for this course and other online courses?

With the described research questions guiding the research, the null hypothesis was as follows:

Scores -- H_0 stated there will be no difference between the posttest scores of students in the seated Math 3 Algebra I course compared to the scores of students in the online Math 3 Algebra I course.

A nonequivalent control group design determined if online and seated students performed at comparable rates. Since students enrolled in these classes came from varying backgrounds; using a pretest to measure their initial mathematical proficiency was imperative. Moreover, choosing to utilize ANCOVA took into consideration the differences in the groups before making a determination if they faired the same on the posttest administered at the completion of the course. Matching Statistics with the Research Design (n.d.) suggested an ANCOVA analysis was best suited when researchers have two or more groups that are not assimilated through random assignment,

researchers desire to measure the dependent variable before and after participants are subjected to the treatment, and after the treatment there was at least one observation.

Furthermore, the researcher created a 16-question survey for the online students to complete. Although many standardized surveys were reviewed, the researcher failed to locate one that was specific to the actions of students taking an online course with the ability to view the lectures from a seated course. The survey questions determined the viewing practices of the online students, whether they would suggest this course to other students, and whether the practice of recording lectures from a seated course should be considered for other online classes.

Participants

Participants of this study were either enrolled in a seated or online Math 3 Algebra class offered through Valley View Community College during the spring 2011 or summer 2011 semester. The seated classes were taught at one of the off-campus sites of Valley View Community College. During the spring 2011 semester the class met on Mondays and Wednesdays from 4:00-6:00 p.m., and during the summer 2011 semester the class met on Tuesdays and Thursdays from 8:00-11:50 a.m. It was expected that these seated classes would consist of students primarily from the immediate area.

The experimental online class was offered to all students who lived within the 4,200 square mile service district of Valley View Community College during the spring 2011 or summer 2011 semesters. It was a natural consequence that the experimental group would be more geographically diverse and consist of both working adults and traditional students. Participants in the experimental group completed and scored appropriately on the READI assessment to enroll in the online class. The READI

assessment measures the degree to which students are ready to enroll in online classes.

Items that were assessed included self-motivation, time-management skills, self-discipline, on-screen reading rate and recall, persistence, availability of time, ability to use a computer and accompanying software and hardware, preferred learning style, and typing speed and accuracy (About READI, 2009, p. 1). Students' READI assessment results were recorded on the database for students, advisors, and student services personnel. If students were deemed as not ready by the READI assessment score to enroll in online classes, their advisors prohibited them from enrolling in the Math 3 Algebra I online class.

Participants in this study were divided into four groups. Group A consisted of students enrolled in the spring 2011 Math 3 Algebra I seated class that met at one of the many off-campus locations of the college on Mondays and Wednesdays from 4:00-6:00 p.m. Group B consisted of students enrolled in the spring 2011 Math 3 Algebra I online class. Group C consisted of students enrolled in the summer 2011 Math 3 Algebra I seated class that met at one of the many off-campus locations of the college on Tuesdays and Thursdays from 8:00-11:50 a.m. Group D consisted of students enrolled in the summer 2011 Math 3 Algebra I online class.

Final class rosters and enrollment figures were calculated at the end of the second week of classes each semester to allow for late enrollment and allow time for all students to complete at least one assignment to signify their intent to remain enrolled prior to being deleted from the roster as no-show students. There were 26 students in control Group A at the end of the first two weeks of class, 34 in experimental Group B, 24 in control Group C, and 27 in experimental Group D, for a total of 111 participants.

Students in both the seated Math 3 Algebra I class and the online Math 3 Algebra I class had completed the ASSET placement test and scored in the range of 23-40; completed the COMPASS placement test and scored in the range of 0-31; completed Math 2 with a grade of S (Satisfactory); or were re-enrolling in the course after a prior failed attempt. The range of scores on the placement tests and the numerical average required to receive a grade of S had been predetermined by the administration of Valley View Community College.

Setting

Both the control group who received instruction in a traditional classroom setting and the experimental group who were completing the course online and were provided instruction from a previous seated Math 3 Algebra I class were taught the first five chapters of the sixth edition of *Elementary and Intermediate Algebra: A Combined Course* by Larson and Hostetler (2010). The online instructor captured the instruction from his seated class several semesters prior to this study using a tablet PC, a lapel microphone, the Adobe Connect program, and Windows Journal. Adobe Connect stored the information from his tablet PC and created a hyperlink to store in Blackboard for each seated lecture. Since the lectures were from a previous semester, all links were inserted into Blackboard prior to the course beginning. Trenholm (2006) reported that self-paced instruction may not be suited for developmental math students as they often lack self-discipline and self-motivation. However, the instructor provided a timeline and due dates to ensure students were working at a suitable pace.

Utilizing a similar structure with regard to pacing, the control group was taught by another full-time mathematics faculty member. The control group was instructed at one

of the off-campus sites of Valley View Community College, as that was the location in which this researcher was assigned by the college. This site is a fully refurbished tobacco warehouse servicing the needs of students in the southern portion of the service district. Hence, the control group was not as geographically diverse as the online group of students.

All groups of students were required to complete homework assignments online using Blackboard. Students were required to log into Blackboard to complete timed practice problems from each section of the textbook. Furthermore, once students submitted the assignment they were able to immediately view their grade on the assignment. The homework questions were selected by the instructor from the test generator CD that accompanied the textbook. Seated students had until the next class meeting to complete homework problems, while online students had until Sunday night at midnight to complete the assignments on the sections the instructor had taught during the week or had designated for the week. Having considered the findings of Hastings (2000), who surveyed students at Monroe Community College and discovered online community college students worked more on Thursdays and Sundays completing work and were more prone to work between the hours of 10:00 p.m. and 12:00 a.m. (p. 3), the Sunday deadline seemed to be an appropriate choice.

Instruments

As a means to ensure students were placed into the appropriate classes prior to registration, Valley View Community College used the COMPASS or ASSET test score to place students into developmental classes. The COMPASS placement test is a computer version of the placement test which eliminates questions that are too easy or too

difficult for students, yet maintains an accurate assessment of students' abilities (Fast and Accurate, 2009). The ASSET placement test is created by the same organization, ACT, but allows students to take the assessment using pencil and paper. With the ASSET placement test being pencil-and-paper, students have to complete the entire assessment, as there is no way for the assessment to eliminate questions that are too difficult or too easy for students.

The reliability of the COMPASS placement test was tested by the testing company, ACT, using three groups of students. Students who completed the test answering a minimum number of math questions showed a reliability of .85-.86; students who completed the test having answered an average number of questions showed a test reliability of .86-.87; and students who completed the test answering the maximum number of questions showed a test reliability of .90-.91 (COMPASS/ESL, n.d., p. 90). With regard to the validity of the COMPASS test, the COMPASS test showed a validity of .67 with students who completed Elementary Algebra with a final grade of B or higher (COMPASS/ESL, n.d., p. 99). The COMPASS test had a validity score of .63 with students who completed Elementary Algebra with a final grade of C or higher (COMPASS/ESL, n.d., p. 100).

The internal consistency reliability coefficient for the ASSET placement test is .78 (ASSET Technical, 1994, p. 23). The test-retest reliability of the intermediate algebra section is .87 (ASSET Technical, 1994, p. 23). The equivalent form reliability of the ASSET placement test with respect to intermediate algebra placement is .84 (ASSET Technical, 1994, p. 24). The validity of the ASSET placement test was determined by the numerical score of students on the assessment and the pass/fail rate of students.

However, the cutoff scores for colleges are self-determined and colleges may choose to use their own scale.

Once the semester began, students in both the seated and online classes were required to take a pretest to measure their initial knowledge of Algebra I concepts. Also, at the end of the course students in both the seated and online classes were required to complete an identical posttest assessment. Since the pretest and posttest were identical, the researcher was able to measure the amount of change in participant Algebra I achievement at the end of the semester. The pretest and posttest assessment consisted of 37 multiple-choice questions generated from the test generator that accompanied the teacher's textbook for *Elementary and Intermediate Algebra: A Combined Course* (Larson & Hostetler, 2010). All full-time math faculty members at Valley View Community College provided insight during the selection process and agreed this would serve as a standardized measure to ensure that student success was evaluated equally. This highly coordinated effort is characterized as a best practice by Boylan (2002) when a designated administrator is not available to supervise developmental education.

While the seated students completed the pretest and posttest in class proctored by the instructor, the online students were given one attempt to complete the pretest and posttest online. With the service district of the community college being so large, it was determined that asking students to come to campus to take the pretest and posttest was not feasible. Yates and Beaudrie (2009) examined the beliefs of faculty members at College of Southern Nevada who did not teach online, faculty members who did teach online and required proctored testing, and faculty members who taught online but did not require students to take proctored tests. Initially, all groups of instructors voiced concern

over the credibility of the scores of students who did not complete their test under proctored conditions. However, after teaching for some time and not requiring students to take proctored tests, these faculty members did not notice any differences in scores. Moreover, the researchers found no statistical difference in the scores of students who completed tests in proctored centers or online in a non-proctored environment. In addition, Yates and Beaudrie suggested that "online testing is a viable means of evaluating students and can be effectively used by faculty members who teach distance education courses" (p. 68).

After reviewing the Mental Measures Handbook, it was determined that no pre-existing mathematical assessment with tested validity and reliability existed that strictly focused on the content found in the first five chapters of the textbook used in Math 3 Algebra I. Cronbach's Alpha was utilized to determine the interval consistency of the researcher-made pretest/posttest. This information is presented in chapter four of this dissertation.

The online Math 3 Algebra students voluntarily completed a survey on their experiences using Adobe Connect. The survey consisted of 15 questions predominantly on a five-point Likert scale and one open-ended question developed by the researcher. The purpose of this survey was to examine the Adobe Connect viewing habits of the online students, their satisfaction while viewing the lectures, and to determine whether they would recommend this course to other students based on the ability to view the lectures from a seated course.

The researcher viewed many assessments in various databases prior to arriving at the conclusion that a researcher-made instrument would more closely address the

research questions, even at the cost of the established validity and reliability of available instruments. Five aspects were considered before constructing the survey questions. The focus of the instrument needed to be simple and specific on the viewing behaviors, opinions, and suggestions on the use of Adobe Connect in the online mathematics course. The questions in general needed to be brief, as developmental students may lack the motivation to read and answer questions or doubt their ability to complete such a lengthy survey. Both the question stems and their accompanying choices had to be clearly constructed for students to easily comprehend what was being asked. The vocabulary of the survey needed to be simple enough for developmental English students to comprehend. In addition, each question needed to be a simple question that addressed a single concept, could not be too general or too specific, and worded to avoid unfavorable concepts and answers. Moreover, the researcher wanted to limit the time frame to 10 minutes in order to increase overall participation.

Once the survey was created by the researcher, experts in the field of mathematics, English, and education who had experience using technology in online learning environments at the college level reviewed the survey. They analyzed the intended function of the survey, structure, form, scales, sampling, and instructions to the participants. The mathematics teacher who examined the survey had used Abode Connect in prior semesters and had already compiled a list of questions he wanted to analyze before reviewing the survey. While the English instructor was currently using Breeze to supplement her online developmental English class, she had experience working with the caliber of developmental student the college served and was aware of their needs.

After considering the suggestions of the mathematics and English instructors at the community college, the survey was further analyzed by the researcher's dissertation Chair and committee members. Suggestions were considered and as a result some survey questions were altered prior to administrating the survey.

The researcher emailed the online instructor the weekend before each online class was over to post the Blackboard announcement requesting that students complete the survey. The last week of the online courses was devoted to exams, so students would have already viewed all the lectures captured by Adobe Connect, and they would be in the final stages of the course before responding to the survey. In addition, by students seeing the announcement on Blackboard and using their Blackboard username and password to respond to the survey, it should have reduced the anxiety of having to complete a survey in an unknown environment. Students were also aware the instructor would not see their survey results and the results were protected with a password from the researcher. Using Google Docs, the survey was administrated electronically, which was the same method of administration used for all online courses at this college.

Procedures

During the first week of class, students in the control group and experimental group were required to complete a 37 multiple-choice question pretest to measure their initial mathematical proficiency. For the next 16 weeks during the spring semester and 10 weeks during the summer semester, students completed the corresponding assignments for each section until they had reached the end of chapter five of the textbook selected by the math instructors of Valley View Community College.

During the last week of the course, students from both the seated and online classes were required to complete a final exam. This exam was the posttest and was identical to the pretest. Furthermore, the instructor from the online class posted an announcement on Blackboard stating the purpose of the study and the link to complete the 16-question survey on students' experiences with viewing the online lectures and their thoughts on using this technique for online instruction. Presenting the link during the last week of class ensured students had ample opportunity to complete the vast majority of coursework and still had accessibility to view the online lectures if they desired until the end of the course.

The survey was presented to the online students using Google Docs and the results were automatically posted to the researcher's page using the participants' community college usernames. The participants had to use the username and password assigned to them through the community college system and the researcher was only able to view the results using her username and password assigned by the community college system. Participation from the online Valley View Community College Math 3 Algebra I students was completely voluntarily. Internal Review Board approval was obtained prior to the conduction of research to ensure the safety of all involved during the collection of the data. The college granted permission for data collection as well.

Data Analysis

Reliability of instruments is typically tested using one or more methods including test-retest methods, where the survey may be administered on two separate occasions and the correlation between responses is reviewed; equivalent forms where two forms of the same survey are administered; or internal consistency is evaluated using Cronbach's

Alpha, Split-half, or Kuder-Richardson 20 or 21 formulas (Conner, 1997). The Cronbach's Alpha score was calculated using the posttest scores of the control group and experimental group to determine the internal consistency of the researcher-made assessment. Levene's Test of Equality of Error Variances was employed to determine homogeneity of variances. After the null hypothesis of equal variances was not rejected, the ANCOVA was employed to control for the effects of prior mathematical proficiency gathered by the pretest before determining whether there were significant differences in the posttest scores for the control group and experimental group. Frequency distributions were used to summarize and analyze the findings from the first 15 survey questions. The last survey question was open-ended in order to obtain suggestions for improving the course, and these responses were evaluated qualitatively.

CHAPTER FOUR: FINDINGS

Merseth (2011) recalled how all students no matter their age, ethnicity, or income level, all enter college with hope. After they complete placement tests and the college determines the amount of developmental mathematics they will need to complete prior to enrolling in college-level mathematics, the developmental mathematics classes "represent the graveyard of dreams and aspirations" (p. 32) and "an insurmountable impediment" (p. 37). Conversely, Bahr (2008) found students who successfully completed remedial math courses were able to demonstrate long-term academic attainment compared to students who did not need remedial math courses, and thus deemed remedial education as exceptionally effective.

To study the effectiveness of offering developmental Math 3 Algebra I online, students from seated and online classes during the spring and summer 2011 classes were initially required to complete a pretest. Online students completed the test online and non-proctored, and the seated students completed the pretest during the first day of instruction proctored by the instructor. The independent variable for this research was the mode in which students received instruction over the semester, either online or seated. At the end of the course, both groups took an identical posttest in the same manner in which they took the pretest, and the results of the posttest served as the dependent variable. In addition, the online students completed a 16-question survey that addressed their viewing behaviors and satisfaction with the course.

Participants in this study were enrolled in a spring 2011 Math 3 Algebra I seated class that met at one of the many off-campus locations of the college on Mondays and Wednesdays from 4:00-6:00 p.m. (control Group A); an online Math 3 Algebra I class that had no requirement of campus attendance during the spring 2011 semester

(experimental Group B); a seated Math 3 Algebra I class that met at one of the many off-campus locations of the college on Tuesdays and Thursdays from 8:00-11:50 a.m. (control Group C); or an online Math 3 Algebra I class that had no requirement of campus attendance during the summer 2011 semester (experimental Group D).

Final class rosters and enrollment figures were calculated at the end of the second week of classes each semester to allow for late enrollment and allow time for all students to complete at least one assignment, which signified their intent to remain enrolled prior to being deleted from the roster as no-show students. There were 26 students in control Group A at the end of the first two weeks of class, 34 in experimental Group B, 24 in control Group C, and 27 in experimental Group D, for a total of 111 participants.

Over the course of the semester, some students either stopped attending the seated courses or stopped logging in to the online classes. Hence, they did not complete the posttest and their pretest scores were discarded prior to the statistical analysis. After adjusting for this, control Group A had nine students whose scores were discarded for a total of 17 complete data sets, experimental Group B had five students whose scores were discarded for a total of 29 complete data sets, control Group C had three students whose scores were discarded for a total of 21 complete data sets, and experimental Group D had five students whose scores were discarded for a total of 22 complete data sets. Due to the research questions, Groups A and C were combined to form the set of data values representing learners in seated learning environments (the control group), and Groups B and D were combined to form the set of data values representing learners in online learning environments (the experimental group). Thus, the seated group (control) had a sample size of 38 and the online group (experimental) had a sample size of 51.

The online students were also invited to complete an online survey at the end of their course. Twenty-one online students completed the survey at the end of the spring 2011 semester and 20 completed the survey at the end of the summer 2011 semester. This indicated a 68% response rate. Dillman (2007) suggested the typical response rate for emailed surveys is 34%. The increase in response rate could be attributed to the college's Quality Enhancement Plan (QEP), which designated a goal of increasing the participation rates of online students to complete end of course surveys. In order to reach this goal, the Valley View Community College's Dean of Institutional Effectiveness reminds all online teachers to post information suggesting online students complete the end of course evaluations; the dean employs work study students to contact online students via telephone in an effort to have them complete the end of course evaluations; and emails are sent to all online students through the community college email system to complete the evaluations for the online classes in which they are enrolled.

With four guiding research questions, the data attempted to provide answers to each of the following research questions.

Research Question One with Null Hypothesis

The first research question asked if the online Math 3 Algebra I students achieve at comparable rates with students in the seated Math 3 Algebra I classes. The null hypothesis stated that there would be no difference between the scores of students in the seated Math 3 Algebra I class compared to the scores of students in the online Math 3 Algebra I class. Reviewing the sample sizes, means, and standard deviations of the control group and experimental group shows the experimental group had a significantly

higher average with a larger standard deviation on the pretest. Table 1 presents the

descriptive statistics of the two groups with regards to their performance on the pretest.

Table 1

Descriptive Statistics of Pretest Scores by Learning Environment

Learning Environment	*N*	*M*	*SD*
Online	51	50.55	18.40
Seated	38	38.61	13.83
Total	89	45.45	17.12

Analyzing the means and standard deviations of the control group and

experimental group shows the experimental group had a significantly higher average with

a smaller standard deviation on the posttest. Table 2 presents the descriptive statistics of

the two groups with regards to their performance on the posttest.

Table 2

Descriptive Statistics of Posttest Scores by Learning Environment

Learning Environment	*N*	*M*	*SD*
Online	51	78.80	13.80
Seated	38	62.75	16.96
Total	89	71.95	17.11

Although initially the researcher had desired to use an independent *t*-test to

compare the means of the two groups' posttest scores, this was not possible. The

assumptions of the *t*-test include that the dependent variable is normally distributed, the

two groups have approximately equal variances of the dependent variable, and the two

groups are independent of one another. There was a substantial difference in the sample

size of the two groups, as the seated group had 38 students and the online group had 51

students. Furthermore, Levene's Test of Equality of Error Variances was employed to

test the homogeneity of variances with results indicating $F(1,87) = 3.584$, $p = .062$.

Hence, the null hypothesis of equal variances was not rejected. Table 3 presents the

results of Levene's Test of Equality of Error Variances to ensure homogeneity of

variances prior to conducting the ANCOVA.

Table 3

Levene's Test of Equality of Error Variances

Variable	F	df1	df2	Sig.
Instruction	3.584	1	87	.062

Note. Tests the null hypothesis that the error variance of the dependent variable is equal
across groups.
[a]Design: Intercept + Pretest + Group

A one-way ANCOVA was conducted using SPSS to determine if there was a

significant difference in the posttest scores of students completing Math 3 Algebra I

seated compared to the posttest scores of students completing Math 3 Algebra I online.

The pretest scores of the two groups were used as the covariate. The assumptions of the

ANCOVA test include reliability of covariate, linearity, homogeneity of regression,

normality, and homogeneity of variance, and the data met each criterion. The differences among mean posttest scores were significant, with $F(1,86) = 22.109$, p=.000.

To compensate for imbalances in the data and to control for outliers, the adjusted mean was calculated using the posttest scores of the students. While the actual average of the posttest scores was 71.9461, the adjusted average was 71.135. This represents a 0.8111 difference. Table 4 displays the adjusted mean for the posttest scores.

Table 4

Adjusted Means and 95% Confidence Intervals for Posttest Scores

| | M | SE | 95% CI | |
			LL	UL
Posttest	71.135	1.465	68.223	74.048

Note. CI = confidence interval; LL = lower limit; UL = upper limit.

After considering the results of the ANCOVA, the null hypothesis of there being no difference in the posttest scores of online and seated Math 3 Algebra I students can be rejected due to statistically significant results.

The reliability of the 37 multiple-choice question assessment that served as the pretest/posttest was calculated using the Cronbach's Alpha. The score for the instrument was .596. Frisbie (1988) suggested teacher-made tests usually have a reliability score of approximately 0.50. Taking into account the formula that calculates the Cronbach's Alpha, a larger number of questions would have likely yielded a higher coefficient of reliability.

Only students in the online spring and summer courses were asked to participate in a short 16-question survey the last week of the course. Preliminary questions revealed that 56.1% of students reported working full-time, 17.1% reported working part-time, and

11% reported they did not have a job while completing the online course. In addition, 39% of students claimed to not have taken Algebra I in high school, while the remaining 61% of students claimed to have taken Algebra I in high school.

With regard to developmental mathematics, students needing to complete all developmental math courses offered would have completed Math 2 Basic Arithmetic, Math 3 Algebra I, Math 4 Algebra II, and Math 7 Developmental Trigonometry. Of the students participating in this survey, 31.7% of students reported passing Math 2 Basic Arithmetic and enrolling in Math 3 Algebra I as the next prescribed course, 48.8% of students were directly placed into Math 3 Algebra I due to their placement test scores, and 19.5% of students were re-enrolling in Math 3 Algebra I having failed the course previously.

Examining the computer and Internet access of online learners, 4.9% used a computer and Internet at one of the college campuses, 43.9% used their personal computer at home with dial-up Internet service, and 51.2% used their personal computer at home with high-speed Internet service. Thirty-one out of the 41 students reported not receiving tutoring while completing the course, four reported receiving tutoring during less than 50% of the class, one student reported receiving tutoring during 50% of the course, three students reported receiving tutoring more than 50% of the time, and two students reported receiving tutoring the entire time s/he was enrolled in the course.

It is common for instructors to suggest that students should spend three hours of individual study time for every one hour in class, and the students in the online Math 3 Algebra I class seemed to devote time to that degree in their studies. In fact, 68.3% of students reported that they worked between one and three hours on assignments for each

lecture. Figure 1 examines the breakdown in the amount of time students spent on the

material after viewing each lecture.
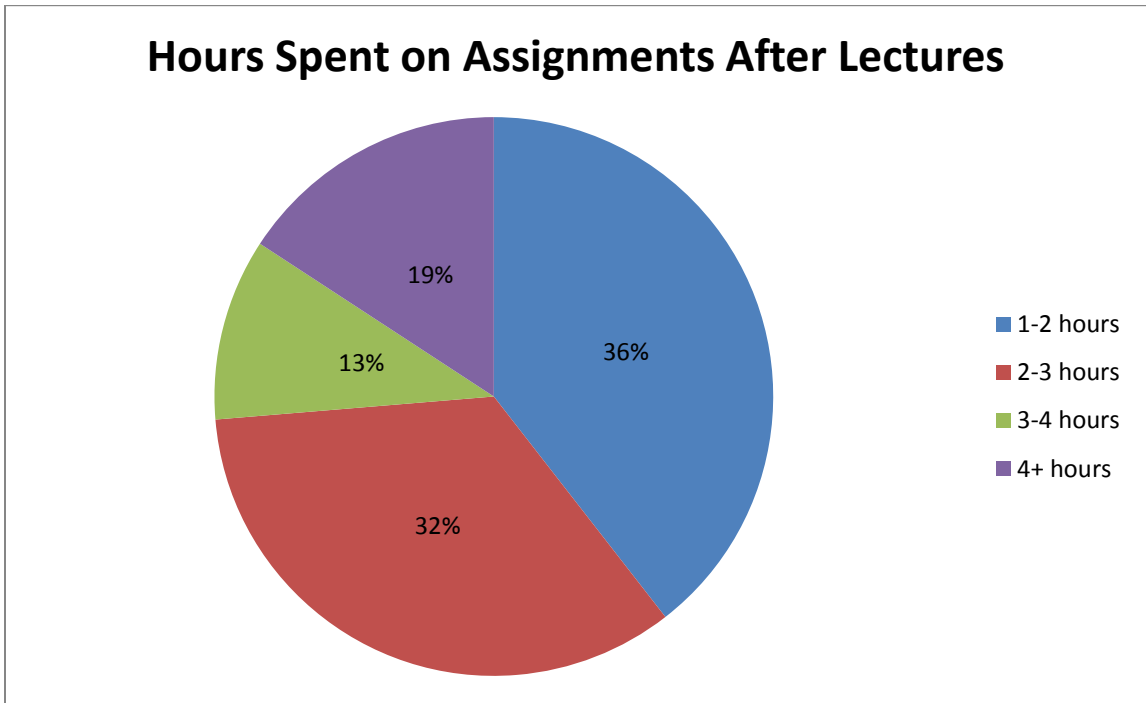
Figure 1. Responses to the Number of Hours Students Spent Working on Assignments
after Each Lecture. N = 41.

Research Question Two

      The second research question asked if online students utilized the online lectures

provided by the instructor from a seated class. Examining the responses of students on

the number of times they viewed individual lectures showed that 90.3% viewed the

lecture one or more times. Only 10% of the students reported they did not view the

lectures.   The category with the highest frequency was twice, followed by once. Figure

2 reviews the breakdown on the number of times online Math 3 Algebra I students

viewed the individual lectures.

Average Number of Times Lectures were Viewed
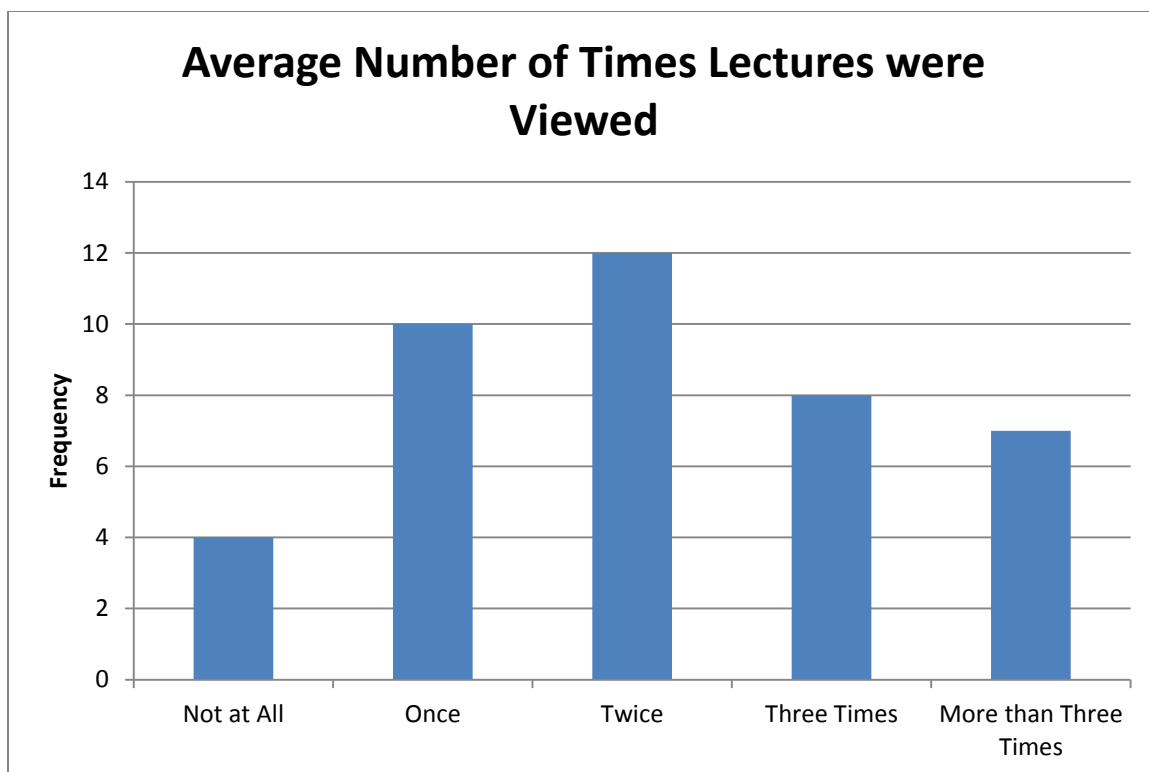
Figure 2. Responses to How Often Students Viewed Individual Lectures. N = 41.

The amount of time spent viewing individual lectures provided detailed information on the viewing practices of online Math 3 Algebra I students. The categories with the greatest frequencies included viewing the entire lecture and viewing 20-30 minutes of the lecture. Each lecture was approximately one hour in length. Cumulatively, 39.1% of the students viewed at least half of each lecture. While some students chose not to view the entire lecture, they may have viewed the lecture to refresh their skill base or to feel comfortable enough to work problems independently. Figure 3 presents the lecture viewing times in 10-minute intervals.
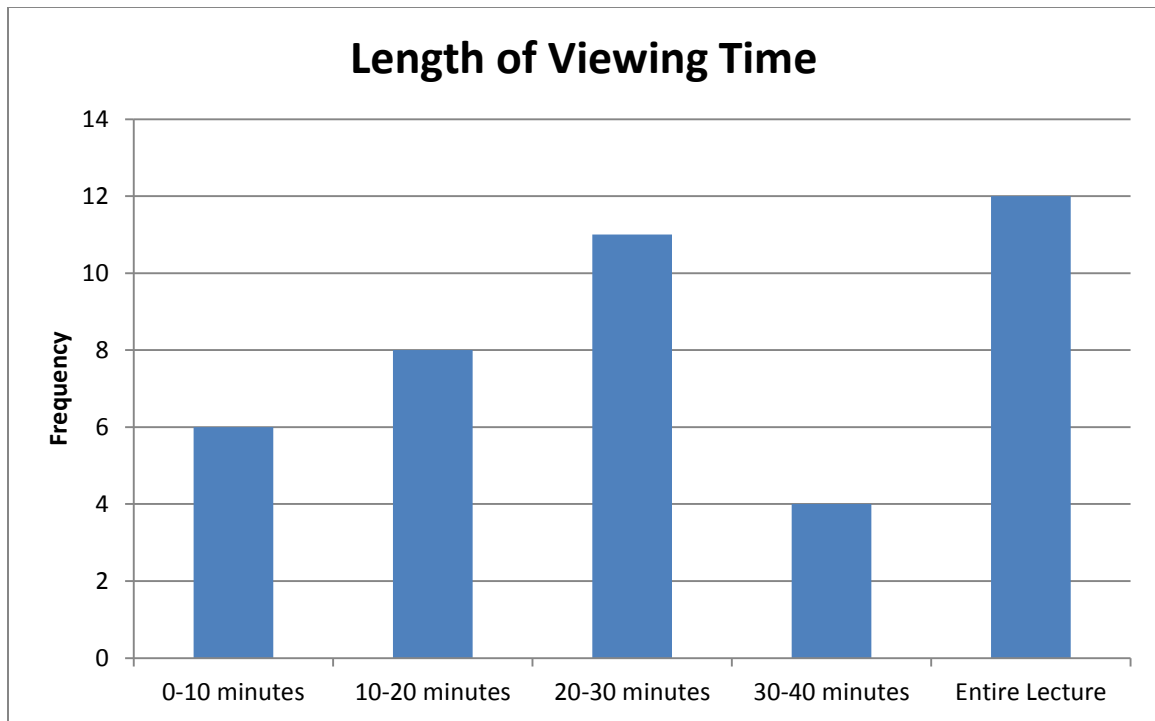
Figure 3. Responses to the Average Length of Time Spent Viewing Each Lecture. N = 41.

The service district of Valley View Community College covers 10 counties in the state, all of which are considered to be rural areas of the state. As a consequence, some students still have dial-up Internet service. In fact, 10 of the 41 students had dial-up, and 29 out of the 41 reported having high-speed Internet access. The two main campuses and the six other off-campus sites all have high-speed Internet. Moreover, it is important to note that an overwhelming number of students reported minimal Internet issues. The video lectures captured through Adobe Connect do now allow students to download the videos to their computers. This information shows most students did not experience issues while playing such large files and using the features of pause, rewind, and fast-forward. Figure 4 shows the type of Internet access participants had and the degree of issues they experienced when opening or viewing the lectures captured through Adobe Connect.

Technological Issues
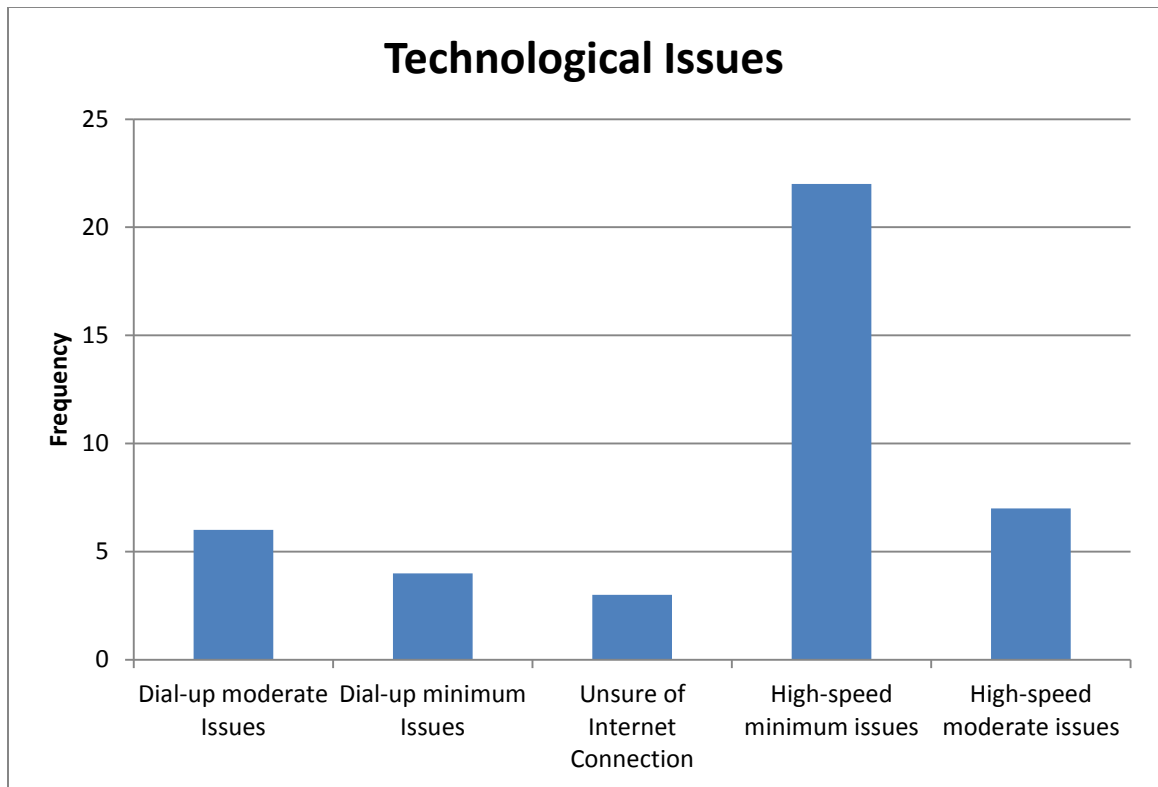
Figure 4. Responses to Viewing Experiences with Regard to Technological Issues. N = 41.

Research Question Three

The third research question asked if online students experienced satisfaction while completing the online math class. Several questions were combined together to answer this research question. With regard to the satisfaction level that students experienced while viewing the online lectures, 78% of the online Math 3 Algebra I students were satisfied or very satisfied with the online lectures, 17% were undecided on the issue, and 5% were very unsatisfied. Figure 5 displays the level of satisfaction students experienced while viewing the online lectures on a five-point Likert scale.
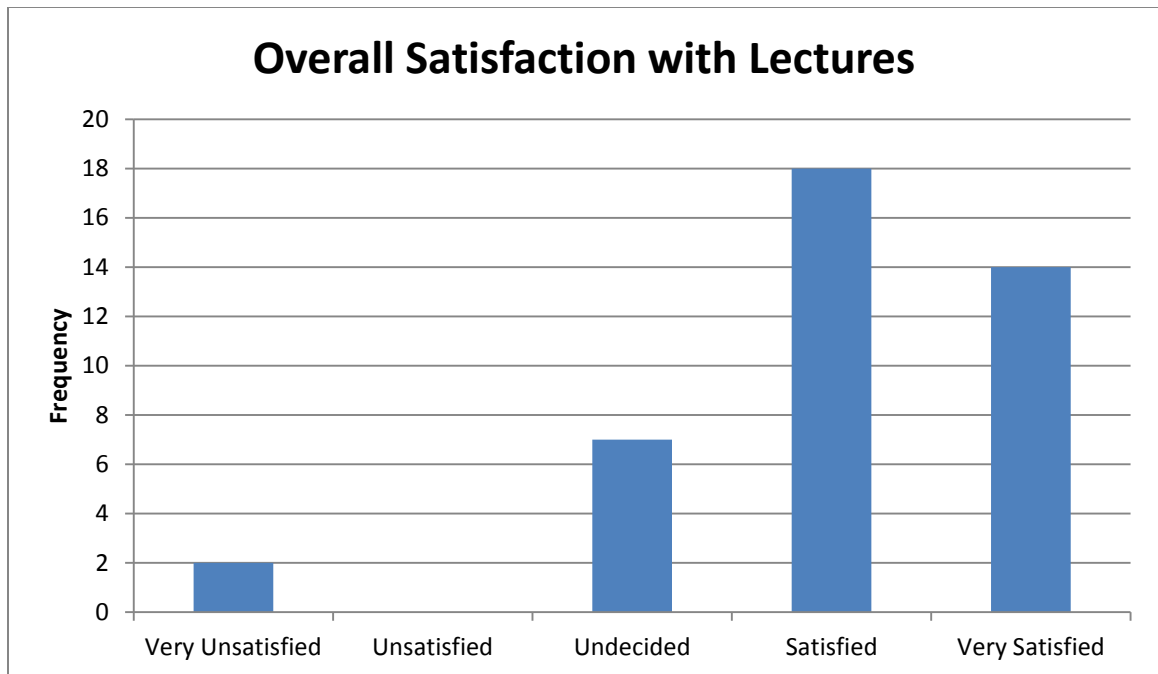
Figure 5. Responses to the Overall Satisfaction with Online Lectures. N = 41.

Developmental students oftentimes dislike being placed into a developmental mathematics class, especially when they have demonstrated they learned the material in high school through the earning of a verified mathematics credit. A verified mathematics credit means students passed the course with a satisfactory final average and passed the standardized test created by the state on the material. Responses to the question on their satisfaction with the overall class showed 39% of students were very satisfied, 36.6% were satisfied, 14.6% were undecided on the matter, 2.4% were unsatisfied, and 7.3% were very unsatisfied. Cumulatively, 75.6% were either satisfied or very satisfied with the online course. Figure 6 shows how the 41 participants responded in regard to overall satisfaction with the online course on a five-point Likert scale.

Overall Satisfaction with Class
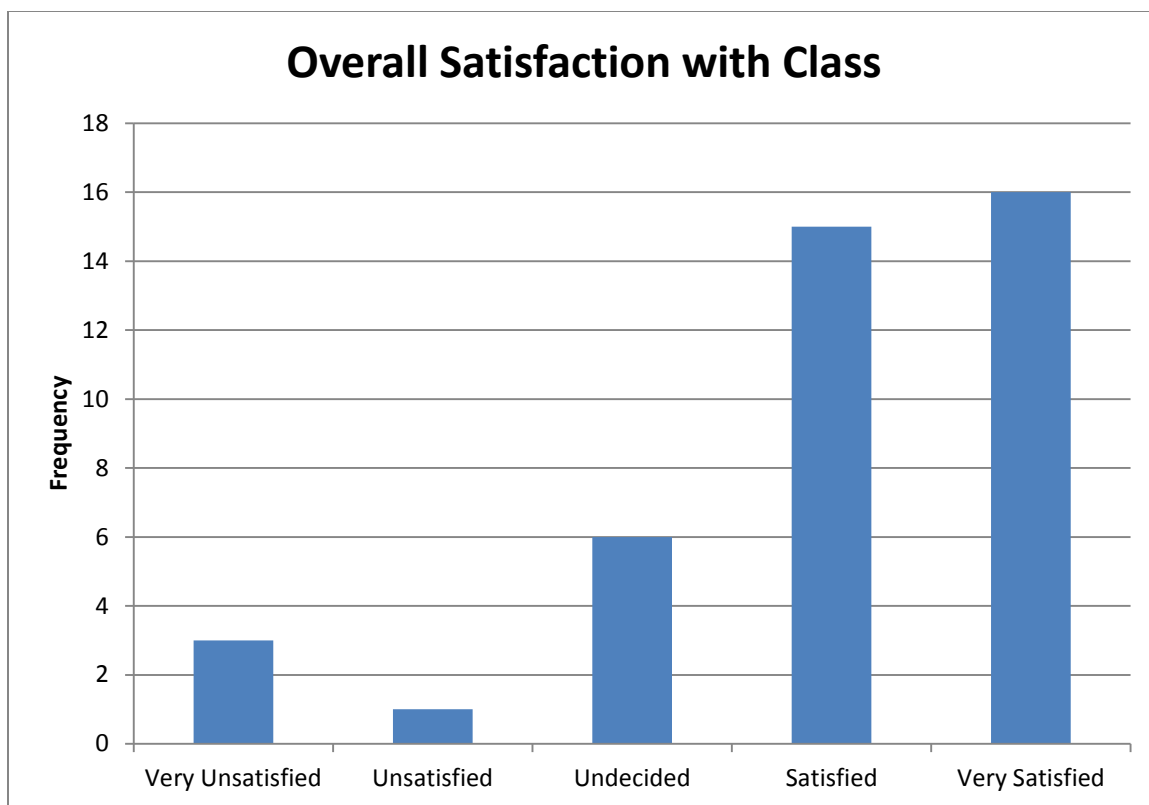
Figure 6. Responses to the Overall Satisfaction with the Online Class. N = 41.

Depending upon their individual program of study and desire to obtain more advanced degrees, the mathematics classes in which students enroll may vary. Some students need to complete Math 4 Algebra II, while others have met the mathematical requirements for their program or will be entering their first college-level course. The online Math 3 Algebra I students results showed 34.1% of students definitely would enroll in another online mathematics class, 26.8% would probably enroll in another online mathematic class, 22% were undecided, 26.8% probably would not enroll in another online mathematics class, and 2.4% would definitely not enroll in another online mathematics class. Cumulatively, 25 of the 41 students reported they would probably or definitely enroll in another online mathematics class. Figure 7 displays the responses to the likelihood students would enroll in another online mathematics class on a five-point Likert scale.
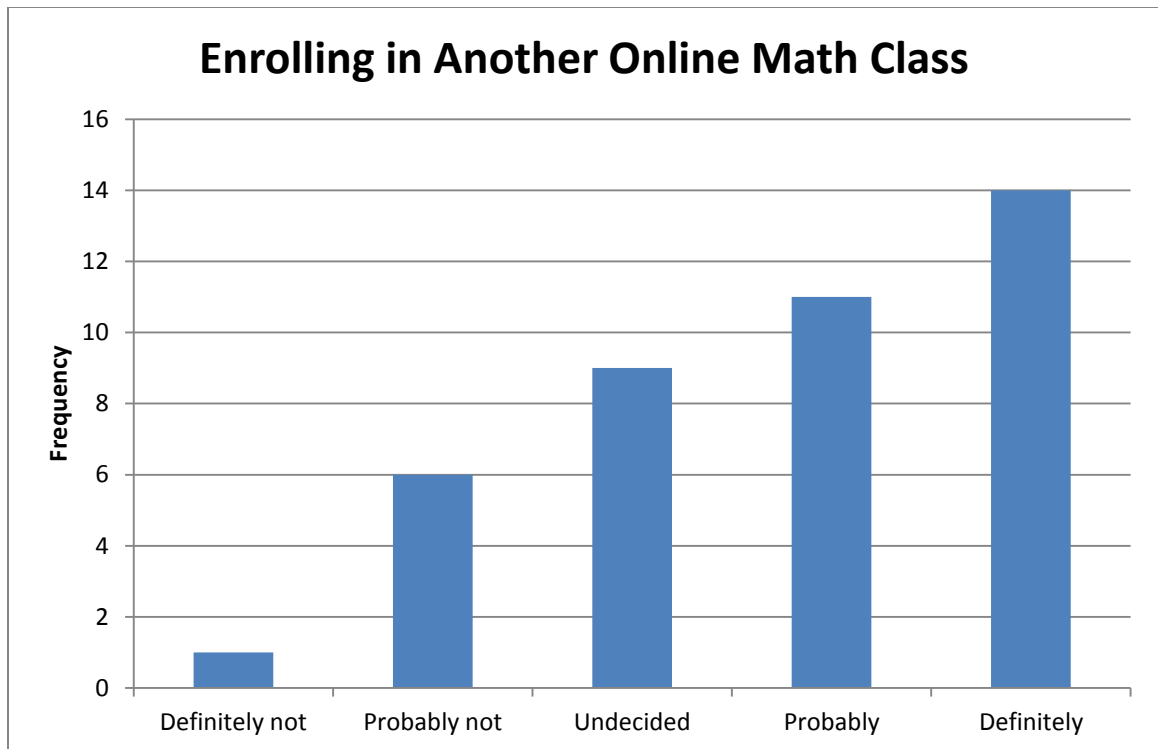
Figure 7. Responses to the Likelihood of Enrolling in another Online Math Class. N = 41.

At the conclusion of each semester and at the beginning of the enrollment for the subsequent semester, oftentimes students turn to their peers for advice about which class to enroll in and under which professors. Only 4.9% of students reported they would not recommend this course to other students, while 12.2% students were undecided on the matter, 29.2% of students probably would recommend the course to their peers, and 53.7% of students definitely would recommend the course to their peers. Cumulatively, 83% of students reported they probably would or definitely would recommend the course. Figure 8 depicts the likelihood students would recommend this course to their peers on a five-point Likert scale.
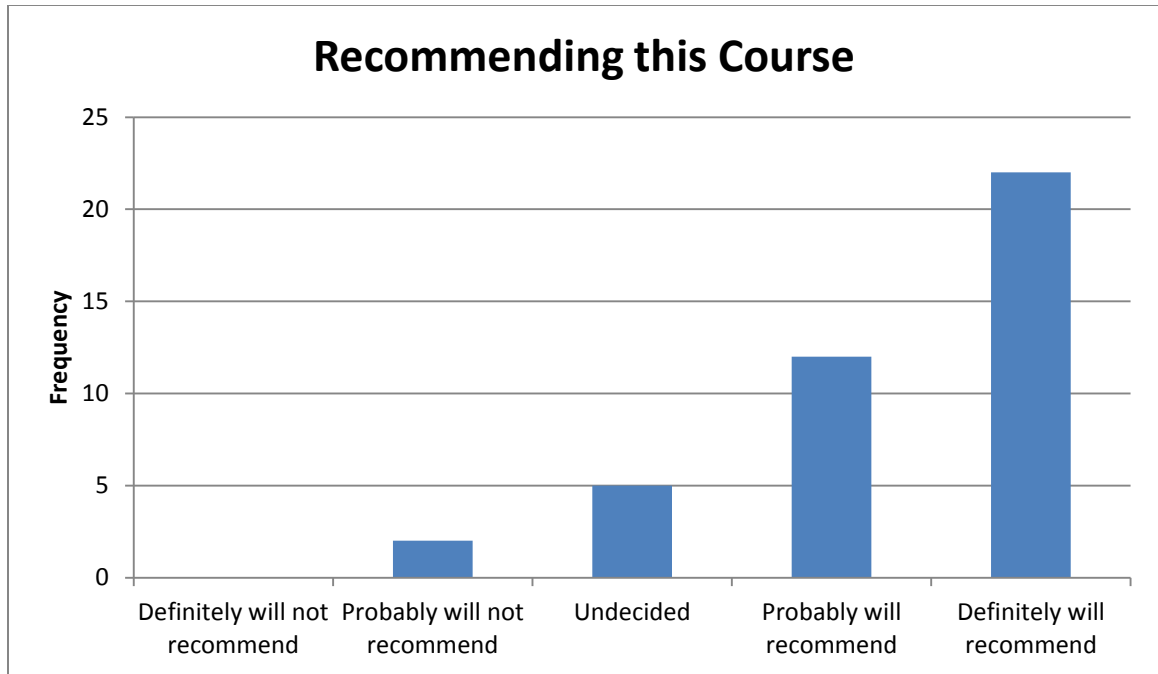
Figure 8. Responses to Likelihood of Recommending this Course to Other Students. N = 41.

Research Question Four

The last research question asked if developmental online students would recommend inclusion of seated lectures for this course and other online courses. While 9.8% of the participants would definitely enroll in another class where lectures from a seated course were provided and 39% of the participants would probably enroll in another class where lectures from a seated course were provided, 36.6% of the students were undecided, 9.8% would probably not enroll in another course in which lectures from seated courses were provided, and 4.9% of students would definitely not enroll in another course in which lectures from the seated courses were provided. Figure 9 displays the survey responses on a five-point Likert scale.
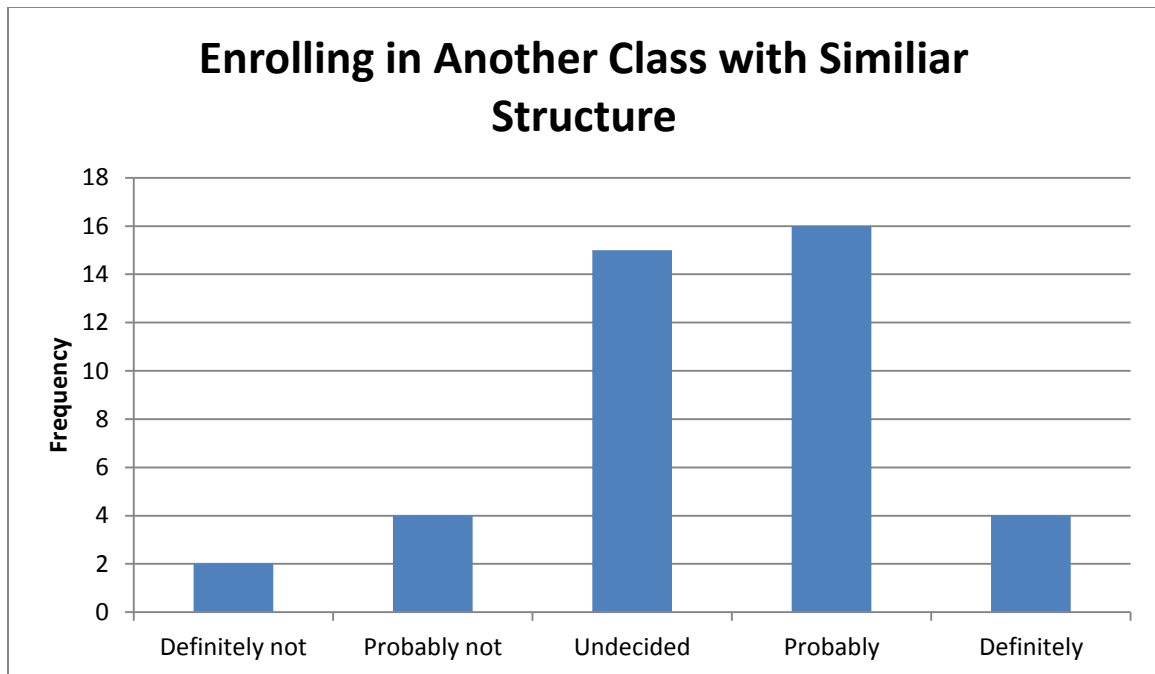
Figure 9. Reponses to How Likely Students are to Enroll in Another Online Math Class Where They Would Be Provided the Instruction from a Seated Class. N = 41.

Recording lectures can be costly to colleges, as colleges have to purchase servers to store the information, tablet PC's, and microphones for faculty members to capture the instruction, and provide significant group and individual training. Although the process that instructors undergo in order to capture the instruction is not difficult, compiling a list of lectures for an online class can be time consuming with the number of hyperlinks that must be inserted in an online course management system. As 39% of the responses indicated, students were undecided if the lectures made the class better and 34.1% of responses indicated the lectures made the class somewhat better, this technology may not meet their expectations for the course. Figure 10 presents results from the survey question that used a five-point Likert scale to determine the opinions of students on the effects of being provided the lectures online from a seated course.
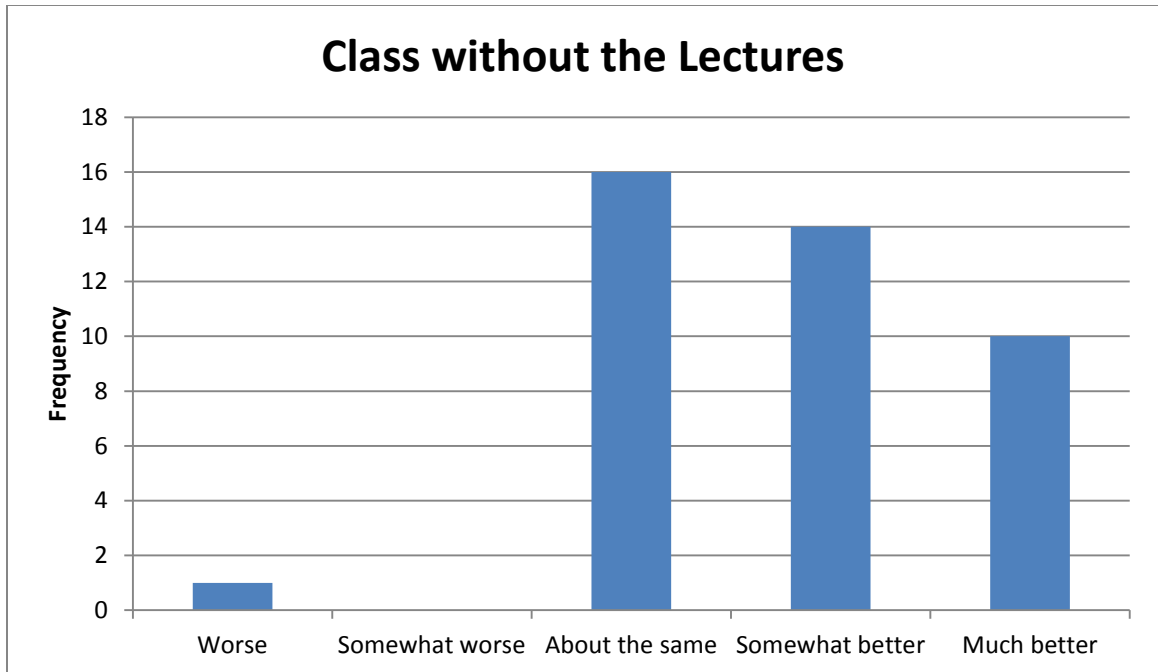
Figure 10. Responses to Compared to Having Taken This Class Without the Ability to Listen to the Lectures from a Seated Class. N = 41.

The last question on the survey was an open-ended question where students could verbalize their suggestions for improving the course. Fifteen participants provided comments on their first submission of the survey. Six of the survey responses gave no suggestions for improvement, as students made comments such as "None, this class was pretty easy to follow and keep up with;" "I have no recommendations. The lectures matched the curriculum in the book and I do not believe that my grades would differ much if any if I had been in a "seated" class; and "None. I thought the lectures were good and the tests and quizzes were fair."

One online student stated, "I would recommend that the students utilize all of the materials that are offered and make sure that they are comfortable with not having an actual teacher that you can have in front of you. Math is not a strong subject for me but this course was broken down so that it is easy to understand as long as you use the materials that are there for you."   Conversely some students did report issues as one

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student wrote, "Just for this class I would have taken the seated class instead. I think I would have done much better. Also do it when I was not pregnant and sick. This was not an issue with you at all. You are a great teacher." Another student wrote, "Some of the questions on the test should have somewhat of the same things in the book because it's very hard to take a test on something that isn't even in the book."

Summary

Understanding whether online Math 3 Algebra I students could achieve comparably based on posttest score results was the goal of this study. Reviewing the mean of 78.80 for the posttest scores of online students and the mean of 62.75 for the posttest scores of seated students revealed a large gap in the scores, with the online students outperforming the seated students. The Levene's test score of .062 signified the two groups did not have unequal variances. Although the *t*-test was not used due to the difference in the sample sizes of the control and experimental groups, the ANCOVA was used. Exploring the results of the ANCOVA and using the pretest as a covariate, the ANCOVA showed there was a significant difference between the mean posttest scores of online and seated students. Therefore, the null hypothesis of there being no difference in the posttest scores of online and seated Math 3 Algebra I students was rejected. In fact, it was clear the online Math 3 Algebra I students outperformed the seated students on the final teacher-made posttest when the pretest scores were used as a covariate.

The 41 online students who completed the survey showed overwhelmingly they were viewing the online lectures at least once, with most watching the entire lecture. Although most students reported using high speed Internet and experienced minimal technological issues, students seemed satisfied with their learning experiences to the

point of recommending the course to other students. Although most indicated that they

would take another mathematics class online, they were undecided if they would enroll in

another mathematics class that provided the lectures from a seated course.

CHAPTER FIVE: DISCUSSION

The purpose of this research was to determine if traditional teaching techniques were effective in an online community college learning environment. This was evaluated by comparing the pretest and posttest scores of students enrolled in Math 3 Algebra I in seated and online classes. Online students were asked to complete a survey on their viewing behaviors, satisfaction levels, and desire to enroll in another online mathematics class designed in the same manner.

Bailey et al. (2009) reported almost two-thirds of all community college students are flagged as needing developmental education in at least one subject with only a little over half of community college students enrolling in at least one developmental education class while attending college. In addition, with increases in the use of technology, rising fuel prices, and the continued demands of working adults, colleges are offering more online classes to meet the needs of learners. Together this creates the perfect recipe for community colleges to begin to offer developmental education courses online.

A review of the literature clearly depicts the dismal pass rates of students in developmental education classes (Bailey & Cho, 2010; Boylan, 2011; Fike & Fike, 2008; Milliron, 2010). Coupled with the high dropout rates of online learners, community colleges must identify and address best practices among online teaching and learning. Having students pass gate-keeper courses and enter college-level courses will assist community colleges in successfully meeting President Barack Obama's goal of increasing community college graduates by five million by 2015. This study examined

whether or not the use of traditional teaching techniques was effective in an online developmental mathematics learning environment.

Review of the Methodology

One of the initial phases of preparing students for college entry is to have them complete a placement test on campus to access their abilities in reading, writing, and math. Furthermore, students interested in taking online classes complete an additional assessment to determine if they possess the skill base to be successful online learners. Armed with this information, students next proceed to meet with counselors and advisors to determine a suitable first semester schedule. Optimally, these students would begin taking the prescribed sequence of developmental education courses within this first semester.

A quasi-experimental design was employed for this research due to the fact that some students were not candidates for online learning as determined through the READI assessment, and advisors assisted students with developing appropriate course schedules. Furthermore, this design was appropriate due to the sheer size of the service district and the pre-determined best environment for students to complete Math 3 Algebra I. Participants in this study were enrolled in a spring 2011 seated Math 3 Algebra I class that met at one of the many off-campus locations of the college on Mondays and Wednesdays from 4:00-6:00 p.m. (control Group A), an online Math 3 Algebra I class that had no requirement of campus attendance during the spring 2011 semester (experimental Group B), a seated Math 3 Algebra I class that met at one of the many off-campus locations of the college on Tuesdays and Thursdays from 8:00-11:50 a.m.

(control Group C), or an online Math 3 Algebra I class that had no requirement of campus attendance during the summer 2011 semester (experimental Group D).

The first assignment for all students required them to complete a 37-item multiple choice pretest generated by the full-time faculty members on the content of Math 3 Algebra I to ensure all students were accurately placed into the course and to collect data on the mathematical skill base of students prior to instruction. Boylan (2002) stated that no assessment instrument is foolproof and best practices among developmental education allow students the opportunity to challenge the results from placement tests. Students from the seated courses took their test proctored with the ability to use their calculator and scrap paper. Students from the online courses took their pretest online and were told to use their calculator and scrap paper as needed.

Over the duration of the two semesters this research was conducted, students from the seated courses attended class and were taught using traditional lecture methods on the first five chapters of the sixth edition of *Elementary and Intermediate Algebra: A Combined Course* by Larson and Hostetler (2010), and completed within Blackboard the assigned problems. Students in the online course followed a similar pace of instruction, as the online teacher had previously recorded his lectures from a seated class using Adobe Connect. Adobe Connect captured the screen image during the instructional process and in conjunction with a lapel microphone the audio from the lecture was recorded and saved onto a server housed on one of the main campuses of the college. At the beginning of the semester, the online instructor posted all of the lectures from the previous seated class into the online section's Blackboard shell. Students completed homework in Blackboard as prescribed by the instructor.

At the end of the semester, students were required to take an identical 37-item multiple-choice posttest to measure their achievement in the class. Again, seated students were required to take the test proctored on the last day of class and could use scrap paper and their calculator. Online students were allowed to complete their posttest online using their calculator and scrap paper as well. Yates and Beaudrie (2009) suggested that "online testing is a viable means of evaluating students and can be effectively used by faculty members who teach distance education courses" (p. 68).

While beyond the scope of this research, many Math 3 Algebra I students withdrew from the course prior to the deadline for withdrawing without academic penalty, stopped completing assignments after the withdrawal date, or did not complete the posttest. Hence, these data values were discarded prior to the statistical analysis.

Students in the online spring and summer Math 3 Algebra I classes were invited to answer a 16-question survey on their experiences while completing the course. With the research questions being precisely tailored to their online experiences, the researcher independently created the survey instrument. Moreover, the online instructor placed an announcement on Blackboard asking students to complete the survey one week prior to the end of the course to ensure students were nearing completion of the course. Twenty-one students completed the survey at the end of the spring 2011 semester and 20 completed the survey at the end of the summer 2011 semester. All 41 responses were used to calculate the Cronbach's Alpha score.

Summary of Findings

Research question one with null hypothesis: Scores–H_0. The null hypothesis stated there was no difference between the scores of students in the seated Math 3

Algebra I compared to the scores of students in the online Math 3 Algebra I. The ANCOVA analysis yielded a significant difference in the posttest scores of students in the seated Math 3 Algebra I classes compared to the online Math 3 Algebra I students when the pretest scores of the groups were used as a covariate; therefore, the null hypothesis was rejected.

Research question two: viewing. Research question two asked if online students utilized the online lectures provided by the instructor from a seated course. A total of 29.3% of students viewed each lecture in its entirety, 19.5% viewed 10-20 minutes of each lecture, 26.8% viewed 20-30 minutes of each lecture, and 9.8% viewed 30-40 minutes of each lecture. Only 14.6% of the students reported watching 0-10 minutes of the lectures. Cumulatively, 85.4% of the students reported watching 10 or more minutes of the instruction. Furthermore, students reported watching the lectures predominantly one or two times using high speed Internet and experienced minimal issues.

Research question three: satisfaction. Research question three asked if online students experienced satisfaction while completing the online math class. The survey showed 78% of online students reported being satisfied or very satisfied with the online lectures, 75.6% of online students reported being satisfied or very satisfied while completing the course, 60.9% of online students noted that they would probably or definitely enroll in another online mathematics class, and 80% of online students reported that they would probably or definitely recommend the course to other students.

Research question four: future. The fourth research question asked the developmental online students if they would recommend inclusion of seated lectures for this course and other online courses in the future. Results showed that 36.6% of students

were undecided about whether they would enroll in another mathematics class that provided lectures from seated classes, and 34.1% of students felt the online lectures made the class somewhat better. Hence, these data suggest that providing lectures from a seated course did not influence students' decisions to enroll in an online mathematics class; however, the lectures did tend to make the class somewhat better.

Discussion of Results

Prior to the statistical analysis, incomplete data had to be discarded in an effort to control for extreme outliers. Out of the 50 seated Math 3 Algebra I students, 12 did not complete the posttest and their pretest scores were thus discarded. In addition, out of the 61 online Math 3 Algebra I students, 10 students did not complete the posttest therefore their pretest scores were discarded. This equates to a 76% completion rate for seated students and an 84% completion rate for online students. This negates the findings of Jaggar and Xu (2010), which suggested that online students may be more prone to drop online courses than pursue assistance from their teacher or fellow classmates.

It is obvious with a posttest average of 62.75 for seated students and a posttest average of 78.80 for online students there was a difference in the posttest scores. The Levene's Test of Equality of Error Variances was used to ensure homogeneity of variances prior to running the ANCOVA. The ANCOVA of the pretest and posttest showed a significant difference in the posttest scores of the seated and online students, even when using the pretest scores of the two groups as a covariate.

Jaggars and Xu (2010) reported students' employment and/or child care responsibilities were determining factors in students choosing to enroll in online courses (p. 6). Qings and Akins (2005) noted students opt for online classes as a means in which

to find a happy medium between attending school, working, spending time with family, and developing relationships with people around the world (p. 55). This previous research may explain why 56.1% of the online students reported working full time. Fike and Fike (2008) performed research that suggested students may turn to distance learning options when they cannot locate classes they need at convenient sites with convenient times.

Question two of the survey asked students to report whether they had completed Algebra I in high school. According to the responses 39% of participants reported they did not take Algebra I in high school and 61% of participants reported they did take Algebra I in high school. The state in which this study was conducted implemented policies in the K-12 learning environment to state first-time ninth graders during the 2003-2004 school year seeking to earn a standard diploma were required to take three credits of mathematics classes to include Algebra I part A, Algebra I part B, and Geometry. Students were given the opportunity to take the end of course test after having completed the second part of Algebra I and Geometry in an attempt to earn the one verified credit in mathematics required for graduation. A verified credit is a credit in which the student has passed both the course and end of course test with a satisfactory score set by the state.

This policy has changed and now requires first-time ninth graders during the 2011-2012 school year and beyond who seek to earn a standard diploma to complete Algebra I, Algebra II, and Geometry to graduate. In addition, students will continue to be required to earn at least one verified math credit to graduate. Hence, it would be expected that all community college students in the future will have taken Algebra I in

high school. From the results of this study, some students either were older students and had graduated high school prior to the implementation of the Algebra I policy, or had earned a modified standard diploma and were not required to complete such rigorous mathematics graduation standards.

After further investigation of the 11 Standards of Learning of Algebra I as prescribed by the state in which this study was conducted, the researcher discovered that the course description for developmental Math 3 Algebra I through the community college system is not fully aligned with the state standards. The course description for developmental Math 3 Algebra I in the college's academic handbook simply states the course "covers the topics of Algebra I including real numbers, equations and inequalities, exponents, polynomials, Cartesian coordinate systems, rational expressions, and applications; and develops the mathematical proficiency necessary for selected curriculum entrance" (p. 156). In fact, the Standards of Learning of Algebra I that are not included in the course description for developmental Math 3 Algebra I included the following:

1.) SOL A.3 The student will express the square roots and cube roots of whole numbers and the square root of a monomial algebraic expression in simplest radical form.

2.) SOL A.4.E Solving systems of two linear equations in two variables algebraically and graphically.

3.) SOL A.4.F Solving real-world problems involving equations and systems of equations.

4.) SOL A.5.D Solving systems of inequalities

5.) SOL A.8 The student, given a situation in real-world context, will analyze a relation to determine whether or direct or inverse variation exists, and represent a direct variation algebraically and graphically and an inverse variation algebraically.

6.) SOL A.9 The student, given a set of data, will interpret variation in real-world contexts and calculate and interpret the mean absolute deviation, standard deviation, and z-scores.

7.) SOL A.10 The student will compare and contrast multiple univariate data sets, using box-and-whisker plots.

8.) SOL A.11 The student will collect and analyze data, determine the equation of the curve of best fit in order to make predictions, and solve real-world problems, using mathematical models. Mathematical models will include linear and quadratic functions.

Although, both the K-12 learning environment and community college learning environment include Algebra I classes in their mathematics curricula, they are not covering the same information. Haycock (2002) stated that there must be a coordinated effort between K-12 and higher education leaders to improve the overall mathematical achievement of students. In addition, Haycock stated the astonishing finding that one in four American elementary school students are considered to be proficient in mathematics, and the situation worsens with one in six American elementary students being proficient in mathematics at the high school level. Haycock investigated American classrooms and concluded that the United States covers more mathematical topics than other countries.

This obviously brings to the forefront the question of quality versus quantity of material taught in classrooms around the world.

Question three of the survey asked students to describe how they were placed into Math 3 Algebra I. Nearly 49% of students reported being placed directly into Math 3 Algebra I via either the ASSET or COMPASS placement test, 31.7% had successfully completed Math 2 Basic Arithmetic, and 19.5% of students were re-enrolling after a previous failed attempt. Boylan (2011) reported students who have failed a developmental course and are repeating the course an additional time fail at higher rates than students who are enrolling in the course for the first time, which in turn raises the question of how many times these students will re-enroll in the same developmental math course prior to dropping out of the college.

As suggested by the research of Petrides & Nodine (2005), colleges should survey their entire student body, including developmental students, on their knowledge of access to computers (p. 46). Over 51% of online students reported using high speed Internet, 43.9% of students used dial-up Internet, and 4.9 % of students used computers on one of the college campuses. According to Qing and Akins' (2005) myths of online learning, students do not need expensive equipment to enroll in online classes, as modem speed is not an issue when instructors use content that requires less bandwidth. Students can also easily access computers at local libraries or campuses of the college when they do not have a computer at home, which was the case for some students in this research.

Qing and Akins' (2005) first myth of online learning is the tendency of online instructors to simply copy and paste their seated courses into online courses. Instead, Qing and Akins suggested the need for online teachers to study e-pedagogy prior to

attempting to teach online courses. However, the online instructor in this study did simply copy and paste the previous instruction from a seated Math 3 Algebra I course into an online learning environment using traditional teaching pedagogy. In fact, 29.3% of students reported watching the entire online lecture from a seated class. On the other hand, 34.1% of students reported viewing between 0-20 minutes of the lecture.

The hardships of some online students' viewing capabilities using various forms of Internet access could keep them from utilizing the tools their instructors provide. Evans and Champion (2007) noted methods such as instructors capturing screen shots and adding verbiage-created documents that were often too large for dial-up users to download, as students may experience lockouts and shutdowns. In fact, Evans and Champion suggested online teachers use programs such as Camtasia that capture screen movements and PowerPoint presentations, and then compress the files onto a server which allows easy access among students with the worst of Internet connections. In the current study, 53.7% of students used high speed Internet and experienced minimal issues when viewing lectures the instructors captured using Abode Connect. Pagliari et al.'s. (2009) review of online faculty members with the North Carolina Community College system cited training with Camtasia, Centra, and voice-over PowerPoints as training they had received as a means of building their knowledge of best practices associated with online teaching and learning (p. 6).

Adobe Connect, the program that captured the instruction recorded for online learning in the current study is very similar to Camtasia, as both systems have the ability to capture screen movements and audio. Professors initially enter into a website to name the lecture, engage some form of microphone, and begin to record their screens. At the

end of the lecture, professors stop the recording device, access a database of their lectures, select and copy the hyperlink for the lecture, and post the link in the desired location within Blackboard. The server at the college retains the lectures and allows students to download the lecture at their convenience. However, students are unable to save the lecture to any device.

With regard to the overall satisfaction of students completing the course, 36.6% of students were satisfied and 39% of students were very satisfied while completing the online course. O'Dwyer et al. (2007) conducted a survey of eighth and ninth graders taking Algebra I online who reported similar findings, as 40.8% of online students had a satisfactory learning experience taking Algebra I online compared to 62.8 % of students in a traditional face-to-face learning environment (p. 300).   This can be surprising, as Smith et al. (2003) commented on the complexities teachers and students experienced while completing online mathematics classes, as Web-based learning environments do not have adequate support in place to teach mathematics. The videos provided the instructor with an effective way to write mathematical problems without the use of Equation Editor, but students may have been frustrated communicating the mathematical situation to the teacher.

Hastings' (2000) survey of online community college students at Monroe Community College stated 36.5% of students found that one of the greatest disadvantages of online classes was not being able to meet their professor and classmates. This disadvantage set aside, 82.8% of students in Hastings' study stated they would enroll in another online course. The findings of the current study were similar, as 60.9% of online students stated that they would probably or definitely enroll in another online math class.

When Chow and Shutters (2002) asked community college online math students whether they would enroll in another online math class they reported mixed results. Some participants indicated they would, due to the flexibility associated with online learning, while others encountered so many computer problems they responded no to the survey question. In the current study, there were only seven students who responded they would definitely not or probably not enroll in another online math class.

Hastings (2000) determined that online community college students ranked lectures from online classes as one of the best three learning activities within the course. However, the results of the current study suggested that the majority of online students were undecided as to whether they would enroll in another online math class in which they would be provided online lectures from the seated class to review. As the current study found that 34.1% of students thought the course was somewhat better by having the lectures provided from a seated course, this may lead researchers to believe online students do not truly value the lectures provided to them, or perhaps desired another form of multimedia instruction or wanted a more interactive approach. Hastings further determined that 8% of online learners ranked lectures as one of the least effective learning activities.

Having completed an online developmental mathematics class is a notable accomplishment, and knowing whether students recommended this course to others is treasured information for community college leaders. The current study found that 83% of students probably would or definitely would recommend the course to other community college students. This is surprising, as Chow and Shutters (2002) surveyed students and found them to make comments such as, "Only take them if you have great

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self-discipline and take advantage of all your resources;" "Don't wait until an assignment is due to start it;" and "Time discipline and allocation is essential" (p. 43). These comments may suggest that some online developmental math students would steer future online mathematics students away.

Much of the success found in developmental mathematics can be associated with student time spent on task. According to Hastings (2000), 72.8% of online community college students reported not having a scheduled time in which they worked on the assignments for online classes. This may suggest why 36.6% of online students in the current study spent between one and two hours working on homework. This is obviously not enough time to master content in preparation for college-level mathematics courses, when many instructors ask that students spend at least three hours working on assignments for each one-hour class meeting.

According to the survey responses from online students as to whether they received tutoring while completing the Math 3 Algebra I course, 75.6% reported not having received any tutoring services, 9.8% reported receiving tutoring less than 50% of the course, 2.4% reported receiving tutoring during 50% of the course, 7.3% reported receiving tutoring more than 50% of the course, and 4.9% reported having received tutoring during the entire course. Zavarella & Ignash (2009) conveyed the importance of making students in computer-based developmental mathematics classes aware of the importance of seeking tutoring early in a course, as well as the importance of instructors reiterating this over the duration of the course. Furthermore, Boylan (2002) referred to individualized tutoring as the key component to successful developmental programs. In the current study, mathematics tutoring was available at each of the eight community

college locations to those students who were recommended by their mathematics instructor, and who were currently taking college-level mathematics classes. This is considered to be best practice according to Boylan (2011), as it provides quality control.

The college where the current study occurred provides students the opportunity to seek free online tutoring from SmartThinking, which is an online tutoring service that connects students with highly qualified and well trained tutors in a variety of subject areas. Students can connect and interact live for a one-on-one tutoring session or submit individual questions and receive answers within 24 hours. The current study results revealed that a very small percentage of students requested tutoring, which aligns with the findings of Stillson and Nag (2009), who reported remedial algebra students enjoyed working at home on assignments without the assistance of formal tutoring.

Chow and Shutter (2002) reviewed the frustrations students experienced while completing an online mathematics course that had embedded video lectures. Complaints ranged from not being to read the lecture screen size, not being able to read numbers, and the media player being too slow. In the current study, the researcher noted many misspellings and grammatical errors on the written responses to the last open-ended survey question, suggesting that there may have been several students with developmental writing needs. Although there were no major complaints, one student wanted more examples and another student thought the test questions should have come from the textbook. Mathematics is not like other subjects, where students memorize definitions or dates; rather this field's ultimate goal is for students to be able to solve problems and apply the knowledge to real-world situations. Thus, students cannot simply memorize a set of problems with corresponding answers.

Limitations

This research was conducted at a rural, multi-campus community college that covered a large geographic area to include 10 cities and counties within the state. With over 50 locations within the service district offering courses through the college, many classes were not over-populated. This research used two online classes offered to everyone within the service district and two seated classes at one of the off-campus locations of the college. Findings could have been affected by the unique infrastructure of the individual counties, such as the high school graduation rates and broadband capabilities. Hence, the findings may not represent the entire community college system within the United States.

Due to the 4,200 square mile service district of this community college and the multitude of developmental math classes offered that were not filled to capacity, future researchers may want to examine the feasibility of conducting this research again in an environment capable of allowing for random assignment of participants into the control group and experimental group. Furthermore, with a larger, consistent sample size between the control group and experimental group, the statistical analysis could be completed using the family of *t*-tests and ANCOVA analysis. There was a large difference in the posttest scores of the seated and online developmental scores.

Reliability. The 37 multiple-choice question pretest and posttest were teacher-made using the test generator that accompanied the sixth edition of *Elementary and Intermediate Algebra: A Combined Course* by Larson and Hostetler (2010). Frisbie (1988) noted reliability scores of tests can vary between 0.0 and positive 1.0. Moreover, Frisbie (1988) suggested teacher-made tests usually have a reliability score of

approximately 0.50, while commercially prepared standardized tests have reliability scores of 0.90 (p. 25). The Cronbach's Alpha score for the 37 multiple-choice question assessment was .596. It should be noted scores of .9 or higher are considered excellent, .9 to .8 good, .8 to .7 acceptable, .7 to .6 questionable, .6 to .5 poor, and less than .5 unacceptable. The brevity of the assessment may have affected the reliability, but the full-time faculty members of Valley View Community College created a shorter assessment to ensure students could complete the assessment in the two-hour time frame requested by college administrators.

Threats to internal validity. Several factors affected the internal validity of this research. Although students in the control group and experimental group were required to complete the ASSET or COMPASS placement test and earn a score within the range deemed appropriate for MTH 3 Algebra I, or had previously passed MTH 2 Basic Arithmetic, the groups of students were not identical. The best that could be expected would be groups of a similar nature, which introduced a threat of selection bias.

In addition, the history of students in the control group and experimental group could have impacted the study. With the recent changes to the state requirements for high school graduation with a standard diploma, students would have had to have completed Algebra I. The experiences these students had in their past, whether successful or unsuccessful, may have impacted their work and experience in Math 3 Algebra I. Furthermore, some participants may have experienced success in high school mathematics classes and may have been using Math 3 Algebra I as a refresher course prior to entering into college-level mathematics. There were also students who had already completed the Math 3 Algebra I course, but had failed to achieve the required

75% average and may have continued to experience the pain and frustration of their previous failed attempt.

Participants were eliminated from the study due to attrition over the course of the spring and summer semesters. During the spring semester, there were 26 seated students in the Monday and Wednesday 4:00-6:00 p.m. class who completed the pretest. However, over the course of the 16-week semester, nine students stopped attending the seated class or failed to complete the posttest that also served as the final exam. During the summer semester, there were 24 students who were enrolled in the Tuesday and Thursday 8:00-11:50 a.m. seated class who completed the pretest. Over the 10-week semester three students stopped attending this seated class or did not complete the posttest.

With regard to the online students, there were 34 students during the spring 2011 semester who completed the pretest, with five who stopped completing work online or did not complete the posttest that additionally served as the final exam. In addition, during the summer semester 27 online students completed the pretest, with five students who stopped completing work online or did not complete the posttest that also served as the final exam. Hence, 12 seated pretest scores and 10 online pretest scores had to be discarded prior to completing the statistical analysis of the data.

This negates the findings of Ashby et al. (2011) who examined the completion rates of developmental math students taking Intermediate Algebra, as they reported that 93% of students in face-to-face classes completed the course, while 76% of online students completed the course. It was beyond the scope of this research to determine the

motivation for students either ceasing to produce work in the course or not completing the final exam.

The current study was heavily centered on testing and thus testing effect was a threat to internal validity. Participants in both the control group (seated classes) and experimental group (online classes) were required to take an identical teacher-made pretest and posttest at the beginning and end of the course. Although there were either 10 or 16 weeks between the time when students completed the pretest and when the instructor disabled the printing ability and ability for the online students to review their submission on the pretest and posttest, students may have remembered questions on the pretest, which may have ensured over the course of the class that they knew how to solve those particular problems.

In addition, the researcher searched many databases to find a survey instrument that would adequately address the research questions; however, no such instrument existed. Hence, the researcher created the 16-question survey independently. This affected the testing effect's aspect of internal validity, as these students knew that their viewing practices and opinions of the course were being tested.

Due to the small size of the community college where the study occurred, the instructor who taught the online math classes was not the same instructor for the seated classes. There was a finite number of math classes that could be taught by the 10 full-time community college math faculty members, and allowing one instructor to teach both the seated and online MTH 3 Algebra I both semesters was not a possibility. However, all full-time math faculty members used the same layout for the course syllabus and also administered the same pretest and posttest in order to standardize the learning process.

Threats to external validity. The instructor who recorded his lectures to upload onto Blackboard for his online students in future classes informed his seated students of the recording process. He wore a lapel microphone during instruction and would often have to rephrase questions during lectures to ensure that the online students could follow the process as he answered questions from the seated students. The seated students were given the ability to review the lectures that had been uploaded onto Blackboard. Students who had to miss class for one reason or another found it vitally important to review a missed lecture prior to the next face-to-face class meeting. These seated students were not part of the control group. This controlled for the John Henry effect, which refers to the instructor or students in the control group trying to outperform the experimental group (Sarersky, 1972).

All of the lectures from the seated classes were embedded into Blackboard as hyperlinks for the online students to view. The only difference in instruction was that the students in the online classes were not able to experience the non-verbal gestures made by the instructor, as Adobe Connect only captured the screen of the instructor. The recordings only captured the screen movements of the professor to ensure students could see problems clearly and completely, as recording lectures using a video setup would have potentially not allowed students to clearly see worked examples on the board.

The Hawthorne Effect may have been a slight threat to external validity as the online students would have known by the survey announcement in Blackboard that their performance was being evaluated. Thus this may have impacted their studying and performance on the posttest.

Lastly, the seated classes were offered at one of the community college's off-campus sites, therefore the student body was composed primarily of students from that geographic location. The online classes were offered to anyone in the 4,200 square mile service district of the community college and as a natural consequence the students were more geographically diverse. Hence, demographic characteristics could have impacted the scores on the pretest and posttest. Likewise, the abilities of the students in the cities and counties serviced by this particular community college may not represent the population of all community college students in the country, which limits the generalizability of the results. A much more extensive and diverse sample would be needed for such a study.

Shuttleworth (2009) suggested that pretest and posttest designs improve internal validity at the expense of external validity. The current study did not have a third group of students who did not receive treatment with which to compare the online and seated class's pretest and posttest scores. It would have been unethical to deny students the opportunity to take developmental classes, as the research shows these students experience higher failure rates.

Implications

One of the goals of President Barack Obama for community colleges is to increase the number of graduates at community colleges by five million by 2015. It has already been shown that students are entering college with an inadequate skill base to immediately begin college-level work, and the demand for developmental education will likely not decrease with expanded enrollment. While many researchers and educators

question whether developmental education should be offered online without concrete e-pedagogy, research must continue to find best practices for effective online instruction.

After comparing the pretest and posttest scores of two online and two seated classes, there was a difference in the posttest scores even when the pretest scores were used as a covariate. Moreover, the online students scored significantly higher than the seated students. Thus, this study adds to the body of literature that suggests that online teaching and learning can be effective, even at the community college remedial education level.

With rapid changes in technology, online instructors must attempt to find effective instructional methods, although at times these may involve trial and error. This research specifically used Adobe Connect, which is a program that records the screens of instructors. These can include the use of PowerPoint slides or writing with a stylus, and when coupled with the use of a lapel microphone, can capture audio simultaneously. The lectures are then stored on a server and generate a hyperlink that instructors can easily share with students. The current research showed that online students did watch the lectures provided to them by their online instructor, as 90.2% of students reported watching the lectures one or more times. Some watched the entire lecture and some watched a small portion of the lecture. With only 29.3% watching the entire lecture, 46.3% of the students watched between 10 and 30 minutes of the hour-long lectures.

Lastly with the multitude of underprepared students entering higher education learning environments, it would seem that initiatives should be underway to align the K-12 curriculum with the college curriculum. This is clearly a large undertaking that would require joint effort between many institutions.

Recommendations for Future Research and Practice

Due to poor success rates of developmental math students and the need to increase student enrollment in college-level courses, many colleges have implemented redesigns of their developmental classes. The community college system where this research was collected developed teams of math and English faculty members to redesign both remedial math and English courses. Starting with the spring 2012 semester, this community college system no longer offered Math 2 Basic Arithmetic, Math 3 Algebra I, or Math 4 Algebra II. Instead, these courses were divided into nine Math Essentials course modules (MTE) with the goal of allowing the student body to expedite their journey through developmental courses and enroll in college-level courses.

The community college system where this study took place worked with McCann testing to create a seamless computer adaptive test to measure the prior knowledge of incoming and current mathematics students. Although the test was seamless as it was delivered to the students, there were multiple phases going on behind the scenes. Students were initially given the most basic questions. If the students did not complete those questions to a certain level, they were placed into a diagnostic test that would measure their needs with regard to placement into MTE 1-5. If students were successful on the first battery of tests, they moved into a second section of questions on MTE 6-9. If they passed those questions with a significant score, they were deemed not to need any developmental math coursework. If they did not score sufficiently during that testing phase, the test moved them into a diagnostic test on MTE 6-9. The hope of the new placement test was to isolate and pinpoint the strengths and weaknesses of the students. Bailey (2009) warned that students who have the same placement test scores do not

necessarily have the same skill sets, and placement tests should be reassessed (p. 3).

When a new placement test is implemented, there must be research conducted to ensure

that the new placement test adequately measures and places students into the correct

MTE courses.

It was the ultimate desire of the community college leaders for students to

complete all developmental math requirements within one year. Bailey et al. (2009)

recommended accelerating the remedial process to lessen the frustrations of students in

developmental education (p. 27). The community college system suggested that MTE

courses be run within three and five weeks. Most community colleges within the state

offered MTE courses on a four-week interval, which allowed time for students to

complete a pretest on the module, complete the homework and quizzes over a three-week

period, and complete the final posttest during the fourth week. It was dictated that

students be given a maximum of three attempts on the final posttest to earn at least a

score of 75 or higher. Students who passed the final posttest were allowed to advance to

the next prescribed MTE course. However, students who failed to meet the benchmark

on the posttest were required to immediately enroll in the same MTE course during the

next four weeks. Researchers could study the correlation between the number of weeks

the courses are offered and the percentage of students who are able to pass the posttest.

Studies could also examine the average length of time students spend with developmental

mathematics courses prior to enrolling in college-level courses. More importantly,

studies could examine the success rate of developmental students in college-level courses

who have previously taken MTE courses compared to students who did not need

developmental classes or completed Math 2, Math 3, and/or Math 4.

The community college system in this study did not dictate the media in which instruction could occur, but Boylan (2002) stated that best practices among colleges include offering as many different teaching methods as possible to accommodate the needs of the student body (p. 71). Some community colleges in the state were large enough to offer sections of face-to-face learning, online learning, hybrid learning, and emporium models, all within the same semester. Hybrid models of instruction blend face-to-face instruction with online learning, while emporium models offer on-demand tutoring and small group instruction in a less structured environment. Zhu & Polianskaia (2007) conveyed the importance of having a variety of options for students enrolled in high-risk courses (p. 70). Smaller colleges with a limited student body have had to make decisions on what type(s) of learning models would best suit their students.

The community college in which this research was conducted initially chose to implement hybrid learning, with students coming to campus one day a week for one hour and 20 minutes, and then requiring most of the work to be completed at home or in the lab setting for those students who chose to attend. However, as of fall 2012 this college has chosen to implement a complete emporium model in which students complete the work at home or in the tutoring lab that will be staffed with college instructors, work-study students, and professional tutors. Hodges (2009) tracked the performance of seven students taking a math class utilizing the emporium model to find that many felt successful after completing the course by making comments such as, "I feel that I am able to learn in different settings," and "I'm not afraid to teach a class to myself anymore" (p. 236). Conversely, Hodges reported this learning format may not be for students who perceive courses to be difficult. In fact, Boylan (2002) reported instructors

who used the computer to provide the majority of instruction saw far higher failure rates than instructors who used the computer to supplement instruction.

Squires, Faulkner, and Hite (2009) researched the effectiveness of a redesign at Cleveland State Community College who implemented a redesign of three developmental math classes and three college-level math classes. Each course contained 10 to 12 modules and students were required to complete at least one module per week. Students viewed a short instructional video, completed homework, and passed a quiz on each module. This process ensured continuous assessment. Having experienced a pass rate of 54% before the redesign, the redesign brought about great changes to the college, as students who completed the redesigned courses experienced success rates of 72%. In addition, the college implemented a continuous enrollment plan in which students who completed modules early could continue on at their own pace and begin the subsequent class. This created the one-room school house which resolved the problem of low enrollment courses and the increased need for course offerings. Hence, future research could be conducted on the optimum learning environment for community colleges based on their specific enrollment and demographic characteristics. In addition, research could be conducted on the continuous enrollment concepts at community colleges and the costs associated with the changes.

Bassett and Frost (2010) investigated the math redesign at Jackson State Community College that forewent the "one size fills all" model and transitioned to the SMART (Survive, Master, Achieve, Review, and Transfer) initiative that focused on student success. This redesign initially reviewed which modules were needed for chosen career paths in the college, which resulted in the number of programs needing all

modules from 41 programs down to seven programs (p. 870). Students within the modules were required to complete online homework using MyMathLabsPlus and earn a minimum score of 80% on each assignment, and as a deciding factor for passing the module students had to score at least 75% on the final exam (p. 871). With the MyMathLabPlus program grading all assignments, faculty members were required to dedicate more time to assisting students in the SMART math lab. Costs were reduced, as full-time faculty members previously taught 78% of the developmental classes and the redesign reduced the sections taught down to 58% (Bassett & Frost, 2010). Reviewing scores from previous semesters, the college experienced a 42% pass rate in developmental math classes prior to the redesign and the semesters in which the redesign was studied saw pass rates soar to 54%, 57%, 59%, and 60%. The grading policies of this research are identical to the new grading policies of the community college in which this research was conducted once the redesign becomes effective in fall 2012. Future research could examine the cut-off scores for homework, quizzes, and tests and their overall effectiveness on student achievement.

During Boylan's (2011) interview with Paul Nolting, Nolting suggested schools eliminate costly math textbooks and insist publishers use technology to offer such materials. Although not dictated by the community college system, most all of the 23 community colleges within the state where this research was conducted elected to use either MyMathLab or MyLabsPlus as a course supplement, and to use Elayn Martin-Gay's *Math Essentials* textbook that was correlated to the new nine math essentials modules. With the MyMathLab program, students had the option of purchasing the textbook and code, or the stand-alone code with an e-book. Future research could also

examine the behaviors and textbook preferences of all developmental mathematics students.

Kodippill & Senaratne (2007) asked the question whether computer-generated interactive homework generated from the MyMathLab software package was more effective than traditional instructor graded homework. Although by examining the results of 72 students enrolled in college algebra their research did not show a statistically significant difference between the two groups, their results did suggest the benefits of using MyMathLab. MyMathLab presents students with a question and three opportunities to correctly answer the question before marking it wrong. Students can accept that they missed the question or can request a similar problem and be allowed three more attempts. Teachers using MyMathLab reported having significantly more time to devote to assisting students, spending less time grading assignments, and that students could maintain the pace of learning more suitable for their individual needs. Future research could examine the effectiveness of MyMathLab.

With the new redesign, all subsequent college-level mathematics courses were evaluated to determine the minimum MTE needed to master the course objectives of each course. Boylan (2011) suggested that colleges need to undergo this process and specifically identify the developmental skills needed for each college-level course. In fact, some majors require other mathematics courses instead of college algebra. For instance, nursing students would benefit more from a statistics course that would prepare them to read and comprehend studies on various medical procedures or therapies. Future research could be conducted to ensure that the new prerequisites for college-level courses yielded more positive pass rates.

For community colleges who offered MTE courses online, future research could be conducted to examine the pass rate of the students compared to the success rate of students taking the courses through other media. Similar to the current study, future researchers could have faculty members record the lectures from seated MTE courses and include the lectures in the MTE courses offered online. A comparison of each group's pretest and posttest scores would yield important information about the new abbreviated learning in MTE courses. Furthermore, Jaggars and Xu (2010) suggested students who completed online coursework at the beginning of their academic endeavors were less likely to complete their studies and transfer to a four-year institution. It would take several years to collect data to answer this question.

With regard to the pretest/posttest instrument used in the current study, future research could be done to test the internal consistency of the instrument. The low Cronbach's Alpha score could be attributed to the small number of questions and/or the low number of responses. A larger sample size of 100 or more may produce a higher value. Due to the discontinuation of Math 3 Algebra I, further validity research with the community college in this study was not feasible.

Summary

The purpose of this study was to contribute to the body of knowledge with regard to teaching and learning developmental Algebra I online. The results of the ANCOVA suggest that online students outperformed seated students when comparing their pretest and posttest scores. However, a larger study with more control over the group could yield different findings. Moreover, data from the survey suggested that the online

students did watch the lectures provided by their instructor as a source of knowledge, but they were not convinced that this is the best instructional technique.

The community college system in which this research was conducted has undergone a redesign; therefore replicating this identical study is now no longer feasible. However, the researcher has made multiple suggestions for future research within the community college system. Online education is still in its infancy and e-pedagogy has not been distinctively defined. All research studies on the topic will continue to add to the body of knowledge on the subject.

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APPENDIX A: PERMISSION LETTER FROM THE COLLEGE

January 18, 2011

Institutional Review Board

Campus North Suite 1582

1971 University Blvd.

Lynchburg, VA 24502

Dear Institutional Review Board:

In November of 2009, Christy Lowery-Carter requested to collect data from students enrolled in Math 3 Algebra I, at deleted. President, deleted, granted her permission to collect this data.

Mrs. Lowery-Carter will collect student data for the spring, summer, and fall 2011 semesters. This data will consist of pretest/posttest scores and surveys and her research will not impede with the teaching and learning of the students. Furthermore, participation will be voluntary from the students and their participation will not affect their grade. The college requested that students not be identified and that the collect remain anonymous in her dissertation.

If there are additional questions, please contact me by email at deleted, by telephone at deleted, or by mail at deleted.

Sincerely,

Dean of Planning and

Institutional Effectiveness

APPENDIX B: SURVEY

Which best describes your employment status while enrolling in Math 3?

> None
> Part-time
> Full-time

Did you complete Algebra I in high school?
> No
> Yes

How were you placed into this course?
> Successfully completed Math 2 Basic Arithmetic
> Directly placed in this course through the Asset or Compass placement test
> Re-enrolling in Math 3 Algebra I

Which best describes your computer access?
> Used a computer/Internet at one of the campuses of the college
> Used my personal computer at home with dial-up Internet service
> Used my computer at home with high-speed Internet service

On average, how often did you view individual lectures?
> Not at all
> Once
> Twice
> Three times
> More than three times

On average, which best describes the length of time you viewed the individual lectures?
> 0-10 minutes
> 10-20 minutes
> 20-30 minutes
> 30-40 minutes
> The entire lecture

Overall, how satisfied were you with the online lectures?
> Very unsatisfied
> Unsatisfied
> Undecided
> Satisfied
> Very Satisfied

Which best describes your viewing experience with regards to technical issues while accessing the online lectures?

        Dial-up moderate issues
        Dial-up minimum issues
        Unsure of Internet connection
        High-speed minimum issues
        High-speed moderate issues

Overall, how satisfied were you with the class?

        Very unsatisfied
        Unsatisfied
        Undecided
        Satisfied
        Very Satisfied

How likely are you to enroll in another online math class?

        Definitely not
        Probably not
        Undecided
        Probably
        Definitely

How likely are you to enroll in another online math class where you would be provided the instruction from a seated class?

Definitely not
        Probably not
        Undecided
        Probably
        Definitely

Compared to having taken this class without the ability to listen to the lecture from the seated class, would you say that being provided the lecture from the seated was

        Worse
        Somewhat worse
        About the same
        Somewhat better
        Much better

How likely are you to recommend this course to other SVCC students?

        Definitely will not recommend
        Probably will not recommend
        Undecided
        Probably will recommend
        Definitely will recommend

Which best describes the number of hours you spent working on your assignments after each class meeting/lecture?

0-1

1-2

2-3

3-4

4+

Did you receive tutoring services through the college?

Yes, throughout the entire course

Yes, more than 50% of the length of the course

Yes, 50% of the length of the course

Yes, less than 50% of the length of the course

No, I received no tutoring services

What recommendations would you offer to improve this online class?

APPENDIX C: PRETEST/POSTTEST

1. Simplify

    $5\frac{1}{2} \times \frac{2}{7}$

    A) $5\frac{11}{14}$

    B) $\frac{1}{2}$

    C) $1\frac{4}{7}$

    D) None of these

2. Simplify

    $\frac{4}{7} \div 28$

    A) $\frac{1}{49}$

    B) 1

    C) $\frac{1}{16}$

    D) None of these

3. Solve

    $\frac{4}{5} - \frac{1}{9}$

    A) $\frac{1}{15}$

    B) $\frac{31}{45}$

    C) $\frac{41}{45}$

    D) None of these

4. Simplify

$2(21 - 9 + 6)$

A) 32

B) 12

C) 36

D) 34

5. Evaluate $2x^2 + 2x - 3$ when x = -6

A) 57

B) -39

C) -57

D) 39

6. Simplify

$-6b + 13 a - 2b + 7a$

A) 7a + 5b

B) a + 11b

C) 20a - 8b

D) 91a + 12b

7. Simplify

$-8(x + 8) + 7x$

A) -x + 64

B) -x - 64

C) -x + 8

D) 15x - 64

8. Simplify

   $9(x + 10) - 2(x - 12)$

   A) $11x + 66$

   B) $7x + 66$

   C) $7x + 114$

   D) $11x + 114$

9. Simplify

   $-2[4x + 5(9 - x)]$

   A) $-x - 90$

   B) $2x - 90$

   C) $-x - 2$

   D) $2x + 2$

10. What Property is illustrated by the fact that $v \times 1 = v$

   A) Commutative Property for Multiplication

   B) Distributive Property

   C) Associative Property for Multiplication

   D) Identity Property for Multiplication

11. Translate into an equation.

   The sum of four times a number and fifteen is negative one.

   A) $4x - 1 = 15$

   B) $4x + 15 = -1$

C) x + 60 = -1

D) -1x × 4 = 15

12. Solve.

   2x + 9 = x + 7

   A) 2

   B) -1/2

   C) ½

   D) -2

13. Solve.

   $2 = 3(x - 2) + 1 - 2x$

   A) 9

   B) 3

   C) 5

   D) 7

14. Solve

   $$\frac{2}{x} = \frac{10}{30}$$

   A) 11

   B) 9

   C) 6

   D) 5

15. Find 26% as a decimal.

   A) 0.026

B) 0.0026

C) 2.6

D) 0.26

16. Find 2.5 as a percent.

A) 0.025%

B) 25%

C) 250%

D) 0.25%

17. What is 90% of 30?

A) 2.715

B) 27

C) 27.15

D) 271.5

18. Express the ratio as a unit rate.

$2.60 for 20 ounces of popcorn

A) $1.30 per oz

B) $0.80 per oz

C) $0.13 per oz

D) $0.52 per oz

19. Covert 63° Celsius to Fahrenheit

A) 55.8

B) 67.0

C) 17.2

D) 145.4

20. Solve

$|3x − 3| = |6x + 8|$

A) $\frac{3}{11}, \frac{9}{5}$

B) $\frac{-11}{3}, \frac{-5}{9}$

C) $\frac{11}{3}, \frac{5}{9}$

D) $\frac{-3}{11}, \frac{-9}{5}$

21. Solve.

$\frac{x}{5} < 7$

A) $x < 12$

B) $x < 35$

C) $x > 35$

D) None of these

22. Solve the inequality

$-4 < -2x − 10 < 8$

A) $-9 < x < -3$

B) $6 < x < 18$

C) $18 < x < 6$

D) $-3 < x < -9$

23. Find f(-3) given that f(x) = 2x + 1

    A) -6

    B) 19

    C) -7

    D) -5

24. The cost of renting a car is given by the formula C = 50n + 0.15d, where C is the cost in

dollars, and n is the number of days the car is rented, and d is the distance driven in kilometers.

How much would you budget to rent a car for a 7-day trip, if you plan to drive 425 kilometers

each day?

    A) $6725.00

    B) $896.25

    C) $6726.00

    D) $796.25

25. Find the domain of the relation {(1,0), (3, -1), (2, -5)}

    A) {0, 1, 5}

    B) {1, 3, 2}

    C) {0, -1, -5}

    D) {-1, -3, -2}

26. Find the domain and range, then determine whether the relation is a function.

    {(-4, 4), (-3, 4), (-5, 6), (-2, 2)}

    A) D = {-5, -4, -3, -2} R = {2, 4, 6} yes

    B) D = {2, 4, 6} and R = {-5, -4, -3, -2} yes

C) D = {2, 4, 6} and R = {-5, -4, -3, -2} no

D) D = {-5, -4, -3, -2} R = {2, 4, 6} no

27. Find the slope of the line going through the points (-4, 5) and (-1, 7)

A) $\frac{3}{2}$

B) $\frac{8}{9}$

C) $\frac{2}{3}$

D) $\frac{9}{8}$

28. Find the equation in slope intercept form, of the following.

-6x + 9y = 72

A) 9y = 6x + 72

B) x = 2/3y + 8

C) y = 2/3 x + 8

D) x = 8y + 2/3

29. Find the point-slope form of an equation of the line that passes through the given points and have the given slope. (4, -7) and m = -4

A) y + 4 = -4 (x − 7)

B) y − 4 = -4 (x + 7)

C) y − 7 = -4 (x + 4)

D) y + 7 = -4 (x − 4)

30. Simplify $(-4xy^3)(4xy^4)$

A) $16x^2y^7$

B) $-16xy^{12}$

C) $16xy^4$

D) $-16x^2y^7$

31. Simplify

$\dfrac{56x^4y^4}{8x^3y}$

A) $56xy$

B) $7x^7y^5$

C) $7xy^3$

D) $\dfrac{1}{7xy^3}$

32. Simplify

$(8x^5y^2)(3xy^4)^2$

A) $48x^7y^{10}$

B) $72x^7y^{18}$

C) $24x^7y^{10}$

D) $72x^7y^{10}$

33. Simplify

$\dfrac{7a^{-3}b^{-4}}{49a^9b^{-7}}$

A) $\dfrac{7a^{12}}{b^{-3}}$

B) $\dfrac{7a^{12}}{b^{-3}}$

C) $\dfrac{b^{-3}}{7a^{12}}$

D) $\dfrac{b^3}{7a^{12}}$

34. Simplify $(4x^3 + 5x) - (-3x + 4 - 8x^3)$

   A) $12x^3 + 8x - 4$

   B) $7x^3 - 3x + 4$

   C) $-4x^3 - 8x - 4$

   D) $-4x^3 + 2x + 4$

35. Simplify

   $(7x - 8)(7x - 7)$

   A) $49x^2 - 105x + 56$

   B) $49x^2 + 104x + 56$

   C) $49x^2 + 7x - 57$

   D) $39x^2 - 105x - 57$

36. Simplify

   $(q + 8)^2$

   A) $q^2 - 16q + 64$

   B) $q^2 - 64$

   C) $q^2 + 16q + 64$

   D) $q^2 + 64$

37. Simplify

 $(y + 3)(y^2 - 8y + 6)$

A) $y^3 + 5y^2 + 18y + 18$

B) $y^3 - 5y^2 + 18$

C) $y^3 - 5y^2 - 18y + 18$

D) $y^3 - 5y^2 - 18$

APPENDIX D: BLACKBOARD ANNOUNCEMENT

I am Christy Lowery-Carter, an Assistant Professor of Mathematics at the college. I am currently working towards earning a Doctorate of Education from Liberty University with a concentration in Teaching and Learning. My dissertation topic is whether traditional teaching techniques are effective in an online Algebra I learning environment. You are invited to be in a research study of whether traditional teaching techniques captured through the use of Adobe Connect from a face-to-face Math 3 class allowed you to be more successful in your online studies. You were selected because you enrolled in Math 3-K6 through the college. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

Background Information
The purpose of this study is to seek answers with regards to multiple research questions. The researcher is examining the academic achievement of students in the online Math 3 class compared to the academic achievement of students in a seated Math 3 class. Secondly, do developmental community college math students use the teaching source (Adobe Connect saved instruction) to supplement their online learning? Lastly, do community college online developmental math students support the continued use of this technology in online teaching and learning in this course and others?

Procedures:

If you agree to be in this study, we would ask you to do the following things:

Students in this study will complete a pretest prior to instruction on any course objectives deemed appropriate for Math 3 during the first week of the semester. In addition at the end of sixteen weeks (spring and fall semesters) or ten weeks (summer semester) of instruction, students will complete an identical posttest to measure the extent of academic gain. Students in the online class will have access to all the lectures from the seated class through the use of Adobe Connect. Students in the online class will be required to complete a pretest at the beginning of this course, chapter tests through the semester, and a posttest at the end of the course. Students will complete the survey related to this study prior to completing the final exam/posttest. Students will not video or audio recorded at anytime.

Risks and Benefits of being in the Study
The study has minimal risks. Students are required to complete tests which include the pretest, chapter tests, and posttest. Also, students should have been screened prior to enrolling in this course to ensure they are ready to complete the course objectives and whether or not their learning preferences could be met through online instruction. This procedure too should decrease the risk students were not adequately prepared to enroll in Math 3.

There are no benefits to participating in this study. However, the findings could greatly impact future online learning at the college.

Compensation:

You will not receive payment for participation in this study. The grading policy for developmental mathematics courses at this college states students who earn a 75 or higher numerical score at the completion of Math 3 will be awarded a grade of "S" for Satisfactory. Students who score numerically lower than a 75 overall average will receive an "R" for Re-enroll or a "U" for Unsatisfactory depending on the extent of course completion. Students passing this class with a grade of "S" will be awarded four credit hours

Confidentiality:

The records of this study will be kept private. In any sort of report we might publish, we will not include any information that will make it possible to identify a subject. Research records will be stored securely and only researchers will have access to the records.

Instructors are required to retain all tests and exams of students for one academic school year. Hence, all tests and contact information related to this study will be retained by the instructor until the end of one academic school year or the completion of her doctoral studies at Liberty University. All tests and contact information related to this study will be stored in her office in a locked file cabinet. Once the data is no longer needed, it will be destroyed by the researcher in a paper shredder.

Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the college or Liberty University. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions:

The researchers conducting this study are Christy Lowery-Carter and Dr. John Pantana (dissertation chair). You may ask any questions you have now. If you have questions later, **you are encouraged** to contact Mrs. Christy Lowery-Carter at crlowerycarter@liberty.edu or Dr. John Pantana at Liberty University, (434)582-2000, jjpantan@liberty.edu.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher(s), **you are encouraged** to contact the Institutional Review Board, Dr. Fernando Garzon, Chair, 1971 University Blvd, Suite 2400, Lynchburg, VA 24502 or email at fgarzon@liberty.edu.

You will be given a copy of this information to keep for your records.

To participate simply click this link (deleted), enter the same username and password you use for Blackboard, and complete the survey questions. Your participation and comments are greatly appreciated!

APPENDIX E COURSE OUTLINES
MATH 3-90
Algebra I
Course Outline
Spring 2011

Instructor: Number of Credit Hours: 4
Office Number: 46B   Number of Sessions: 30
Office Phone: Number of Hrs/Session: 2 hours
Home Number: Time: MW 4:00-6:00
Class Location: TBA   Office Hours: As posted
Email:

Course Description: The course will develop an understanding of algebra and strengthen
computational skills. Emphasis will be placed on real numbers, algebraic expressions and linear
equations, rational expressions, and polynomials. Sound knowledge in arithmetic skills is strongly
needed as prerequisite. Graphing calculators will be used.

Textbook: Elementary and Intermediate Algebra by Ron Larson/Kimberly Nolting; 5th Edition,
Brooks/Cole Cengage Learning.

Course Outcomes: The student will be exposed to and be able to compute basic operations with
polynomials such as addition, subtraction, multiplication, division and factoring, acquire the
knowledge of exponents, rational expressions, and systems of equations and inequalities. After
completing Math 3 the student will have acquired the knowledge for further study in mathematics
including Math 04 and Math 120.

Instructional Activities: Class will generally consist of lecture and discussion.

COURSE REQUIREMENTS: Student must:

       I.   attend class/be on time.
      II.   participate in classroom discussion/ask questions
     III.   read and practice assigned problems after each class meeting/check odds.
     IV.   be able to spend at least 3 hours of own time for each class meeting.
     V.   get help if needed.
     VI.   Bring required materials

Evaluation System**:**
Homework Average 33 13%
Tests   33 1/3%
Exam   33 1/3%

<u>Grading Scale:</u>

 S – Satisfactory--Average of 75% or better

 R - Re-enroll--Less than 75% average but student made satisfactory attempt to complete the course.

 U – Unsatisfactory--Student did not make satisfactory attempt to complete the course. This includes stopping attending class after the Drop Date.

 W – Withdrawal --Student responsible for filling the form and follow the procedure.

<u>ATTENDANCE POLICY</u>: Regular attendance at classes is required. When absence is unavoidable, students should call the instructor prior to absence if possible (otherwise as soon thereafter as possible.) Students are responsible for completing all study missed during absence. <u>Missing more than 20% of the class results in dismissal from course</u>. (Rarely do students who miss a lot of classes complete the course successfully.) Tardiness will not be tolerated. Being in class and on time is mandatory.

<u>Topics to be covered</u>:

 I. Basic review of arithmetic, exponents, properties of real numbers, basic operations of algebraic expressions, order of operations, and introduction to variables.

 II. Introduction to signed numbers and its basic operations. Evaluating the algebraic expressions with signed numbers.

 III. Introduction to Linear Equations & functions, properties of linear equations, introduction to graphing, Solving equations and their applications to real world cases.

 IV. Polynomials and its basic operations, special product rules, more applications on equations involving polynomials.

 V. Introduction to factoring, difference of squares, factoring trinomials, solving equations by factoring, and word problems on direct and inverse variations.

<u>MATERIALS NEEDED:</u>
Text
Scientific Calculator required Graphing Calculator optional
Notebook with perforated pages
Loose-leaf paper

Pencils
Colored pens/pencils
Graph paper and ruler

<u>LATE WORK:</u> No make up or late homework/classwork/quizzes will be accepted. Make-up tests are given <u>only</u> in case of extenuating circumstances (hospitalization, death in family, required court appearance, etc.)

<u>HONOR CODE:</u>   Students are expected to sign an Honor Code Pledge on all quizzes/classwork and tests. If students are informed that a homework assignment is to be their own work (no help), this should also be pledged.

The college complies with the provisions set forth in the Americans with Disabilities Act (ADA) of 1990 and in Section 504 of the Rehabilitation Act of 1973. The College's commitment to equal educational opportunities for students with disabilities includes providing reasonable accommodations to qualified students with documented disabilities. Any student who may need an accommodation based on the potential impact of a disability should contact the Counselor for Special Populations to establish eligibility and to coordinate reasonable accommodations. The Disability Services Office is located in Room 35E in the Student Services department.

TENTATIVE SCHEDULE

Date	SECTIONS COVERED	Your Scores
1-10	Syllabus, Blackboard and Pretest	
1-12	1.1-1.2	
1-17	No Class	
1-19	1.3	
1-24	1.4	
1-26	1.5	
1-31	Test Chapter One	
2-2	2.1-2.2	
2-7	2.3	
2-9	2.4	
2-14	Test Chapter Two	
2-16	3.1 and 3.2	
2-21	3.3 and 3.4	
2-23	3.5	
2-28	3.6	
3-2	Test Chapter Three	
3-14	4.1	
3-16	4.2	
3-21	4.3	
3-23	4.4	
3-28	4.5	
3-30	4.6	
4-4	Test Chapter Four	
4-6	5.1	
4-11	5.2	
4-13	5.3	
4-18	5.4	
4-20	Chapter 5 Test	
4-25	Exam Review	
4-27	Exam Review	
5-2	Exam	

Reminders:

1. Children should not attend class with parents. Children should not be left unattended at any time in the facility or the premises.

2. The last day to drop Math 3 with a refund is January 20th. The last day to drop without an Academic Penalty is March 18th.

HONOR CODE

<u>Cheating - Prohibitions</u>:

1. The intentional giving or receiving of help on all written assignments or examinations without the permission of the instructor.

2. Looking at another's test paper or other material (notes, paper, text) with the intent to gain or give unfair academic advantage without the permission of the instructor.

3. Talking or signaling to another while taking a quiz or exam with the intent to gain or give unfair academic advantage.

4. Collaborating with another in preparing written assignments without the permission of the instructor.

<u>Plagiarism - Prohibitions</u>:

1. Copying another's paper and handing it in as one's own.

2. Intentionally footnoting an incorrect source.

3. Using passages of ideas of another as one's own work without giving proper credit.

The following HONOR CODE PLEDGE is required of all students to be written and signed on all work submitted for a grade in connection with a class:

HONOR CODE PLEDGE

I have not violated nor am I aware of any violation of the Honor Code.

_____ _____
Signature of the student   Date

Course Number:_____   Section:_____

MATH 3-K6
Algebra I
Course Outline
Spring 2011

Instructor: Number of Credit Hours: 4
Office Number: Number of Sessions: online
Office Phone: Number of Hrs/Session: online
Home Number: Time: online
Class Location: TBA   Office Hours: As posted
Email:

Course Description: The course will develop an understanding of algebra and strengthen computational skills. Emphasis will be placed on real numbers, algebraic expressions and linear equations, rational expressions, and polynomials. Sound knowledge in arithmetic skills is strongly needed as prerequisite. Graphing calculators will be used.

Textbook: Elementary and Intermediate Algebra by Ron Larson/Kimberly Nolting; 5th Edition, Brooks/Cole Cengage Learning.

Course Outcomes: The student will be exposed to and be able to compute basic operations with polynomials such as addition, subtraction, multiplication, division and factoring, acquire the knowledge of exponents, rational expressions, and systems of equations and inequalities. After completing Math 3 the student will have acquired the knowledge for further study in mathematics including Math 04 and Math 120.

Instructional Activities: Class will generally consist of lecture and discussions found in Blackboard.

COURSE REQUIREMENTS: Student must:

- participate in classroom discussion/ask questions
- read and practice assigned problems checking odds answers in the back of the book.
- get help if needed

Evaluation System:
Homework Average   1/3
Tests   1/3
Exam   1/3

Grading Scale:

S – Satisfactory--Average of 75% or better

R - Re-enroll--Less than 75% average but student made satisfactory attempt to complete the course.

U – Unsatisfactory--Student did not make satisfactory attempt to complete the course. This includes stopping attending class after the Drop Date.

W – Withdrawal --Student responsible for filling the form and follow the procedure.

ATTENDANCE POLICY: Regular attendance at classes is required. When absence is unavoidable, students should call the instructor prior to absence if possible (otherwise as soon thereafter as possible.) Students are responsible for completing all study missed during absence. Missing more than 20% of the class results in dismissal from course. (Rarely do students who miss a lot of classes complete the course successfully.) Tardiness will not be tolerated. Being in class and on time is mandatory.

Topics to be covered:

I.   Basic review of arithmetic, exponents, properties of real numbers, basic operations of algebraic expressions, order of operations, and introduction to variables.

II. Introduction to signed numbers and its basic operations. Evaluating the algebraic expressions with signed numbers.

III. Introduction to Linear Equations & functions, properties of linear equations, introduction to graphing, Solving equations and their applications to real world cases.

IV. Polynomials and its basic operations, special product rules, more applications on equations involving polynomials.

IV.   Introduction to factoring, difference of squares, factoring trinomials, solving equations by factoring, and word problems on direct and inverse variations.

MATERIALS NEEDED:
Text
Scientific Calculator required Graphing Calculator optional
Binder with notebook paper for note taking
Pencils
Colored pencils
Graph paper

Ruler

<u>LATE WORK:</u> No make up or late homework/classwork/quizzes will be accepted. Make-up tests are given <u>only</u> in case of extenuating circumstances (hospitalization, death in family, required court appearance, etc.)

<u>HONOR CODE:</u>   Students are expected to sign an Honor Code Pledge on all quizzes/classwork and tests. If students are informed that a homework assignment is to be their own work (no help), this should also be pledged.

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TENTATIVE SCHEDULE

Week	Assignments
January 10 – January 16	Review syllabus, review layout in Blackboard, complete pretest, and sections 1.1 and 1.2
January 17 – January 23	1.3
January 24 – January 30	1.4 and 1.5
January 31 – February 6	Test on Chapter One & 2.1 and 2.2
February 7 – February 13	2.3 and 2.4
February 14 – February 20	Test on Chapter Two & 3.1 and 3.2
February 21- February 27	3.3, 3.4, and 3.5
February 28 – March 6	3.6 & Test on Chapter Three
March 7 – March 13	No assignments as this is Spring Break week
March 14 – March 20	4.1 and 4.2
March 21 – March 27	4.3 and 4.4
March 28 – April 3	4.5 and 4.6
April 4 – April 10	Test on Chapter Four & 5.1
April 11 – April 17	5.2 and 5.3
April 18 – April 24	5.4 & Test on Chapter Five
April 25 – May 1	Exam review
May 2 – May 8	Exam

Reminders:

1. **The last day to drop Math 3 with a refund is January 20th. The last day to drop without an Academic Penalty is March 18th.**
2. **All assignments must be completed in Blackboard by Sunday night at midnight.**

HONOR CODE

Cheating - Prohibitions:

1. The intentional giving or receiving of help on all written assignments or examinations without the permission of the instructor.

2. Looking at another's test paper or other material (notes, paper, text) with the intent to gain or give unfair academic advantage without the permission of the instructor.

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_____ _____

Signature of the student   Date

Course Number:_____ Section:_____

MATH 3-90
Algebra I
Course Outline
Summer 2011

Instructor: Number of Credit Hours: 4
Office Number: Number of Sessions: 20
Office Phone: Number of Hrs/Session: 3 hours 50 min
Home Number: Time: TTH 8:00-11:50
Class Location: TBA   Office Hours: As posted
Email:

Course Description: The course will develop an understanding of algebra and strengthen
computational skills. Emphasis will be placed on real numbers, algebraic expressions and linear
equations, rational expressions, and polynomials. Sound knowledge in arithmetic skills is strongly
needed as prerequisite. Graphing calculators will be used.

Textbook: Elementary and Intermediate Algebra by Ron Larson/Kimberly Nolting; 5th Edition,
Brooks/Cole Cengage Learning.

Course Outcomes: The student will be exposed to and be able to compute basic operations with
polynomials such as addition, subtraction, multiplication, division and factoring, acquire the
knowledge of exponents, rational expressions, and systems of equations and inequalities. After
completing Math 3 the student will have acquired the knowledge for further study in mathematics
including Math 04 and Math 120.

Instructional Activities: Class will generally consist of lecture and discussion.

COURSE REQUIREMENTS: Student must:

    VII.   attend class/be on time.
    VIII.   participate in classroom discussion/ask questions
    IX.   read and practice assigned problems after each class meeting/check odds.
    X.   be able to spend at least 3 hours of own time for each class meeting.
    XI.   get help if needed.
    XII.   Bring required materials

Evaluation System:
Homework Average 33 13%
Tests   33 1/3%
Exam   33 1/3%

<u>Grading Scale:</u>

> **S – Satisfactory--Average of 75% or better**
>
> **R - Re-enroll--Less than 75% average but student made satisfactory attempt to complete the course.**
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<u>Topics to be covered</u>:

I.   Basic review of arithmetic, exponents, properties of real numbers, basic operations of algebraic expressions, order of operations, and introduction to variables.

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V. Introduction to factoring, difference of squares, factoring trinomials, solving equations by factoring, and word problems on direct and inverse variations.

<u>MATERIALS NEEDED:</u>
Text
Scientific Calculator required Graphing Calculator optional
Notebook with perforated pages
Loose-leaf paper
Pencils

Colored pens/pencils
Graph paper and ruler

LATE WORK: No make up or late homework/classwork/quizzes will be accepted. Make-up tests are given <u>only</u> in case of extenuating circumstances (hospitalization, death in family, required court appearance, etc.)

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TENTATIVE SCHEDULE

Date	SECTIONS COVERED	Your Scores
5/24	Syllabus, Blackboard, Pretest 1.1-1.2	
5/26	1.3-1.5	
5/31	Test on Chapter One	
6/2	2.1-2.2	
6/7	2.3-2.4	
6/9	Test on Chapter Two	
6/14	3.1-3.2	
6/16	3.3-3.4	
6/21	3.5-3.6	
6/23	Test on Chapter Three	
6/28	4.1-4.2	
6/30	4.3-4.4	
7/5	4.5-4.6	
7/7	Test on Chapter Four	
7/12	5.1-5.2	
7/14	5.3-5.4	
7/19	Test on Chapter Five	
7/21	Exam Review	
7/26	Exam	
7/28	Exam	

Reminders:

1. **Children should not attend class with parents. Children should not be left unattended at any time in the facility or the premises.**

2. **The last day to drop Math 3 with a refund is June 2nd. The last day to drop without an Academic Penalty is July 5th.**

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Signature of the student   Date

Course Number:_____   Section:_____

MATH 3-K6
Algebra I
Course Outline
Summer 2011

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Homework Average   1/3
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Exam   1/3

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S – Satisfactory--Average of 75% or better

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Pencils

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Graph paper
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TENTATIVE SCHEDULE

Week	Assignments
May 23 – May 29	Review syllabus, review layout in Blackboard, complete pretest, and sections 1.1-1.5
May 30 – June 5	Test on Chapter One & 2.1-2.2
June 6 – June 12	2.3-2.4 & Test on Chapter Two
June 13 – June19	3.1-3.4
June 20 – June 26	3.5-3.6 & Test on Chapter Three
June 27 – July 3	4.1-4.4
July 4 – July 10	4.5-4.6 & Test on Chapter Four
July 11 – July 17	5.1-5.4
July 18 – July 24	5.5- 5.6 & Test on Chapter Five
July 25 – July 31	Exam review and exam

Reminders:

1. **The last day to drop Math 3 with a refund is June 2nd. The last day to drop without an Academic Penalty is July 5th.**
2. **All assignments must be completed in Blackboard by Sunday night at midnight.**

HONOR CODE

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1. Copying another's paper and handing it in as one's own.

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I have not violated nor am I aware of any violation of the Honor Code.

_____ _____
Signature of the student   Date

Course Number:_____   Section:_____