Assessing the Impact of a Computer-Based College Algebra Course

Ningjun Ye
University of Southern Mississippi

Follow this and additional works at: https://aquila.usm.edu/dissertations

Part of the Algebra Commons, and the Science and Mathematics Education Commons

Recommended Citation
https://aquila.usm.edu/dissertations/868

This Dissertation is brought to you for free and open access by The Aquila Digital Community. It has been accepted for inclusion in Dissertations by an authorized administrator of The Aquila Digital Community. For more information, please contact aquilastaff@usm.edu.
ASSESSING THE IMPACT OF A COMPUTER-BASED COLLEGE ALGEBRA COURSE

by

Ningjun Ye

Abstract of a Dissertation
Submitted to the Graduate School of The University of Southern Mississippi in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

May 2010
ABSTRACT

ASSESSING THE IMPACT OF A COMPUTER-BASED

COLLEGE ALGEBRA COURSE

by Ningjun Ye

May 2010

USM piloted the Math Zone in Spring 2007, a computer-based program in teaching MAT 101 and MAT 099 in order to improve student performance. This research determined the effect of the re-design of MAT 101 on student achievements in comparison to a traditional approach to the same course. Meanwhile, the study investigated possible effects of the Math Zone program on students’ attitude toward studying mathematics.

This study shows that there was no statistically significant difference on MAT101 final exam scores between the Math Zone students and the Classroom students in Fall 2007, Spring 2008 and Fall 2008. At the same time, the study also shows that there was no statistically significant difference in students’ attitude toward math between the two groups in each of the three semesters. However, this study reveals a significant relationship between the hours the students spent in the Math Zone and the scores they made on the final exams in Spring 2008 and Fall 2008.
ASSESSING THE IMPACT OF A COMPUTER-BASED
COLLEGE ALGEBRA COURSE

by

Ningjun Ye

A Dissertation
Submitted to the Graduate School
of The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy

Approved:

[Signatures]

Director

Dean of the Graduate School

May 2010
ACKNOWLEDGMENTS

I would like to thank my advisor Dr. Sherry Herron for her continued guidance, encouragement, and inspiration that have contributed much to this study.

I would like to thank my committee members: Dr. Myron Henry, Dr. J.T. Johnson, Dr. K.S. Lundy, and Dr. Haiyan Tian for their time, effort, and advice.

Appreciation is expressed to Dr. J.T. Johnson, an expert in statistics, who was very helpful in the analysis of the quantitative data.

Special thanks are expressed to Dr. K.S. Lundy who gave me not only encouragement, but also valuable suggestions after her careful proofreading.

Finally I would like to extend my thanks to the Math Department: the chair of the department, Dr. C.S. Chen, the director of the Math Zone, Ms. Janice Fletcher, and those who provided me with opportunities and resources for my data collection such as surveys and interviews.
TABLE OF CONTENTS

ABSTRACT ..................................................................................................................... ii

ACKNOWLEDGMENTS .................................................................................................. iii

LIST OF TABLES .......................................................................................................... vi

LIST OF ILLUSTRATIONS ............................................................................................ vii

CHAPTER

I. INTRODUCTION .........................................................................................................1

Background
Purpose of the Study
Research Questions
Hypotheses
Delimitations
Assumptions
Definitions
Justification

II. LITERATURE REVIEW ................................................................................................7

Findings
Changes on Pedagogy
Attitude, Motivation and Achievement
Concern

III. METHODOLOGY .......................................................................................................17

Subjects
Data Collection
Instrumentation
Data Analysis

IV. ANALYSIS OF QUANTITATIVE DATA .....................................................................23

Introduction
Subjects
Descriptive Data
Hypotheses
Summary
V. ANALYSIS OF QUALITATIVE DATA ........................................32

  Introduction
  Descriptive Survey Data
  Descriptive Interview Data
  Analysis of Survey Data
  Analysis of Interview Data
  Summary

VI. SUMMARY, CONCLUSIONS, AND SUGGESTIONS ..................53

  Introduction
  Summary of Procedures
  Summary of Quantitative Results
  Summary of Qualitative Results
  Conclusions
  Discussion
  Limitations
  Suggestions for Practice
  Suggestions for Future Research

APPENDIXES .................................................................................63

REFERENCES ..................................................................................70
### LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Comparison of Achievements Scores</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>Comparison of Confidence Levels</td>
<td>26</td>
</tr>
<tr>
<td>3.</td>
<td>Regression</td>
<td>27</td>
</tr>
<tr>
<td>4.</td>
<td>Mean, Standard Deviation and Scale of the Lab Hours</td>
<td>27</td>
</tr>
<tr>
<td>5.</td>
<td>Numbers and Percentages of Responses to Survey Question 1</td>
<td>35</td>
</tr>
<tr>
<td>6.</td>
<td>Numbers and Percentages of Responses to Survey Question 7</td>
<td>36</td>
</tr>
<tr>
<td>7.</td>
<td>Numbers and Percentages of Responses to Survey Question 2</td>
<td>38</td>
</tr>
<tr>
<td>8.</td>
<td>Numbers and Percentages of Responses to Survey Question 3</td>
<td>39</td>
</tr>
<tr>
<td>9.</td>
<td>Numbers and Percentages of Responses to Survey Question 5</td>
<td>41</td>
</tr>
<tr>
<td>10.</td>
<td>Numbers of Responses to the Interview Questions from Instructors</td>
<td>43</td>
</tr>
</tbody>
</table>
LIST OF ILLUSTRATIONS

Figure

1. Comparison of the final exam mean scores between the two types of students in the three semesters. The lavender color represents the traditional class and the purple color represents the Math Zone class…………….25

2. Comparison of the confidence level mean scores between the two types of students in each of the three semesters. The lavender color represents the traditional class and the purple color represents the Math Zone class…………….26

3. Comparison of the percentages of responses to Survey Question 1 organized by categories between the two groups on an average of the three consecutive semesters. The lavender color represents the Classroom students and the purple color represents the Math Zone students……………………………………….35

4. Comparison of the percentages of responses to Survey Question 7 between the two groups in an average of the three semesters. The lavender color represents the Classroom students and the purple color represents the Math Zone students……37

5. Comparison of the percentages of responses to Survey Question 2 between the two groups in an average of the three semesters. The lavender color represents the Classroom students and the purple color represents the Math Zone students……38

6. Comparison of the percentages of responses to Survey Question 3 between the two groups in an average of the three semesters. The lavender color represents the Classroom students and the purple color represents the Math Zone students……40

7. Comparison of the percentages of responses to Survey Question 5 between the two groups in an average of the three semesters. The lavender color represents the Classroom students and the purple color represents the Math Zone students……41
CHAPTER I
INTRODUCTION

Background

College algebra reform is taking place in higher education across the country. The focus of a traditional college algebra course has been on the students who intend to take calculus afterwards, and this traditional style has dominated for more than four decades (Elington, 2005). Changes are being made to ensure that the college algebra course can provide a worthwhile quantitative experience for students who are not planning a career requiring higher level mathematics while also preparing others for calculus. Computer programs have been focused on mathematics education since they were first created. In fact, mathematics software is one of the most popular categories of software (TERC, 1999). The implementation of these programs in the classroom has been a long-term goal for many researchers because of the potential that this technology has for the future mathematics students. Contrary to a popular belief, this technology is meant as an aid for the teacher to use in combination with other teaching techniques and is in no way a replacement for the teacher (TERC, 1999). The computer-based class allows students to access assignments and participate in activities, manipulate problems, verbalize mathematical processes, and get immediate feedbacks about why certain answers are correct while others are not (Bottino, 2004). This form helps students stay current with their work by reducing the amount of turn-around time it would normally take to get a detailed explanation of why a particular line of reasoning fails in one case but works in another. In some cases, the software can tell students immediately that a mistake was...
made and give them a detailed description of how to correct it, which allows the students to fix mistakes before they finish the assignment (Bottino, 2004).

Following the experiences of the University of Idaho, the University of Alabama, and Virginia Tech, the University of Southern Mississippi (USM) began to implement a computer-based instruction program for College Algebra (MAT 101) and Intermediate Algebra (MAT 099) in Spring 2007.

Mathematics has embarked on a re-design using MyMathLab (Pye, 2007). MyMathLab is a software program from textbook publisher Wiley, providing instruction on mathematics contents, homework drill, quizzes, and tests.

The computer lab named the Math Zone at USM is equipped with 60 computers and is staffed 50-70 hours per week by mathematics faculty, adjunct instructors, graduate students and undergraduate students. A student working at a computer in the Math Zone can get almost instantaneous help from one of the lab workers. The required homework consists of different problems than the ones in the textbook, although the textbook exercises can also be completed on the computer as well. Students have several resources to use when doing their homework. “Help Me Solve This” guides students from one problem to another step by step, providing more exercises to do if they want to try. “View an Example” shows a similar problem in another screen. “Similar Exercise” allows students to do the same type of problems as many times as they want until they understand it completely. “Animation” provides a lecture like a PowerPoint presentation for each section. “Textbook Pages” gives students an opportunity to find the exact page of the textbook that contains their current homework problem. “Ask My Instructor” allows students to email their instructors whenever they need. “Video Lectures” for each
section gives students opportunities to “listen to the teacher” to experience the traditional learning method. “Tracked Tutorial Exercises” allows students to make a study plan to ensure that they understand each mathematical topic covered. Students who enroll in the Math Zone class are required to spend at least 3 hours in the Math Zone, and attend a lecture given once a week in the classroom by their instructor who gives the overview of the content sections for the week.

Purpose of the Study

A significant funding ($170,000) to set up the Math Zone was provided by the College of Science and Technology and other grants, hoping that the re-design of these courses could improve student performance (Pye, 2007). As a result, the purpose of this study was to determine the effect of the Math Zone program. This was assessed by looking at the effect of the Math Zone on student achievement. At the same time, the study was to investigate possible effects of this program on students’ attitudes toward mathematics.

Research Questions

The following research questions were addressed:

1. Is there a difference in MAT 101 final exam scores between the students who used the Math Zone as the instructional delivery method and the students who experienced the traditional method of classroom delivery?

2. What are the attitudes of students toward math in both the Math Zone and traditional classes?

3. Do the hours students spend in the Math Zone have a positive correlation to the scores they make on the final exam?
Hypotheses

The following null hypotheses were investigated in this study:

\( H_{01a} \): There is no statistically significant difference on MAT 101 final exam scores between Fall 2007 Math Zone students and Classroom students.

\( H_{01b} \): There is no statistically significant difference on MAT 101 final exam scores between Spring 2008 Math Zone students and Classroom students.

\( H_{01c} \): There is no statistically significant difference on MAT 101 final exam scores between Fall 2008 Math Zone students and Classroom students.

\( H_{02a} \): There is no statistically significant difference in students’ attitude toward math between Fall 2007 Math Zone students and Classroom students.

\( H_{02b} \): There is no statistically significant difference in students’ attitude toward math between Spring 2008 Math Zone students and Classroom students.

\( H_{02c} \): There is no statistically significant difference in students’ attitude toward math between Fall 2008 Math Zone students and Classroom students.

\( H_{03a} \): There is no relationship between the hours the students spend in the Math Zone and the scores they make on the final exam for Fall 2007 students.

\( H_{03b} \): There is no relationship between the hours the students spend in the Math Zone and the scores they make on the final exam for Spring 2008 students.

\( H_{03c} \): There is no relationship between the hours the students spend in the Math Zone and the scores they make on the final exam for Fall 2008 students.

Delimitations

The subjects of the study were limited to students enrolled in MAT 101 in Fall 2007, Spring 2008 and Fall 2008 semesters. Measurement of student attitude toward math
was limited to the surveys and interviews conducted during the three consecutive semesters.

Assumptions

During the study the following assumptions were made:

1. Students respond to surveys and open-ended questions in a way that accurately reflects their attitude toward math.

2. Testing conditions in both types of classes are appropriate and uniform.

Definitions

*MAT099* - Intermediate Algebra, a course given at the University of Southern Mississippi.

*MAT 101* - College Algebra, a course given at the University of Southern Mississippi.

*Math Zone* - 1. A computer-based program in teaching MAT099 and MAT 101.

2. A computer lab where the computer-based MAT 099 and MAT 101 courses are delivered.

*MathLab* - From textbook publisher Wiley, a software program that provides instruction on mathematics content, homework drill, quizzes, and tests.

*CBI* - Computer-based Instruction.

*CAI* - Computer-assisted Instruction

*USM* - The University of Southern Mississippi.

*Math Zone students* - The students who enroll in the computer-based class.

*Classroom students* - The students who enroll in the traditional class.

*SD* - Standard Deviation.
Justification

Computer-based algebra courses were accepted and used by more schools due to the increasing number of students who were not math or science majors and the positive effect of this program on students’ achievements happening in many schools. Following the experiences of the University of Idaho, the University of Alabama, and Virginia Tech, the University of Southern Mississippi began to implement the Math Zone program, a computer-based instruction for College Algebra (MAT 101) and Intermediate Algebra (MAT 099) in the spring semester of 2007, hoping to improve the students’ performance. This research evaluated the effectiveness of using the Math Zone program. It was a perfect situation to investigate the effectiveness of this program since both Math Zone and traditional courses were taught at the same semester and most of the students were freshmen. It was very convenient and practical to compare the two groups. For example, the researcher could get all the Math Zone class final exam scores including the lab hours from one person who was in charge of the Math Zone data management. The researcher could conduct the survey of both groups within one semester each time. The hours the student spent in the Math Zone could be obtained directly from the computer since the students had to scan their student ID cards whenever going in and out of the Math Zone.
Findings on Pre-College Students

During the past three decades, an increasing number of studies have systematically investigated the impact of computer-based instructions (CBI) outcomes in mathematics (Lipsey & Wilson, 1993). Hartley (1977) was the first to apply meta-analysis to findings on CBI. Her analysis on mathematics education in elementary and secondary schools reported that the average effect of CBI was to raise student achievement from the 50th to 66th percentile (Kulik, Bangert, & Williams, 1983). Burns and Bozeman (1981) conducted a meta-analytic study and discovered that student achievement was significantly increased when using computer-aided math instruction at both elementary and secondary levels. Rooth (2006) indicated that computer-based learning was understandable and that goals were best served by the creation of communities of learners where students were actively engaged in the process of mathematical sense making so that each student may learn a different way to approach a topic. He claimed that the students in computer-based classes did better on standardized tests than those in traditional classes. Kulik, Bangert, and Williams (1983) further noted the similar findings which were also given by Kulik and Bangert-Drowns (1986).

Findings on College Students

The students of Virginia Commonwealth University in the model-based approach sections had a higher success rate in the college algebra course, performed better on common final exam questions and the percentage of the model-based students required
for their major was significantly larger than the corresponding percentage of traditional section students (Ellington, 2005). Ganguli (1992) conducted a study to investigate the effect of the computer as a demonstration tool on the achievement and attitude of college students enrolled in an intermediate algebra class. The treatment effect was significant for the comprehensive examination. He concluded that the significant difference in the final exam indicated that students had acquired and retained conceptualizations of algebra better when using the computer. Using a two-way analysis of variance with a data set from 160 students in eight college algebra classes in a historically black college and university, Carter (2008) found a statistically significant difference on the common final exam score for the computer-enhanced curriculum and no significant difference between males and females.

Findings on Different Levels of Students

C. Kulik and J. A. Kulik (1991) used a meta-analysis of findings from 254 controlled evaluation studies to show that computer-based instruction usually produces positive effects on students of all age levels. Another meta-analysis conducted by Bayraktar (2002) investigated how effective computer-assisted instruction (CAI) is on student achievement in secondary and college science education when compared to traditional instruction. Results showed a positive effect for CAI use. Liao and Bright (1991) also found positive effects of computer-based programs on students’ performance.

Findings on Disruptive and Lower-ability Students

Computer-based instruction has become a useful learning option for disruptive students. The results of the study by Ragasa (2008) showed that CAI and collaborative work had improved learning with a significant effect on achievement. With teacher
guidance, the disruptive students appeared to take more responsibility for their learning. Powell (2003) found a significant improvement in grade point average for the students using CBI with the teacher intervention. They concluded that evidence from their study provided hope that CBI can improve the grade point averages of disruptive students. Ku, Harter, Liu, Thompson, and Chen (2004) found that personalized CBI was effective in improving lower-ability students’ performance to solve mathematics problems.

Overall, these studies along with some recent, major studies and narrative reviews of the research have documented positive effects of educational technology on student achievement.

However, Lazari and Simons (2001) found that the traditional method had a statistically significant higher retention rate in college algebra than the software interactive method during the six semesters at Valdosta State University. Young and Bembry (1995) found that the traditional-lecture group on the average scored higher than the computer-assisted instruction group in Algebra I. Villarreal (2003) claimed that a fully computer-based program was not as effective as a combination of traditional and computer-based instructions.

Furthermore, these studies and reviews typically look at different aspects or types of technology and this knowledge base has not really provided information on how to appropriately integrate and use technology in schools. In addition, the rapid growth and improvement in technology exceeds current knowledge of how to effectively use technology in schools and the impact of technology is different than it was in the past (Allen, 2001). Mills (2004) found that the most common negative reactions for students included waiting for computers to become available and not being able to get help when
they needed it. Students with both positive and negative reactions cited frustrations with technical problems.

In conclusion, there is not enough statistical evidence to conclude that one method is better than the other (Lazari & Simons 2001) and the arguments concerning the effect of computer-based mathematics courses on student outcomes are still critical (Brynes, 2001).

Changes in Pedagogy

Computer-based learning has three components: hardware, software and ‘underware’, the pedagogy that underpins its development. The latter is the most important, as the approach adopted will influence the creation of computer-based learning materials and determine the way in which students engage with subject matter. Teachers are responsible for the quality of their courses and have a vital role in helping to develop the most appropriate electronic learning activities that will facilitate students to acquire the knowledge and skills necessary for clinical practice. Therefore, they need to have an awareness of what contributes to educationally effective, computer-based learning materials (Adams, 2004).

Traditional teaching based on behaviorist views of learning is being replaced by inquiry-based teaching, reflecting a constructivist view of learning (Handal & Herrington, 2003). Behaviorism focuses on the manipulation of external conditions to modify behaviors that will lead eventually to “knowledge-centered” learning (Elliot, Kratochwill, & Travers, 1996). In contrast, constructivism claims that knowledge must be actively constructed by learners and the education philosophy is “learner-centered.” Learning depends on the way the learners interact with situations, beliefs, attitudes, and previous
experiences (Biggs & Moore, 1993). Educators are moving from a teaching or instructional paradigm to a learning paradigm. In a learning paradigm, Barr and Tagg (1995) pointed out that the mission of the school should be to provide environments and experiences that encourage and enable students to explore new concepts. Consequently, a school’s purpose is not to transfer knowledge but to create environments and experiences that bring students to discover and construct knowledge for themselves, to make students members of communities of learners that make discoveries and solve problems.

According to the findings, it seems that “the sage on the stage” is being replaced by “the coach in the team.” Once a computer-based mathematics course has been implemented, the role of the instructor becomes that of a facilitator (Villarreal, 2003). Surveys of reactions from students and instructors reveal that instructors find their new role rewarding, but the students have more mixed reactions toward computer-based learning (Galbraith, 2002; Mills, 2004; Yushau, 2004). Synder (2004) discovered that teachers’ duties have become shared when using computer-based software in a college algebra course. The computer software is co-teaching and students view their roles as learners differently. They have more responsibility in a computerized mathematics course, especially the training of management skills and the ability to work independently. Both teachers and students’ roles, duties and responsibilities have changed in a computer-based college algebra course. Mills (2004) reported that students like more control over scheduling when doing course work and some students believe that their independent study skills and organization skills have been improved by taking a computer-based course.
Attitude, Motivation and Achievement

Attempts to determine the relationship between attitude and achievement on mathematics learning have produced numbers of studies on student performance including survey items designed to measure attitudes of students toward mathematics (Bassarear, 1991). Attitudes are generally regarded as having been learnt. They predispose an individual to action that has some degree of consistency and can be evaluated as either negative or positive (Fishbein & Ajzen, 1975). According to Aiken (1996), attitude is defined as a learned predisposition or tendency on the part of an individual to respond positively or negatively to some object, situation, concept, or another person.

The nature of mathematics learning requires the exploration of affective as well as cognitive factors (Leder, 1987). Current efforts in reforming mathematics curriculum and instruction have placed a special emphasis on the relationship between affective domain (attitudes, beliefs, emotions and motivations) and cognitive domain (knowledge and thinking). Caraway (1985) revealed that mathematics competency and achievement were both positively correlated with attitude toward mathematics. The results were supported by the findings from Rech, Hartzell, and Stephens (1993) who compared the mathematical competencies and attitudes of American pre-service elementary education students against a representative college population over 3 years.

Ma (1997) assessed 113 studies that looked at these factors, hoping for indications of a clear causal relationship. They found that a positive attitude toward the subject was correlated with success. The findings suggested that the reciprocal or interactive nature between attitude toward mathematics and achievement in mathematics can substantially
modify their casual relationship. A unilateral relationship is likely to overestimate the causal effect between attitude toward mathematics and achievement in mathematics.

Many educators found it difficult to separate the relationship between one’s attitude and one’s reasoning skills in any activity of teaching and learning, if not impossible (Fazio, 1990). Rather than exploring all the components in the affective domain as they relate to the cognitive domain, mathematics educators have usually taken the relationship between attitude toward mathematics and achievement in mathematics as their major concern. Ku and Sullivan (2002) found that student attitudes are more positive when student interests and preferences are incorporated into instruction in order to personalize it. They have also found personalized subjects and higher-ability students both had significantly more positive attitudes toward the instructional program than their non-personalized and lower-ability counterparts. Herndon (1987) found that high school students who received instruction based on common group interests had significantly more favorable attitudes and higher return-to-task motivation than students whose instruction was not interests-based. Human-computer interaction is a complex phenomenon and attitudes and feelings involved with the relationship are difficult to identify (Willis, 1995). In 1976, Fennema and Sherman suggested that the anxiety may take the form of hostility, fear, and resistance, which may inhibit the acquisition of computer skills, much as math anxiety can inhibit achievement in mathematics. They claimed that anxiety toward a subject area may affect the learning process and negative or ambivalent attitudes toward computer-based learning could be a deterrent to learning the subject in the computer-based learning environment (Mulhern, 1998). The key point is whether modern curricula could foster more positive attitudes toward the subjects.
Furthermore, it is necessary for educators to know how general these negative attitudes are, what cause them, and what can be done to make them positive (Aiken, 1970).

It seems likely that students’ attitudes toward the computer technology, as well as learning about the subject, may be an important factor of their performance during the learning process. If positive attitudes increase (Clement, 1981), students can master the computer skills involved, which then offers many advantages in the educational process: student interaction, absence of embarrassment, student-paced operation, problem solving, tutoring, immediate feedback, and absence of subjectivity. So, students’ confidence in their ability to handle a traditional or non-traditional mathematics class was the factor that related most consistently with success in the class (Tartre & Fennema, 1995).

Menager-Beeley (2001) reported that the results from the student motivation survey during the first week can be strong predictors of students at a risk for dropping out of the class by week five in either traditional or non-traditional class. Askar, Yavuz and Kosal (1992) found a positive correlation between students’ attitude toward math and their outcomes in the computer-assisted algebra course. Cretchley and Galbraith (2002) confirmed a strong relationship between students’ mathematics attitudes (both confidence and motivation) and their achievement on a wide range mathematical task.

However, according to Tall and Razali (1993), the egg and chicken argument can apply here: Computer-based learning can stimulate students’ positive attitude toward math since success leads to positive attitudes about the subject. Fogarty, Cretchley, Harman, Ellerton, and Konki (2001) found in their study that the use of technology had a strong educational impact on students’ learning of mathematics. They showed that students’ attitudes and confidence in mathematics had improved by using software which
enabled them to compare, classify, analyze errors and solve problems. Young and Bembry (1995) conducted a mixed method research to find that the use of computers and software did help create a positive learning environment to improve students’ attitudes from negative to positive. These examples may explain Cretchley and Galbraith’s research discovery that mathematics attitude measured late in the computer-based program correlated much more strongly with performance on assessment items. Attitude is one aspect of motivation, but motivation includes the notions of engagement and persistence. For success in a computer-based class, students must have the self-discipline to be engaged through the software and persist in doing the work independently (Snyder, 2004).

There was always a group of students who fell so far behind that they failed. As a result, it is essential to structure computer-based classes with weekly time requirements since it can help monitor the students and ensure that they develop better independent work skills, or they are forced by the requirements to compensate for the lack of them (Matthews-Lopez, Lopze-Permouth, & Keck, 2002; Villarreal, 2003). Thus the notion of engagement in a computer-based mathematics may be more complex than that in a traditional class (Snyder, 2004). Therefore, understanding students’ attitudes about mathematics including the use of technology may be one of the keys for schools to gain a better understanding of the mathematics learning process of these students enrolled in a college algebra course no matter whether it is traditional or computer-based (Frost et al., 1994).
Concern

These studies and reviews typically look at different aspects or types of technology and this knowledge base has not really provided information on how to appropriately integrate and use technology in schools. In addition, the rapid growth and improvement in technology exceeds current knowledge of how to effectively use technology in schools and the impact of technology is different than it was in the past (Allen, 2001). What shall we do to maximize the effect of computer-based college algebra course? This is the general problem facing many math educators.
CHAPTER III

METHODOLOGY

Subjects

The study was conducted at the Hattiesburg campus of the University of Southern Mississippi (USM). Participants in this study were the students enrolled in the traditional MAT 101 class and the students enrolled in the Math Zone MAT 101 class during Fall 2007, Spring 2008 and Fall 2008. The number of students enrolled in this course varies between 400 and 900. It is necessary to state that it is difficult to find pure traditional classes in the United States because most entry-level mathematics courses such as college algebra provide or require software for homework (Villarreal, 2003). In this study, traditional students were defined as those who never or seldom went to the Math Zone for help. Selection was done without any errors because students must scan their student ID cards to go into and out of the Math Zone. The data were collected in the semesters of Fall 2007, Spring 2008 and Fall 2008 and the results showed that most traditional students’ lab hours were zero.

Data Collection

Quantitative and qualitative methods were combined in an attempt to provide more information than either method can yield alone.

The following steps were used in the collection of data:

1. An application for approval was sent to the University of Southern Mississippi Human Subjects Protection Review Committee to use the data and to administer interviews and surveys in Fall 2007, Spring 2008 and Fall 2008, and to use the test data (Appendix A).
2. Final Exam scores of both types of students enrolled in Fall 2007, Spring 2008, and Fall 2008 were retrieved.

3. Interviews with seven instructors were conducted.

4. Attitudinal surveys were administered at the end of each semester. The results were collected and compared (Appendix B).

Instrumentation

Confidence Level Surveys

Students enrolled in either the traditional or the Math Zone class were asked to complete attitudinal surveys at the end of their math course. The reliability and validity were tested by using the Fall 2007 survey data which were found to produce scores reliable with a Cronbach’s alpha = 0.956. The revised version (Appendix B) met the needs of the particular study which consists of 29 Likert-type and 6 open-ended questions examining attitudes toward mathematics. Students’ attitudes included confidence in their understanding of key concepts in college algebra and confidence in their ability to visualize key concepts, to be successful in future math courses and to apply mathematics into the real world. This survey concentrated on the attitudes of students toward mathematics. Since the survey questionnaire was designed backwards, the data were assigned one point for answering with “Very Strongly Agree”, two points for answering with “Strongly Agree”, three points for answering with “Agree”, four points for answering with “Disagree”, five points for answering with “Strongly Disagree”, and six points for answering with “Very Strongly Disagree.”
Open-ended Questions

During Fall 2007, Spring 2008, and Fall 2008, students were randomly selected from the whole number of students who answered the open-ended questions according to Miscellaneous Tables by Shavelson (1995). The number was 70 for each of the Classroom students and Math Zone students in Fall 2007 and Fall 2008, and 60 for each type of students in Spring 2008. They were asked about their attitudes toward mathematics and the feelings about the course they took (Appendix B).

Interview

Seven instructors including three faculty members, two adjunct teachers and two graduate students were interviewed during the three semesters. These instructors had both the Math Zone class and the traditional class teaching experiences and they gave their opinions and feelings on the two types of MAT 101 courses when answering eight interview questions (Appendix C).

Content coding and major theme were used to analyze the survey and interview data and the process was guided by Dr. Sherry Herron of USM: (a). The surveys and interviews were divided into four categories; (b). The survey and interview questions were discussed in their respective categories; (c). Responses to the questions were analyzed and reported categorically. During the process of content coding, the patterns and similarities were found by tracing the frequently used words or sentences with the help of computer technology and then the decision was made on what was important and what was unimportant. Once the data were coded, the statistical treatment was a matter of data processing, followed by further acts and analysis.
**Final Exam**

A common final exam was used to benchmark performance in each semester, which was arranged at the same time for both classes and administered by the same instructors. The MAT 101 final exam contained 37 multiple choice questions, and 4 word problems made by the Developmental Math Committee. The perfect score of the exam was set at 105 points. The assigned time for the exam was 150 minutes. Scores of this exam for both groups were compared.

**Data Analysis**

First, null hypothesis 1 (H\(_{01a}\), H\(_{01b}\), H\(_{01c}\)) was investigated which as stated in Chapter I is:

- H\(_{01a}\): There is no statistically significant difference on MAT 101 final exam scores between Fall 2007 Math Zone students and Classroom students.
- H\(_{01b}\): There is no statistically significant difference on MAT 101 final exam scores between Spring 2008 Math Zone students and Classroom students.
- H\(_{01c}\): There is no statistically significant difference on MAT 101 final exam scores between Fall 2008 Math Zone students and Classroom students.

The final exam scores of the Math Zone students and the Classroom students in Fall 2007, Spring 2008 and Fall 2008 were tabulated and compared using an independent t-test. Students from the traditional class were the control group. Students enrolled in the Math Zone classes were the experimental group.

Second, null hypothesis 2 (H\(_{02a}\), H\(_{02b}\), H\(_{02c}\)) was investigated which as stated in Chapter I is:
\text{H}_{02a} \text{: There is no statistically significant difference in students’ attitude toward math between Fall 2007 Math Zone students and Classroom students.}

\text{H}_{02b} \text{: There is no statistically significant difference in students’ attitude toward math between Spring 2008 Math Zone students and Classroom students.}

\text{H}_{02c} \text{: There is no statistically significant difference in students’ attitude toward math between Fall 2008 Math Zone students and Classroom students.}

The scores on both Math Zone and Classroom students’ attitudinal surveys in each semester were tabulated and compared using an independent t-test. Students from the traditional class were the control group. Students enrolled in the Math Zone class were the experimental group.

Third, null hypothesis 3 (\text{H}_{03a}, \text{H}_{03b}, \text{H}_{03c}) was investigated which as stated in Chapter I is:

\text{H}_{03a} \text{: There is no relationship between the hours the students spend in the Math Zone and the scores they make on the final exam for Fall 2007 students.}

\text{H}_{03b} \text{: There is no relationship between the hours the students spend in the Math Zone and the scores they make on the final exam for Spring 2008 students.}

\text{H}_{03c} \text{: There is no relationship between the hours the students spend in the Math Zone and the scores they make on the final exam for Fall 2008 students.}

The relationship between the hours students spend in the Math Zone and the scores they get on the final exam was tested by the correlation. The lab hours were the independent variable and the final exam scores were the dependent variable.

All the quantitative data were calculated by using SPSS 15. The significance level for testing all hypotheses was set at 0.05.
Interviews and open-ended survey questions were done following qualitative research methods. The responses to the survey and interview questions were translated and analyzed. Content coding and major theme analysis were used to analyze the survey and interview data. The results of the responses were tabulated and studied with more insight added. This was done to answer Research Question 2 and to add more insight to the study. The questions from both the attitudinal survey and the interviews were divided into four categories or four major themes:

1. General attitude toward math.
2. Confidence in their ability to learn by themselves.
3. Confidence in their ability to succeed in this class.
4. Whether or not the Math Zone program helps the students learn more effectively.

Responses to these questions were then analyzed and reported categorically. Analysis of data was presented in Chapters IV and V. Results and conclusions were presented in Chapter VI.
CHAPTER IV
ANALYSIS OF QUANTITATIVE DATA

Introduction

The purpose of the study was to assess the effect of the Math Zone on MAT 101. The first part of the study was done quantitatively in three consecutive semesters: Fall 2007, Spring 2008, and Fall 2008. One hypothesis was examined on achievement, one hypothesis was examined on student attitudes toward math, and one hypothesis was examined on the relation between the final exam scores and the lab hours. The first two hypotheses on achievement and attitudes were analyzed by independent sample t-tests and the third hypothesis on the relation between the final exams scores and the lab hours was analyzed by a linear regression method. Besides, the mean, the scale, and the standard deviation (SD) of the lab hours were also examined using descriptive statistics analysis. The second part of the study was done qualitatively and results will be discussed in Chapter V.

Subjects

The data were directly collected from 458 students enrolled in Fall 2007, 426 in Spring 2008, and 885 in Fall 2008. Most of the students in both traditional and Math Zone classes were freshmen. Both groups were learning the same subject by using the same textbook and the same final exam made by the department but with different approaches: one was using the Math Zone and the other was using the traditional lecture. The Fall 2007 final exam scores of 119 Math Zone students (experimental group) were compared to the final exam scores of 339 Classroom students (control group). The Spring 2008 final exam scores of 234 Math Zone students were compared to the final exam
scores of 192 Classroom students. The same comparison was made in Fall 2008 between 264 Math Zone students and 621 Classroom students.

In Fall 2007, 251 out of the 485 registered students took the survey about their confidence level in understanding college algebra. This survey was administered in class at the end of the course. The survey scores of 65 Math Zone students were compared to the scores of 186 Classroom students. The same thing was done at the end of Spring 2008, and 230 out of 426 registered students took the survey. The survey scores of 111 Math Zone students were compared to the scores of 119 Classroom students. The same thing was also done at the end of Fall 2008, and 433 out of 885 registered students took the survey. The scores were compared between 103 Math Zone students and 330 Classroom students.

Descriptive Data

Achievement

The evaluation of the effect of the Math Zone on student achievement was based on the final grades of both types of students during the three semesters. By using the independent t-test, the researcher examined the final exam scores of the Math Zone students and Classroom students in Fall 2007, Spring 2008, and Fall 2008. In an average of the three semesters, the mean of the experimental group was 60.32 and the mean of the control group was 61. The scale of the experimental group was between 0 and 105 which was the same as that of the control group. The SD of the experimental group was 31.77 and the SD of the control group was 29.58. All the results for achievement comparisons in details are shown in Table 1.
Table 1

Comparison of Achievement Scores

| Variables | Control Group | | | | Experimental Group | | | |
|-----------|---------------|---|---|---|---|---|---|---|---|
|           | N  | Min | Max | Mean | SD  | n  | Min | Max | Mean | SD  |
| Fall 07   | 339 | 0   | 105 | 65.36 | 30.75 | 119 | 0   | 104 | 65.51 | 32.31 |
| Spring 08 | 192 | 0   | 105 | 56.26 | 28.69 | 234 | 0   | 105 | 51.91 | 29.20 |
| Fall 08   | 621 | 0   | 103 | 61.40 | 29.31 | 264 | 0   | 105 | 63.53 | 33.80 |
| Average   | 384 | 0   | 105 | 61.00 | 29.58 | 205 | 0   | 105 | 60.31 | 31.77 |

Figure 1. Comparison of the final exam mean scores between the two types of students in the three semesters. The lavender color represents the traditional class and the purple color represents the Math Zone class.

Confidence Levels

The confidence level of students in learning and understanding college algebra was determined using the attitudinal survey. The data were analyzed by an independent t-test. The 29 questions were assigned points ranging from 1 to 6 with 1 meaning the least confident and 6 meaning the most confident. In an average of the three semesters, the mean of the experimental group was 115.76 and the mean of the control group was 112.23. Meanwhile, the scale of the experimental group was between 50 and 170 while the scale of the control group ranged from 34 to 171. The SD of the experimental group was...
was 27.42 and the SD of the control group was 31.17. The results in different semesters are shown in Table 2.

Table 2

*Comparison of Confidence Levels*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Control Group</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Experimental Group</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>Min</td>
<td>Max</td>
<td>Mean</td>
<td>SD</td>
<td>n</td>
<td>Min</td>
<td>Max</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Fall 07</td>
<td>186</td>
<td>38</td>
<td>171</td>
<td>112.94</td>
<td>30.69</td>
<td>65</td>
<td>62</td>
<td>171</td>
<td>119.68</td>
</tr>
<tr>
<td>Spring 08</td>
<td>119</td>
<td>30</td>
<td>169</td>
<td>107.99</td>
<td>30.93</td>
<td>111</td>
<td>47</td>
<td>167</td>
<td>110.52</td>
</tr>
<tr>
<td>Fall 08</td>
<td>330</td>
<td>35</td>
<td>173</td>
<td>115.77</td>
<td>31.90</td>
<td>103</td>
<td>42</td>
<td>172</td>
<td>117.09</td>
</tr>
<tr>
<td>Average</td>
<td>635</td>
<td>34</td>
<td>171</td>
<td>112.23</td>
<td>31.17</td>
<td>93</td>
<td>50</td>
<td>170</td>
<td>115.76</td>
</tr>
</tbody>
</table>

*Figure 2.* Comparison of the confidence level mean scores between the two types of students in each of the three semesters. The lavender color represents the traditional class and the purple color represents the Math Zone class.

*Regression*

The linear regression analysis was conducted to evaluate the prediction of the final exam scores from the lab hours. There was a significant relation between the lab hours and the final exam scores in Spring 2008 and Fall 2008 since the p value is less than 0.001. The results are displayed Table 3.
Table 3

Regression

<table>
<thead>
<tr>
<th>Variables</th>
<th>Fall 07</th>
<th>Spring 08</th>
<th>Fall 08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation (Beta)</td>
<td>0.16</td>
<td>0.42</td>
<td>0.49</td>
</tr>
<tr>
<td>R Square</td>
<td>0.025</td>
<td>0.177</td>
<td>0.236</td>
</tr>
<tr>
<td>P Value</td>
<td>0.084</td>
<td><strong>0.000</strong></td>
<td><strong>0.000</strong></td>
</tr>
</tbody>
</table>

The mean, the scale, and the standard deviation of the lab hours were examined using descriptives. In an average of the three semesters, the mean of the lab hours was 27.24, the SD was 14.70, and the scale of the lab hours was between 1.65 and 72.91. The results in details are given in Table 4.

Table 4

Mean, Standard Deviation, and Scale of the Lab Hours

<table>
<thead>
<tr>
<th>Variables</th>
<th>Fall 07</th>
<th>Spring 08</th>
<th>Fall 08</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>26.80</td>
<td>28.11</td>
<td>26.80</td>
<td>27.24</td>
</tr>
<tr>
<td>SD</td>
<td>12.02</td>
<td>16.44</td>
<td>15.65</td>
<td>14.70</td>
</tr>
<tr>
<td>Min</td>
<td>1.65</td>
<td>0</td>
<td>0</td>
<td>0.55</td>
</tr>
<tr>
<td>Max</td>
<td>69.34</td>
<td>73.27</td>
<td>76.14</td>
<td>72.91</td>
</tr>
</tbody>
</table>
Hypotheses

The results from testing the hypotheses of the study are presented in this section. Each one of the three hypotheses is restated and then the analysis of the data is provided for each hypothesis.

*Hypothesis 1a:*

$H_{01a}$: There is no statistically significant difference on MAT 101 final exam scores between Fall 2007 Math Zone students and Classroom students.

This hypothesis was not rejected. There was no statistically significant difference on MAT 101 final exam scores between the two groups in Fall 2007: $t(456) = 0.04$, $p = 0.964$. The mean of the Math Zone students was 65.51, which was not significantly different than 65.36, the mean of the Classroom students. The scale and SD are presented in Table 1.

*Hypothesis 1b:*

$H_{01b}$: There is no statistically significant difference on MAT 101 final exam scores between Spring 2008 Math Zone students and Classroom students.

This hypothesis was not rejected. There was no statistically significant difference on MAT 101 final exam scores between the two groups in Spring 2008: $t(424) = -1.55$, $p = 0.124$. The mean of the Math Zone students was 51.91, which was slightly lower than 56.26, the mean of the Classroom students. The scale and SD are presented in Table 1.

*Hypothesis 1c:*

$H_{01c}$: There is no statistically significant difference on MAT 101 final exam scores between Fall 2008 Math Zone students and Classroom students.
This hypothesis was not rejected. There was no statistically significant difference on MAT 101 final exam scores between the two groups in the semester of fall 2008: $t(883) = 0.89, p = 0.346$. The mean of the Math Zone students was 63.53, which was a slightly higher than 61.40, the mean of the Classroom students. The scale and SD are presented in Table 1.

**Hypothesis 2a:**

$H_{02a}$: There is no statistically significant difference in students’ attitude toward math between Fall 2007 Math Zone students and Classroom students.

This hypothesis was not rejected. There was no statistically difference in students’ attitude toward math between the two groups in Fall 2007: $t(249) = 1.589, p = 0.113$. The mean of the Math Zone students was 119.68, which was slightly higher than 112.94, the mean of the Classroom students. The scale and SD are shown in Table 2.

**Hypothesis 2b:**

$H_{02b}$: There is no statistically significant difference in students’ attitude toward math between Spring 2008 Math Zone students and Classroom students.

This hypothesis was not rejected. There was no statistically significant difference in students’ attitude toward math between the two groups in Spring 2008: $t(228) = 0.659, p = 0.511$. The mean of the Math Zone students was 110.52 which was slightly higher than 107.99, the mean of the Classroom students. The scale and SD are shown in Table 2.

**Hypothesis 2c:**

$H_{02c}$: There is no statistically significant difference in students’ attitude toward math between Fall 2008 Math Zone students and Classroom students.
This hypothesis was not rejected. There was no statistically significant difference in students’ attitude toward math between the two groups in Fall 2008: \( t(431) = 0.384, p = 0.711 \). The mean of the Math Zone students was 117.09 which was slightly higher than 115.77, the mean of the Classroom students. The scale and SD are shown in Table 2.

**Hypothesis 3a:**

\( H_{03a} \): There is no relationship between the hours the students spend in the Math Zone and the scores they make on the final exam for the Fall 2007 students.

This hypothesis was not rejected. The Fall 2007 regression showed that the two variables had no strong linear relation: \( p = 0.084 \), and \( r^2 = 0.025 \). The scale and SD are presented in Table 4.

**Hypothesis 3b:**

\( H_{03b} \): There is no relationship between the hours the students spend in the Math Zone and the scores they make on the final exam for the Spring 2008 students.

This hypothesis was rejected. The Spring 2008 regression showed that the two variables were strongly linearly related: \( p < 0.001 \), and \( r^2 = 0.177 \). The scale and SD are presented in Table 4.

**Hypothesis 3c:**

\( H_{03c} \): There is no relationship between the hours the students spend in the Math Zone and the scores they make on the final exam for the Fall 2008 students.

This hypothesis was rejected. The Fall 2008 regression gave the same significant result as Spring 2008: \( p < 0.001 \), and \( r^2 = 0.236 \). The scale and SD are presented in Table 4.
Summary

In summary, there was no significant difference on MAT 101 final exam scores between the two types of students in Fall 2007, Spring 2008, and Fall 2008. The Math Zone students scored slightly higher than the Classroom students in Fall 2007 and 2008, but slightly lower in Spring 2008. Meanwhile, there was no significant difference in students’ attitudes toward math between the two groups. The Math Zone students scored slightly higher in each of the three semesters. However, there was a significant relationship between the hours the students spent in the Math Zone and the scores they made on their final exams in Spring 2008 and Fall 2008. The hours students spent in the Math Zone had a positive correlation to the scores they made on their final exams in these two semesters.
CHAPTER V
ANALYSIS OF QUALITATIVE DATA

Introduction

Qualitative analysis consists of two parts: one is the survey among students and
the other is the interview with the instructors. The analysis was conducted to answer
Research Question 3: What are the attitudes of students toward math in both the Math
Zone and traditional classes? For the Math Zone students, 70 were randomly selected
from 90 surveyed in Fall 2007, 60 were randomly selected from 111 in Spring 2008, and
70 were randomly selected from 103 in Fall 2008. For the Classroom students, 70 were
randomly selected from 186 surveyed in Fall 2007, 60 were randomly selected from 119
in Spring 2008, and 70 were randomly selected from 330 in Fall 2008. The interviews
were conducted with seven instructors: three faculty members, two adjunct teachers, and
two graduate teaching assistants. The interviewed instructors were chosen based on their
teaching background: they must have both traditional and Math Zone teaching
experiences. Two instructors were interviewed in Fall 2007, two were interviewed in
Spring 2008, and three were interviewed in Fall 2008. Questions from the surveys and
interviews were divided into four categories or four major themes:

1. General attitude toward math.
2. Confidence in their ability to learn by themselves.
3. Confidence in their ability to succeed in this class.
4. Whether or not the Math Zone program helps the students learn more
effectively.
Descriptive Survey Data

The survey was conducted among the students enrolled in Fall 2007, Spring 2008 and Fall 2008. The survey contains six open-ended questions and five of them were analyzed. Question 6 was not analyzed since the question was only used to check their lab hours. Students were asked to explain their answers for all the questions. Out of the 6 questions, 3 were yes-no questions. These questions were numbered 3, 4, and 5. Students were asked to explain their responses. Responses that were not a definite “Yes” or a definite “No” were designated as “Other.” Tables 5 to Table 10 summarize the responses for those five questions. The questions from the surveys and the interviews were distributed and discussed among their respective categories.

General Attitude toward Math (1)

Survey Question 1: What is your general attitude toward math? Please describe how you feel about math in general.

Category 1 includes Survey Question 1. The responses to this survey question were compiled and then categorized as being positive toward math, negative toward math, or a combination of both (mixed). The responses to this survey question were also categorized as being not challenging, hard, or it depends on the teacher. Following the examples listed below, the numbers and percentages of the responses to this question are shown in Table 5.

Positive

1. Math is very enjoyable. I like to use formulas to solve problems.
2. I have always enjoyed math although upper level math is difficult.
3. I love math. It is very interesting to me because I like problem solving.

*Negative*

1. To be honest, I hate math. In my view it is useless.
2. I hate math. It makes me want to cry.
3. I hate math. It is boring and hard. I just take it because I have to.

*Mixed*

1. Math is challenging, but it is something that comes easy to me. We do it everyday.
2. Math is interesting and challenging. It can be extremely easy or very hard.
3. Math is hard but I do feel a sense of accomplishment when I get an answer right.

*Not Challenging*

1. I enjoy math, but sometimes I feel as if I am not challenged enough and get bored.
2. Math is slightly boring because I have done this before.
3. Math is generally easy after a few practice problems, but it is never interesting.

*Hard*

1. It is hard and complicated.
2. Math is hard. It doesn't come easy for me.
3. Math is not interesting at all, and it has always been very hard for me since I was in high school.

*Teacher*

1. I think it really depends on the teacher because I am not so strong in math.
2. It is easy as long as I have a good teacher. My attitude is somewhat neutral.
3. It depends on my instructor. If my instructor’s lectures are exciting, I will enjoy the class.
Table 5

Numbers and Percentages of Responses to Survey Question 1

<table>
<thead>
<tr>
<th>Class</th>
<th>Semester</th>
<th>Positive</th>
<th>Negative</th>
<th>Mixed</th>
<th>Not Challenging</th>
<th>Teacher</th>
<th>Hard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom</td>
<td>Fall 07</td>
<td>27(38%)</td>
<td>15(21%)</td>
<td>13(18%)</td>
<td>7(10%)</td>
<td>7(10%)</td>
<td>2(3%)</td>
</tr>
<tr>
<td></td>
<td>Spring 08</td>
<td>12(20%)</td>
<td>17(28%)</td>
<td>25(42%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>6(10%)</td>
</tr>
<tr>
<td></td>
<td>Fall 08</td>
<td>24(34%)</td>
<td>15(21%)</td>
<td>17(24%)</td>
<td>3(4%)</td>
<td>4(7%)</td>
<td>9(10%)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>31%</td>
<td>23%</td>
<td>28%</td>
<td>5%</td>
<td>6%</td>
<td>7%</td>
</tr>
<tr>
<td>Math Zone</td>
<td>Fall 07</td>
<td>20(29%)</td>
<td>9(13%)</td>
<td>27(38%)</td>
<td>8(12%)</td>
<td>3(4%)</td>
<td>2(3%)</td>
</tr>
<tr>
<td></td>
<td>Spring 08</td>
<td>16(27%)</td>
<td>15(25%)</td>
<td>20(33%)</td>
<td>3(5%)</td>
<td>1(2%)</td>
<td>5(8%)</td>
</tr>
<tr>
<td></td>
<td>Fall 08</td>
<td>26(37%)</td>
<td>10(14%)</td>
<td>22(31%)</td>
<td>4(6%)</td>
<td>3(4%)</td>
<td>5(7%)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>31%</td>
<td>17%</td>
<td>34%</td>
<td>8%</td>
<td>4%</td>
<td>6%</td>
</tr>
</tbody>
</table>

Figure 3. Comparison of the percentages of responses to Survey Question 1 organized by categories between the two groups on an average of the three consecutive semesters. The lavender color represents the Classroom students and the purple color represents the Math Zone students.
Confidence in the Ability to Learn by Themselves (2)

Survey Question 7: Do you think you are an independent learner? Why or why not?

Category 2 includes Survey Question 7. The responses to this survey question were directly obtained as being “Yes” or “No” since the question was a yes-no question. The responses to this survey question were designated as being other if the student gave the neutral or the complicated statement. The numbers and percentages of the responses are shown in Table 6.

Table 6

Numbers and Percentages of Responses to Survey Question 7

<table>
<thead>
<tr>
<th>Class Type</th>
<th>Semester</th>
<th>Yes</th>
<th>No</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom</td>
<td>Fall 07</td>
<td>40(57%)</td>
<td>17(24%)</td>
<td>13(19%)</td>
</tr>
<tr>
<td></td>
<td>Spring 08</td>
<td>29(48%)</td>
<td>24(40%)</td>
<td>6(10%)</td>
</tr>
<tr>
<td></td>
<td>Fall 08</td>
<td>34(49%)</td>
<td>22(31%)</td>
<td>14(20%)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>51%</td>
<td>32%</td>
<td>16%</td>
</tr>
<tr>
<td>Math Zone</td>
<td>Fall 07</td>
<td>41(59%)</td>
<td>16(23%)</td>
<td>12(17%)</td>
</tr>
<tr>
<td></td>
<td>Spring 08</td>
<td>36(60%)</td>
<td>15(25%)</td>
<td>9(15%)</td>
</tr>
<tr>
<td></td>
<td>Fall 08</td>
<td>47(67%)</td>
<td>15(21%)</td>
<td>8(11%)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>62%</td>
<td>23%</td>
<td>14%</td>
</tr>
</tbody>
</table>
Figure 4. Comparison of the percentages of responses to Survey Question 7 between the two groups in an average of the three semesters. The lavender color represents the Classroom students and the purple color represents the Math Zone students.

**Confidence of Their Ability to Succeed in This Class (3)**

Survey Question 2: What grade did you expect to earn in this class? Please describe the reason.

Category 3 includes Survey Question 2. The responses to Survey Question 2 were directly obtained as A, B, C or D since this survey question is the multiple choice question. The numbers and percentages of the responses to this survey question are displayed in Table 7.
Table 7

Numbers and Percentages of Responses to Survey Question 2

<table>
<thead>
<tr>
<th>Class Type</th>
<th>Semester</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom</td>
<td>Fall 07</td>
<td>32(46%)</td>
<td>25(36%)</td>
<td>12(17%)</td>
<td>1(1%)</td>
</tr>
<tr>
<td></td>
<td>Spring 08</td>
<td>14(23%)</td>
<td>27(45%)</td>
<td>15(25%)</td>
<td>0(0%)</td>
</tr>
<tr>
<td></td>
<td>Fall 08</td>
<td>23(33%)</td>
<td>21(30%)</td>
<td>20(29%)</td>
<td>6(9%)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>34%</td>
<td>37%</td>
<td>24%</td>
<td>3%</td>
</tr>
<tr>
<td>Math Zone</td>
<td>Fall 07</td>
<td>26(37%)</td>
<td>27(39%)</td>
<td>8(11%)</td>
<td>4(6%)</td>
</tr>
<tr>
<td></td>
<td>Spring 08</td>
<td>20(33%)</td>
<td>23(38%)</td>
<td>16(27%)</td>
<td>1(2%)</td>
</tr>
<tr>
<td></td>
<td>Fall 08</td>
<td>30(43%)</td>
<td>18(26%)</td>
<td>15(21%)</td>
<td>7(10%)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>38%</td>
<td>34%</td>
<td>30%</td>
<td>6%</td>
</tr>
</tbody>
</table>

Figure 5. Comparison of the percentages of responses to Survey Question 2 between the two groups in an average of the three semesters. The lavender color represents the Classroom students and the purple color represents the Math Zone students.
Survey Question 3: Do you think the class is stressful and frustrating?

Category 3 includes Survey Question 3. The responses to this question were directly obtained as being “Yes” or “No” since the survey question is a yes-no question. The responses were designated as being other if the student gave the complicated statement. The numbers and percentages of the responses are shown in Table 8.

<table>
<thead>
<tr>
<th>Class Type</th>
<th>Semester</th>
<th>Yes</th>
<th>No</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom</td>
<td>Fall 07</td>
<td>24(34%)</td>
<td>24(34%)</td>
<td>22(31%)</td>
</tr>
<tr>
<td></td>
<td>Spring 08</td>
<td>29(48%)</td>
<td>25(41%)</td>
<td>6(10%)</td>
</tr>
<tr>
<td></td>
<td>Fall 08</td>
<td>31(44%)</td>
<td>33(47%)</td>
<td>6(9%)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>41%</td>
<td>43%</td>
<td>16%</td>
</tr>
<tr>
<td>Math Zone</td>
<td>Fall 07</td>
<td>24(34%)</td>
<td>31(44%)</td>
<td>15(21%)</td>
</tr>
<tr>
<td></td>
<td>Spring 08</td>
<td>27(45%)</td>
<td>20(33%)</td>
<td>13(22%)</td>
</tr>
<tr>
<td></td>
<td>Fall 08</td>
<td>30(43%)</td>
<td>29(42%)</td>
<td>11(15%)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>40%</td>
<td>39%</td>
<td>20%</td>
</tr>
</tbody>
</table>
Figure 6. Comparison of the percentages of responses to Survey Question 3 between the two groups in an average of the three semesters. The lavender color represents the Classroom students and the purple color represents the Math Zone students.

**Survey Question 5**: Do you think your interest in math has increased, decreased, or stayed the same?

Category 3 includes Survey Question 5. The responses to Survey Question 5 were directly obtained as being increased, decreased, or the same since this survey question is the multiple choice question. The numbers and percentages of the responses to this question are displayed in Table 9.
Table 9

*Numbers and Percentages of Responses to Survey Question 5*

<table>
<thead>
<tr>
<th>Class Type</th>
<th>Semester</th>
<th>Increased</th>
<th>Decreased</th>
<th>Same</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom</td>
<td>Fall 07</td>
<td>19(27%)</td>
<td>12 (17%)</td>
<td>39(56%)</td>
</tr>
<tr>
<td></td>
<td>Spring 08</td>
<td>12(20%)</td>
<td>13(22%)</td>
<td>35(58%)</td>
</tr>
<tr>
<td></td>
<td>Fall 08</td>
<td>12(17%)</td>
<td>19(27%)</td>
<td>39(56%)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>21%</td>
<td>22%</td>
<td>57%</td>
</tr>
<tr>
<td>Math Zone</td>
<td>Fall 07</td>
<td>20(29%)</td>
<td>12(17%)</td>
<td>38(54%)</td>
</tr>
<tr>
<td></td>
<td>Spring 08</td>
<td>17(28%)</td>
<td>11(18%)</td>
<td>32(53%)</td>
</tr>
<tr>
<td></td>
<td>Fall 08</td>
<td>8(11%)</td>
<td>19(27%)</td>
<td>43(61%)</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>23%</td>
<td>21%</td>
<td>56%</td>
</tr>
</tbody>
</table>

*Figure 7. Comparison of the percentages of responses to Survey Question 5 between the two groups in an average of the three semesters. The lavender color represents the Classroom students and the purple color represents the Math Zone students.*
Descriptive Interview Data

This researcher interviewed seven instructors. Two of them were interviewed in Fall 2007, two were interviewed in Spring 2008, and three were interviewed in Fall 2008. The interview contained eight questions. Questions 4, 6, 7, and 8 were yes-no questions which were directly related to the research question and were analyzed. Questions 1, 2, 3, and 5 were not analyzed since they were free conversations between the researcher and the instructors, but their opinions were mentioned in Chapter 6. Responses that were not a definite “Yes” or a definite “No” were designated as “Other.” Table 10 summarizes the responses to those four questions. The questions and the responses are distributed among their respective categories which are listed below:

**General Attitude toward Math (1)**

**Interview Question 6:** Do you think the students in this program are more motivated than the traditional class students?

Category 1 includes Interview Question 6. The responses to this question were directly collected as being “Yes” or “No” since the survey question was a yes-no question. Responses that were not a definite “Yes” or a definite “No” were designated as “Other.” The numbers of the responses are shown in Table 10.

**Confidence in the Ability to Learn by Themselves (2)**

**Interview Question 7:** Do you think this program is better in training the students to be more of an independent learner than traditional math classes?

Category 2 includes Interview Question 7. The responses to this question were directly collected as being “Yes” or “No” since the survey question was a yes-no question. Responses that were not a definite “Yes” or a definite “No” were designated as “Other.” The numbers of the responses are shown in Table 10.
Whether or not the Math Zone Program Helps the Students Learn More Effectively (4)

**Interview Question 4:** Is the Math Zone program practical so far?

Category 4 includes Interview Question 4. The responses to this question were directly collected as being “Yes” or “No” since this survey question was a yes-no question. The responses were designated as being “Other” if the instructor gave the complicated statement. The numbers of the responses are shown in Table 10.

**Interview Question 8:** Do you think the Math Zone program helps the students learn more effectively?

Category 4 also includes Interview Question 8. The responses to this question were directly collected as being “Yes” or “No” since this survey question was a yes-no question. The responses were designated as being “Other” if the instructor gave the complicated statement. The numbers of the responses are shown in Table 10.

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Yes</th>
<th>No</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q4</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Q6</td>
<td>5</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Q7</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Q8</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Analysis of Survey Data

*General Attitude toward Math* (1)

Category 1 includes questions about general attitude toward math. This topic was addressed in Survey Question 1.

**Survey Question 1:** What is your general attitude toward math? Is it interesting or boring? Is it easy or hard? Please describe how you feel about math in general.

For the Math Zone students, on an average of the three semesters, 31% of them gave positive responses. Their comments were similar to: “I have always enjoyed math and it is my favorite subject.” The percentage of the negative responses was 17%. For example: “I don't enjoy math at all. It is the worst subject” and “I hate math. It's boring. It is hard. I just take it because I have to.” About 34% students gave mixed responses. They had comments like “Math is challenging, but it is something that comes easy to me. We do it every day” and “Math is interesting and challenging. It can be extremely easy or very hard.” Furthermore, 8% students felt the class “Not challenging” and their comments included “I enjoy math, but sometimes I feel as if I am not challenged enough and get bored.” The percentage of the students who felt math “hard” was 6%. They said: “Math is not interesting and is very hard.” Only 4% students mentioned teacher as a factor. They thought that their interest in math really depended on the teacher.

For the Classroom students, 31% of them showed their positive attitudes. Their comments included “I love math. It is very interesting to me because I do like problem solving” and “I love math. We always struggled but hard work pays off.” The percentage of their negative responses was 23%. They had similar comments such as “To be honest, I hate math. In my view, it is useless” and “I hate math. It makes me want to cry.” There
were 28% of students who had mixed feelings. For example, “Math is not at all interesting. However, I do feel a sense of accomplishment when I get an answer right” and “I think math is all right. It is interesting and may be challenging at times but if you learned, then it is easy.” Only 5% of them felt the class “Not challenging.” Their comments were like “Math is boring because I have done this before.” Meanwhile, 7% of students felt math “hard” and they gave comments like “Math is hard. It doesn't come easy for me.” In addition, 6% of them mentioned teacher as a factor. For example, “My interest in math depends on my instructor. If my instructor’s lectures are exciting, I will enjoy the class.”

*Confidence in the Ability to Learn by Themselves (2)*

Category 2 includes questions about students’ confidence in the ability to learn by themselves. This topic was addressed in Survey Question 6.

**Survey Question 6:** Do you think you are an independent learner? Why or why not?

For the Math Zone students, on an average of the three semesters, 62% of them said that they were independent learners. They thought that they should be an independent learner in the Math Zone class and that they need to figure out problems by themselves. Many of their comments were: “I can learn on my own,” “I enjoy grasping things by myself,” and “The Math Zone program requires independent learners.” The percentage of the students who stated that they were not independent learners was 23%. They claimed that they need to be taught. The comments included “I can not learn on my own,” “I always need help in math,” and “I like having help from others.” However, 14% of the students did not respond with “Yes” or “No.” They stated with “Yes and No” or
“Sometimes.” The comments included “I need help for some problems,” “I need to be taught when I get stuck,” and “It depends on what subject I am learning.”

For the Classroom students, 51% of them claimed that they were independent persons and that they liked to learn things on their own. Some comments were as follows: “I prefer to work problems on my own and use class as reinforcement,” “I basically passed this class without any communication with the teacher,” and “I don't have to learn from the teacher because I can look at a problem and know how to work it.” At the same time, 32% of the students said that they did need a teacher and their comments included “I always need someone to guide me” and “I feel I need someone to teach me everything I need to know.” However, 16% of the students did not respond with “Yes” or “No.” They responded by “Yes and No,” “Sometimes,” and “It depends.” For example, one student said “If I was given good instruction, I can normally take over from there;” another comment was “I like to study on my own but if I have a problem, I will ask for help. After I understand, I will continue by myself.”

**Confidence in their Ability to Succeed in This Class (3)**

Category 3 includes questions about students’ confidence in their ability to succeed in this class. This topic was addressed in Survey Question 2, 3, and 5.

**Survey Question 2:** What grade did you expect to earn in this class, A, B, C, or D? Please describe the reason.

For the Math Zone students, on an average of the three semesters, 38% of them responded A. They gave their reasons like “We had a very good foundation in math and we worked hard at our homework and quizzes.” Meanwhile, 34% of them stated that they expected a B, and the most reasons to this answer were “That is my current average.”
Moreover, 20% of the students gave a C response to this question by saying that math was not their strong subject, and that they just wanted to pass the class. Only 6% of the students responded with a D. Most of them explained that they had never been good in math.

For the Classroom students, 34% of them gave their responses with an A by stating that they usually did well in math, and had a strong high school background. The percentage of the B responses was 37%. The reason for this answer was similar to the Math Zone students. For example, some responses are “I always made B’s in math” and “That was my average for a while.” Besides, 24% of them expected a C by saying that they had trouble in math or they did not spend enough hours studying it. The percentage of the D responses was only 3%. They admitted that they were bad at math, and that they had never liked this subject.

Survey Question 3: Do you think the class is stressful and frustrating? Why or why not? For the Math Zone students, on an average of the three semesters, 40% of them felt that the class was stressful and frustrating. Their reasons included “It is hard to do math on a computer,” “I don’t like to teach myself,” and “I am not good at math.” On the other hand, 39% of the students did not think the class was stressful or frustrating. They gave comments like “The class is easy, and I am succeeding,” and “It is just a review.” However, 20% of the students did not respond by “Yes” or “No.” Their responses included: “A kind of,” “Sometimes” and “It depends.” For example, “I think it can be stressful and frustrating when learning a new concept, but I have been learning them fairly well, so it is not bad,” “This class is not stressful but the work entitled to the class
is frustrating to me due to my poor background,” and “Sometimes, especially if you have to get hours every week in the math lab.”

For the Classroom students, 41% of them felt that the class was stressful and frustrating. They made their comments like “The course is too much and too fast,” “My teacher does not teach well and makes even harder,” and “I did not prepare from high school.” Meanwhile, 43% of them did not think so. Their comments were similar to those of the Math Zone students. For example, some responses were “I have a good high school background,” “We have a good teacher, who explains math well and prepares as well,” and “I feel it is a review of things I have already learned.” There were 16% of the students who did not say by “Yes” or by “No.” Their responses included “Yes and no,” “Sometimes,” and “It depends.” For example, some responses were “Sometimes I will get lost, or the teacher will get lost and I won't understand what's going on,” and “The class itself is not stressful but the online homework is because they count things wrong even when the answer is correct.”

**Survey Question 5:** Do you think your interest in math has increased, decreased, or stayed the same after taking this class? Please describe the reason.

For the Math Zone students, 23% of them thought that their interest in math had increased. The main reason was that they made progress in the ability to solve math problems on their own and that they were more confident by themselves. For example, some responses were “The Math Zone has made math easier to understand,” “I can solve more and more problems on my own,” “I think my interest in math has increased because I see how much stronger I am in this class,” and “I am able to really understand how to do the problems and I can be sure of answers by practicing in the lab.” Meanwhile, 21%
of the students responded to this question by “decreased.” The reasons included “Math is not fun when you are required to teach yourself,” “It is all computer-based and it is hard for me to learn something like that instead of an actual teacher,” and “This class does not have enough in-class time.” However, 56% of the students thought that their interest in math had neither increased nor decreased but stayed the same as before. “The same” has three categories: “positive,” “negative,” and “ok.” The comments included “My interests stay the same, I have always loved math” (positive), “Stay the same, I am never interested in math” (negative), and “It is not my favorite subject, but I can mainly tolerate it” (ok).

For the Classroom students, 21% of them stated that their interest in math had increased. The reason for this response was that they had a good instructor. For example, “My interest in math has increased due to the teacher who explained the materials well,” and “My current teacher is better than my high school teacher.” The percentage of the opposite responses was 22%. They said that their interest in math had decreased. Their reasons contained two factors: the teacher of the class and the concept of the math. For example, some responses were “Because it is more complicated and it stressed me out more,” “Because the teacher doesn't go over things very well and rushes,” and “It just seems pointless and I don’t understand the concept.” The percentage of the students who thought that their interest had stayed the same was 57% in an average of the three semesters. For example, some responses were “My interest stays the same. I always enjoy math” (positive), “Stay the same, because I am an average student” (ok), and “The same. I hate math because I am never good in this subject” (negative).
Analysis of Interview Data

General Attitude toward Math (1)

Category 1 includes questions about students’ general attitude toward math. This topic was addressed in Interview Question 6.

**Interview Question 6:** Do you think the students in this program are more motivated than the traditional class students?

Out of seven interviewed instructors, five instructors expressed that the students in this program were more motivated than the traditional class students. Their comments included “They have to read book by themselves in this class,” “They must be their own motivation, because they have little contact with their instructor unless they specifically seek him or her out during the Math Zone hours,” and “The online assignments seem to be a great motivator for some reason. Maybe it's because students are given instant feedback about their grades.” One instructor did not think that the students were more motivated in this program. The comment was: “They like that they only need to go to class once per week but they tend to dislike the Math Zone,” and the other instructor did not give any comment.

Confidence in the Ability to Learn by Themselves (2)

Category 2 includes questions about students’ confidence in the ability to learn by themselves. This topic was addressed in Interview Question 7.

**Interview Question 7:** Do you think this program is better in training the students to be more of an independent learner than traditional math classes?

All seven instructors strongly felt that this program is better in training the students to become more independent learners. They agreed that this was the greatest
benefit of this program. They thought that this program really made the students take
learning into their own hands so that they had more opportunity to work at their own pace
as opposed to traditional classrooms. However, they also felt that some students seemed
to have trouble realizing how much responsibility for learning the material rests on them.
Those students need to know that they cannot succeed in class without the sense and
ability of independent learning. For example, one instructor said, “It can be much better
at training them to be independent learners. But lots of them do not really want to learn.”

**Whether or Not the Math Zone Program Helps the Students Learn More Effectively (4)**

Category 4 includes questions about whether or not the Math Zone program helps
the students learn more effectively. This topic was addressed in Interview Question 4 and
Interview Question 8.

**Interview Question 4: Is the Math Zone program practical so far?**

The entire seven interviewed instructors thought the Math Zone program was
practical. Their opinions are concluded as follows: “This program really makes the
students learn more actively,” “Due to the excellent management of the Math Zone
director, this program is very practical,” and “The work has been centralized. The tests,
syllabi, etc are prepared by one person instead of each teacher having to do his/her own,”
and “Since college algebra is a core course and a prerequisite for all other math courses,
this format provides more consistency between the classes. Each class is assigned the
same assignments; each class is tested the same; each class moves at the same pace and
as with the traditional classes they are all given the same final exam.”
Interview Question 8: Do you think the Math Zone program helps the students learn more effectively?

Out of the seven instructors, five indicated that the Math Zone helps the students learn more effectively. They said: “The Math Zone helps the students learn more effectively because they have the opportunity to get help as they need it and more students are being successful,” “They are learning the concepts better, primarily due to constant exposure to the material,” “I believe we have the means within this program to accommodate the needs of every student that wants to learn the material.” Two instructors answered this question with neither “Yes” nor “No.” One instructor said, “It depends on what kind of students. If the students are fast learners, the Math Zone is more effective.” The other comment was: “If used correctly, this computer-based course is capable of allowing the students to learn the mathematics just as well as in a traditional based class. Again, the students have to make an effort to use the resources that they need to be successful.”

Summary

According to the responses to the Survey Question 1 (Category1), the Math Zone students had somewhat more positive attitude toward math than the Classroom students. The results of the Survey Question 6 and Interview Question 7 (Category 2) told us that the Math Zone students were more independent in learning MAT 101. In answering Survey Questions 2, 3, and 5 (Category 3), the Math Zone students had more confidence in their ability to succeed in this math course. Seven instructors’ responses to the interview questions indicated that the Math Zone program is practical, which helps the students learn more effectively.
CHAPTER VI

SUMMARY, CONCLUSIONS, AND SUGGESTIONS

Introduction

This chapter presents a summary of the findings and conclusions of both quantitative data analysis and qualitative study. Conclusions are then followed by suggestions made as a result of the findings of this study. The general purpose of this study was to determine the effect of the redesign on students’ achievements in comparison to the effect of a traditional approach to college algebra. The specific questions of the study were:

1. Is there a difference in MAT 101 final exam scores between the students using the Math Zone as the instructional delivery method and those experiencing the traditional method of classroom delivery?

2. What are the attitudes of students toward math in both the Math Zone and traditional classes examined by the use of surveys and interviews?

3. Do the hours students spend in the Math Zone have a positive correlation to the scores they make on the final exam?

Summary of Procedures

The study was conducted in Fall 2007, Spring 2008, and Fall 2009. Students enrolled in the three consecutive semesters were directly involved. Final exams scores were collected from 339 Classroom students and 119 Math Zone students enrolled in Fall 2007. Final exam scores were also collected from 192 Classroom students and 234 Math Zone students enrolled in Spring 2008, and 621 Classroom students and 264 Math Zone students in Fall 2008. In the first part of this study, an independent t-test was used to
compare achievement scores (scores on final exams) of the Math Zone students to the Classroom students. Further the data from the attitudinal surveys conducted for both types of classes in Fall 2007, Spring 2008, and Fall 2008 were analyzed using the independent t-test. In addition, the relation between the final exams scores and the lab hours was analyzed by a linear regression method. The mean and SD of the lab hours were also examined using descriptive statistics. In the second phase of the study, interviews and the attitudinal survey questions were analyzed using content coding and major theme analysis. The attitudinal survey on open ended questions was conducted for both types of classes in Fall 2007, Spring 2008, and Fall 2009. Moreover, seven instructors were interviewed during the three semesters. The questions from both the survey and the interviews were divided into four categories or four major themes:

1. General attitude toward math.
2. Confidence in their ability to learn by themselves.
3. Confidence in their ability to succeed in this class.
4. Whether or not the Math Zone program helps the students learn more effectively.

Summary of Quantitative Results

Analysis of the data resulting from testing of the hypotheses was provided in Chapter IV. A summary of those tests is listed below:

1. There was no statistically significant difference on MAT 101 final exam scores between the Math Zone students and the Classroom students in each of the three semesters. However, the mean value of the Math Zone students was slightly higher than that of the Classroom students in Fall 2007 and Fall 2008, but slightly lower than that of the Classroom students in Spring 2008.
2. There was no statistically significant difference in students’ attitude toward math between the Math Zone students and the Classroom students, but the mean value of the Math Zone students was slightly higher than that of the Classroom students in each of the three semesters.

3. There was a significant relationship between the hours the students spent in the Math Zone and the scores they made on the final exam in Spring 2008 and Fall 2008.

Summary of Qualitative Results

Analysis of the four categories from the open-ended question surveys and interviews was provided in Chapter V. A summary of those results are listed below:

1. The students enrolled in the Math Zone classes had somewhat more positive attitude toward math.

2. The students enrolled in the Math Zone classes had more confidence in their ability to learn by themselves.

3. The students enrolled in the Math Zone classes had more confidence in their ability to succeed in their class.

4. It was agreed that the Math Zone program helps the students learn more effectively.

Conclusions

Using the data presented in Chapters IV and V, the following conclusions were drawn:

Achievement

The quantitative data concerning achievement revealed no significant difference between any of the two groups in Fall 2007, Spring 2008 and Fall 2008. Students who
enrolled in Math Zone class did not differ from students who did not. The data from these measurements were displayed in Table 1.

Confidence Levels

The quantitative data concerning the confidence level of students in learning and understanding college algebra revealed no significant difference. The mean value of the Math Zone students was slightly higher than that of the Classroom students enrolled in Fall 2007, Spring 2008, and Fall 2008. The data from this measurement were displayed in Table 2.

Attitudes toward Mathematics

In the open-ended attitudinal survey, on an average of the three semesters, the attitude toward math of the Math Zone students was somewhat more positive than that of the Classroom students. The negative responses were given by more of the Classroom students. In addition, a greater number of the Classroom students had “mixed” feelings about math and they believed that teacher was an important factor for their interest in math. Some students felt that their interest depended on the topic or the concept of the math. The data analysis was displayed in Table 5.

Regression

There was a significant linear relationship between the hours the students spent in the Math Zone and the scores they made on their final exams during the spring of 2008 and the fall of 2008 semesters. The more lab hours the students spent, the higher their final exams scores were. The data analysis was displayed in Table 3.
Descriptives

The Spring 2008 students spent more time in the Math Zone compared with the students in Fall 2007 and Fall 2008. The Fall 2007 data gave the smallest SD. The data analysis was displayed in Table 4.

Confidence in the Ability to Learn by Themselves

In general, more Math Zone students claimed that they were independent learners because the Math Zone program led them to be independent learners since there was only one lecture per week which was different from traditional classes. Interviewed instructors answered Question 7 related to this theme. They all thought that the students using Math Zone program were more independent learners than those in the traditional classes. See the summary of Chapter V.

Confidence of Their Ability to Succeed in This Class

Surveyed students answered three questions related to this theme. In answering the questions for this category, the Math Zone students from each of the three semesters seemed to have more confidence in their abilities to succeed in their classes. They thought that they did not feel frustrated in class and that they expected an “A.” They also claimed their interest in math had increased.

Whether or Not the Math Zone Program Helps the Students Learn More Effectively

Interviewed instructors answered Question 8 related to this theme. Out of the seven interviewed instructors, five indicated that the Math Zone program helped the students learn more effectively. One instructor thought that the effectiveness depended on the kind of student and that if the students were fast learners, the Math Zone program was more effective. The other instructor said that it depended on whether the program was used
correctly. In conclusion, most instructors liked the Math Zone program and they thought it was a good program which was practical and worthwhile. They thought that students were more motivated to be independent learners to succeed in this computer-based class.

Discussion

Achievement

The results of this study did not strongly support the literature findings when it comes to achievement. Many of the studies showed that students using computer-based program in learning lower level math such as college algebra scored higher than the students experiencing the traditional method of classroom delivery. In this study, there was no significant difference in achievement scores between these two types of students. This study was unique. First, the two groups compared in this study enrolled in the same semester. Second, the comparison was made in three consecutive academic years: Fall 2007, Spring 2008 and Fall 2008. Third, the comparison was not only in a horizontal direction between the two groups but also vertically among three semesters. In Fall 2007 and Fall 2008, the Math Zone students (the experiential group), scored slightly higher in final exams than the Classroom Students (control group). However, in Spring 2008, the control group scored slightly higher than the experiential group. This finding has suggested that instructors take more responsibilities in teaching a traditional class, because it is a critical factor in students’ achievements. More of the Classroom students mentioned the factor of teacher which may explain why the Classroom students performed better than the Math Zone students in Spring 2008. This finding also suggested that students spend more time practicing in the Math Zone because the variable of the lab hours is the predictor of their success in this course.
Confidence Levels

There was no statistically significant difference in students’ attitude toward math between the Math Zone students and the Classroom students. In the quantitative study, the Math Zone students from the three consecutive semesters scored slightly higher in confidence levels, proved in the qualitative study. Generally speaking, the Math Zone students did have more confidence in their ability to learn by themselves because the responsibility for learning the material primarily rested on their shoulders. However, the Math Zone class requires a considerable amount of time and discipline, and the students who do not want to put in the amount of time will not be successful.

Attitudes toward Mathematics

In the three consecutive semesters, both quantitative and qualitative studies show that the students from the Math Zone class had somewhat more positive attitudes toward math than the Classroom students although there were no significant differences. This result supports the literature findings when it comes to the attitude discussed by Askar, Yavuz, and Kosal (1992). They found a positive correlation between students’ attitude toward math and their outcomes in the computer-assisted algebra course. This result also proves the previous study by Tall and Razali (1993), which made the egg and chicken arguments: “Computer-based learning can stimulate students’ positive attitude toward math since success leads to positive attitudes about the subject.”

Regression

There was a significant linear relationship between the hours the students spent in the Math Zone and the scores they made on the final exam during Spring 2008 and Fall
2008. The lab hours were the predictor of the students’ final exam scores. The finding indicates the core of this computer-based program, the changing role between the students and the instructors, and it correlates with the literature discussing the Changes in Pedagogy. Traditional teaching based on behaviorist views of learning is being replaced by inquiry-based teaching, reflecting a constructivist view of learning (Handal & Herrington, 2003). Snyder (2004) discovered that teachers’ duties had become shared when using a computer-based software in a college algebra course. “Less instructor hours (efficient) provide more one-on-one help lab hours to students (effective),” said one instructor during the interview. This significant result also correlates with the concerns from an interviewed instructor who pointed out that some students did not take advantage of the resources available to them. They seemed to want to do the bare minimum in this class and as a result they would not succeed in this class. This concern was also presented by Snyder (2004). She suggested that for the success in a computer-based class, students must have the self-discipline to be engaged through the software and persist in doing the work independently. So, how to make the students spend enough time in the lab efficiently and how to make them be their own motivation have been the main tasks for the manager or the administrator of this program.

Confidence in the Ability to Learn by Themselves and Succeed in This Class

The result of the study shows that more Math Zone students had confidence in their abilities to learn by themselves and succeed in this class which reflected their positive attitude toward learning math. According to the previous study on attitude, motivation and achievement in mathematics learning, Ma (1997) found that a positive attitude toward the subject was correlated with success. On the other hand, success can
also stimulate students’ positive attitude which is the egg and chicken argument again by Tall and Razali (1993). This survey was conducted at the end of each semester when students had experienced their class. Their positive attitude reflected their sense of success in the class.

Limitations

The main limitation in this study was the limited generalizability to measure difference in confidence levels since the number of both type of students, especially the Math Zone students, was inadequate in size.

Suggestions for Practice

This research shows that students, in general, performed well in the Math Zone class, a computer-based college algebra program. The research also shows the significant relation between the lab hours and the students’ final exam scores. Both quantitative and qualitative studies show that in the three semesters, the students enrolled in the Math Zone class scored slightly higher in achievements and attitudes than those who enrolled in the traditional class although there was no significant difference. It is expected that significance will be possible in the future if something is done. In general, students had to adjust their roles, duties, and responsibilities and so did the instructors. They are no longer “the sage on the stage” but “the coach of the team.” Once a computer-based mathematics course has been implemented, the role of the instructor becomes that of a facilitator (Villarreal, 2003). Teachers who wish to make good use of the Math Zone should take this into consideration: many students do not take advantage of the resources available in MyMathLab. Instructors teaching Math Zone classes need training so that they can show students how to use and learn from the resources available in MyMathLab.
Many of the students felt the class frustrating not because of the math but because of the computer. These issues were discussed in the literature review: the rapid growth and improvement in technology exceed current knowledge of how to effectively use technology in schools and the impact of technology is different than it was in the past (Allen, 2001). Since the lab hours are the predictor of students’ outcome, it is necessary for the individual student to have the self-discipline to be engaged through the software and persist in doing the work independently (Snyder, 2004).

Suggestions for Future Research

After the researcher analyzed the results of this study, the following suggestions were made:

1. Study should be replicated in other academic institutions. This would give more insight about the effect of the Math Zone program into diverse settings.

2. Study should be repeated in other mathematics disciplines. This would give a better picture of the difference in the effect of the Math Zone between introductory and advanced levels of math.

3. Study should pay more attention to the faculty attitudes of computer assisted learning.
APPENDIX A

HUMAN SUBJECTS DOCUMENTATION

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

Institutional Review Board

118 College Drive #5147
Hattiesburg, MS 39406-0001
Tel: 601.266.6820
Fax: 601.266.5509
www.usm.edu/irb

HUMAN SUBJECTS PROTECTION REVIEW COMMITTEE
NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Human Subjects Protection Review Committee in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Event Report Form".
- If approved, the maximum period of approval is limited to twelve months.
- Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: 27110105
PROJECT TITLE: Assessing the Impact of Computer-Based College Algebra Course
PROPOSED PROJECT DATES: 10/29/07 to 05/31/09
PROJECT TYPE: Dissertation or Thesis
PRINCIPAL INVESTIGATORS: Ningjun Ye
COLLEGE/DIVISION: College of Science & Technology
DEPARTMENT: Center for Science & Mathematics Education
FUNDING AGENCY: N/A
HSPRC COMMITTEE ACTION: Expedited Review Approval
PERIOD OF APPROVAL: 11/12/07 to 11/11/08

[Signature]
Lawrence A. Homan, Ph.D.
HSPRC Chair

Date
APPENDIX B

ATTITUDINAL SURVEY

Directions: Each of the statements expresses a feeling, which a particular person has toward mathematics. You are to express, on a six-point scale, the extent of agreement between the feeling expressed in each statement and your personal feeling. The six points are: A. Very Strongly Agree, B. Strongly Agree, C. Agree, D. Disagree, E. Strongly Disagree, and F. Very Strongly Disagree.

1. I can not enjoy taking mathematics courses, as math is not very interesting to me.
   A.   B.   C.   D.   E.   F.

2. Even thinking about having to do a math problem makes me nervous.
   A.   B.   C.   D.   E.   F.

3. I feel insecure when doing mathematics.
   A.   B.   C.   D.   E.   F.

4. I have less confidence in my mathematics ability than in my ability with other academic subjects.
   A.   B.   C.   D.   E.   F.

5. Mathematics makes me feel awkward, irritable, impatient, and uncomfortable.
   A.   B.   C.   D.   E.   F.
6. I have fear of not being able to do math, so I approach math problems with a feeling of hesitation.

A. B. C. D. E. F.

7. I have not always enjoyed studying mathematics at school.

A. B. C. D. E. F.

8. My mind goes blank when I do math, and I am unable to concentrate or think clearly.

A. B. C. D. E. F.

9. I have forgotten many mathematics concepts that I have learned.

A. B. C. D. E. F.

10. I never have a positive reaction to math. It’s not enjoyable.

A. B. C. D. E. F.

11. I can not cope with a new mathematical situation, since I have a poor background in mathematics.

A. B. C. D. E. F.

12. I am unsure how to proceed when confronted with a problem different from the problem worked in class.

A. B. C. D. E. F.
13. I am not sure whether I will be able to solve the required problems in this course.

A. B. C. D. E. F.

14. I always refer to my class notes, the textbook or any other help when first attempting to work a problem.

A. B. C. D. E. F.

15. I believe that even if I spend enough time on a math problem, I will not be able to solve it.

A. B. C. D. E. F.

16. Mathematics problems are a challenge, and solving such problems is very frustrating and disappointing.

A. B. C. D. E. F.

17. I don’t like problem solving; it is hard and confusing.

A. B. C. D. E. F.

18. I don’t feel that math classes provide the experiences that are useful in everyday life.

A. B. C. D. E. F.

19. I don’t think I have a wide variety of mathematical techniques I can draw upon to help solve a particular problem.

A. B. C. D. E. F.
20. I feel I have limited grasp of that math knowledge from the math courses I have taken so far.

A. B. C. D. E. F.

21. I learn mathematics not by understanding the underlying principles, but by memorizing rules.

A. B. C. D. E. F.

22. I am not very confident that I will understand the key concepts of this course.

A. B. C. D. E. F.

23. I am not very confident that I will succeed in this course.

A. B. C. D. E. F.

24. I am not very confident that I was able to visualize the key concepts of this course.

A. B. C. D. E. F.

25. I am not very confident that I will be able to apply my knowledge to the real world.

A. B. C. D. E. F.

26. I am not very confident that I will succeed in a math-related discipline (my major).

A. B. C. D. E. F.

27. I would not feel comfortable tutoring anyone in mathematics in grades K-3.

A. B. C. D. E. F.
28. I would not feel comfortable tutoring anyone in mathematics in grades 4-6.

A. B. C. D. E. F.

29. I would not feel comfortable tutoring anyone in mathematics in grades 7-9.

A. B. C. D. E. F.

**Open-ended Questions:**

1. What is your general attitude toward math? Is it interesting or boring? Is it easy or hard? Please describe how you feel about math in general.

2. What grade did you expect to earn in this class? A, B, C, or D? Please describe the reason.

3. Do you think the class is stressful and frustrating? Why or why not?

4. Do you think your interest in math has increased, decreased or stayed the same? Please describe the reason.

5. Do you think you are an independent learner? Why or why not?

6. How many hours per week do you usually spend in Math Zone? Zero, one, two, three or more hours?
APPENDIX C

INTERVIEW PROTOCOL

1. How long have you been teaching math courses?

2. As an instructor, what do you think of your duties on this computer-based course?

3. What do you think of the students’ duties on this computer-based course?

4. Is the Math Zone program practical so far?

5. Could you present the advantages and disadvantages of this program?

6. Do you think the students in this program are more motivated than the traditional class students?

7. Do you think this program is better in training the students to be more of an independent learner than traditional math classes?

8. Do you think the Math Zone program helps the students learn more effectively?
REFERENCES


