ABSTRACT

EDUCATIONAL LEADERSHIP

DAVE, AMIT   B.E. REGIONAL ENGINEERING COLLEGE, 1981

M.B.A. BERRY COLLEGE, 1985

M.S. CLARK ATLANTA UNIVERSITY, 1988

A COMPARISON OF STUDENT PERFORMANCE IN AN ONLINE CLASS

VERSUS A FACE-TO-FACE (TRADITIONAL) CLASS:

A META-ANALYSIS

Advisor: Dr. Trevor Turner

Dissertation dated July 2010

The purpose of this study was to compare student performance in an online college algebra class and a traditional face-to-face (traditional) class so as to determine whether online instruction was more effective than face-to-face (traditional) instruction. The results were expected to provide instructors, administrators, policy makers, and software program writers a better understanding of instructional techniques that can be incorporated along with technology, thus improving student learning and subsequently improving student performance in the class. The results may be important because of claims made by supporters of technology-based education.

The independent variables in the studies were instructional techniques, student perception of online class, experience with web-based/online technology, and demographic variables (age, gender, employment status, and ethnicity). The dependent

variable was student performance in a college algebra class. The study was conducted at a technical college in Atlanta, Georgia. A web-based software program, EDUCOSOFT, was used in the treatment. A pretest was administered to the students enrolled in face-to-face (traditional) class at the beginning of the quarter which determined the weak areas of the student. A study plan was developed on EDUCOSOFT which covered the week areas. Students were required to score a minimum of 70% in the study plan before they were allowed to proceed further. Students were given traditional and online tests and their scores were compared. A posttest and final exam were administered at the end of the term. A survey questionnaire was distributed at the end to the students. Data collected from the tests and questionnaire was used to generate the statistics. The results of the study indicated that gain scores were significantly related to computerized tests and quizzes. Students who made low gain scores viewed the EDUCOSOFT program high and traditional tests and quizzes influenced the final grades significantly. White/ Caucasian and Middle Eastern students gained more than African American and Hispanic students. Results from regression analysis indicated that the EDUCOSOFT program was not effective in helping younger students to learn algebra as compared with older students.

A COMPARISON OF STUDENT PERFORMANCE IN AN ONLINE CLASS

VERSUS A FACE-TO-FACE (TRADITIONAL) CLASS:

A META-ANALYSIS

A DISSERTATION

SUBMITTED TO THE FACULTY OF CLARK ATLANTA UNIVERSITY

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF DOCTOR OF EDUCATION

BY

AMIT DAVE

DEPARTMENT OF EDUCATIONAL LEADERSHIP

ATLANTA, GEORGIA

JULY 2010

ACKNOWLEDGMENTS

First and foremost, I hereby dedicate my Doctoral degree to my father-in-law, the late Mr. Bachubhai M. Desai. I would also like to take this opportunity to express my sincere gratitude to the faculty and staff of the Educational Leadership Department of Clark Atlanta University for their guidance and assistance in the completion of this dissertation. I am especially grateful to Dr. Ganga Persaud, my mentor, for his prompt academic advice throughout each phase of the research process, as well as his sage counsel in many areas during the years that I have been privileged to know him. I am also appreciative of the knowledgeable feedback and direction provided by Dr. Trevor Turner and Dr. Edward Williams, while matriculating through this program. Lastly, but certainly not least, I extend a tremendous amount of appreciation to my family for affording me the constant encouragement and support needed to achieve this phase of my educational career.

TABLE OF CONTENTS

CHAPTER

Table of Contents (continued)

Table of Contents (continued)

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

SUDENT PERFORMANCE IN AN ALGEBRA CLASS IN CONTEXT

Purpose of the Study

The purpose of this study is to compare student performance on algebra in an online class and traditional face-to-face (traditional) class so as to determine whether online instruction was more effective than face-to-face (traditional) instruction when controlling for student demographic variables. The results are expected to be of importance to instructors, administrators of instruction, policy makers and software program writers in mathematics.

Further the results are important because of the various claims made by supporters of the use of technology to enhance student learning in mathematics and related fields. The use of internet has created new opportunities and has expanded learning experiences. The claim is made that technology has changed the way teachers teach and students learn. Since 1994, the National Center for Education Statistics (NCES) has documented the large increase in access to computers and the Internet in the nation's public elementary and secondary schools. Colleges around the nation are offering more and more courses via internet. It is expected that online classes provide a more viable option to nontraditional students such as working individuals with no fixed working hours, stay-at-home mothers, and individuals who travel for job assignments. If colleges were expected to improve their main learning standards through the adoption of technology in

1

instruction, they would need to examine data that would demonstrate the extent to which online classes are more effective than the traditional method of instruction. In 1990, the Software Publishers Association (SPA) published its first *Report on the Effectiveness of Microcomputers in Schools*. In that report, numerous research studies supporting the use of technology as a valuable tool for learning were described. These studies indicated that the use of technology as a learning tool could make a measurable difference in student (a) achievement, (b) attitudes, and (c) interaction with educators and other students. The evidence suggested that positive effects of technology were dependent upon the subject area, characteristics of the student population, the teacher's role, the design of the software and the level of access to technology. Since then, research documenting the effectiveness of educational technology has continued to grow and become more detailed.

Watkins (2005) has recommended several e-learning techniques for instructors and students (e-learners) in order to enhance students' learning in mathematics. With integration of technology in education comes the question of student learning and student perception of online class. Students with the attitude of independent, responsible, and proactive learning style tend to express positive opinion of online learning (Howland & Moore, 2002). Instructors and students are expected to become technologically savvy. Instructors are expected to devise teaching strategies and techniques compatible with the instructional design of the technological software in a manner different from the traditional style to which they have been accustomed. An instructor's role as a facilitator changes in the use of technology drastically from the use of traditional face-to-face

teaching. Therefore, they need to be well trained in distance learning in the use of Power-Point slides, multimedia tools, email and/or online chat room so as to communicate effectively in imparting instructions so as to impact student learning outcomes significantly. If instructors in mathematics are expected to undergo training and adapt technology, they need to be assured by research evidence that the use of technology significantly enable students to make gaining in learning mathematics.

Metro Technical College offers several online classes and the enrollment in online classes has increased significantly. Almost 98% of students out a total of 5,000 students are enrolled in at least one online class. Several factors have affected this increase over past few years. Flexibility and increases in gas prices are the two main factors, since the majority of the students are working students in the age group 18 to 64 years. It is not possible to obtain demographic information of the students due to the college policy of not disclosing personal and confidential information about the students. Most students are over 18 years of age and receive meager or no tuition assistance from their parents. Tuition and expenses are covered by either the employer of the student or by financial aid or HOPE grant/ HOPE scholarship. Policy makers would need to know whether or not such investments in the use of technology in instruction have in fact resulted in the gains made by students when using technology in instruction.

Problem of Student Achievement in a College Algebra Class

Ever since the emergence of online classes, sophisticated computer programs and technological tools have been developed to improve student learning. These tools have also changed the way instructors teach in the classroom as well as in an online class. In

the past years, students in the online college Algebra class tend to perform better than the students in the face-to-face (traditional) classes. There could be a number of reasons for the improved performance in online classes. According to a report published by Software Information Industry Association (2000), technology has been used effectively to support mathematics curricula that focus on problem-solving and hands-on, constructivist, and experiential activities. Students participating in such technology-supported learning experiences have demonstrated superior conceptual understanding of targeted math topics than students receiving traditional instruction.

Table 1 includes grade reports for two Algebra classes at a metropolitan (metro) Technical College. The table represents the grades of students enrolled in an online section and a face-to-face (traditional) section of a college algebra class. The overall class average for the students enrolled in the online class is 88.74. The overall class average for students enrolled in the traditional class is 74.09. There is an obvious difference in student performance between the two forms of classes. The main difference between the classes is the number of "A" and "C" grades. The traditional class has fewer "A" and more "C" grades than the online class. This represents a problem of student achievement in algebra class.

Table 1

Grade Report of two sections of College Algebra Classes at a Metro Technical College,

Summer Quarter 2006

Number of Students	Online Performance		Traditional Class Performance	
	Average Grade	Letter Grade	Average Grade	Letter Grade
1	98.00	A	70.25	C
2	85.00	B	65.00	D
3	85.00	B	70.75	C
4	90.00	A	90.00	A
5	90.00	A	90.45	A
6	80.00	B	80.58	B
7	81.13	B	85.25	B
8	75.82	C	74.35	C
9	93.25	A	71.76	C
10	76.00	C	91.20	A
11	90.00	A	70.50	C
12	96.00	A	87.50	B
13	90.00	A	80.35	B
14	90.00	A	35.25	W
15	90.00	A	90.00	A
16	97.75	A	70.00	C
17	81.50	B	70.00	C

Table 1 (continued)

Number of Students	Online Performance		Traditional Class Performance	
	Average Grade	Letter Grade	Average Grade	Letter Grade
18	27.75	F	70.00	C
19	95.06	A	82.45	B
20	80.00	B	84.75	B
21	80.00	B	74.79	C
22	90.00	A	79.75	B

One simple observation is that students enrolled in the online class seem to perform better compared to the students enrolled in the traditional classroom. This has been supported by various studies. O'Callaghan (1998) found that students using technology in a constructivist college algebra class achieved a better overall understanding of functions and were better at the components of modeling, interpreting, and translating among symbols, tables and graphs than students in two face-to-face (traditional) algebra classes. Students in a Computer-Intensive Algebra (CIA) course completed activities that typically required them to solve problems, often with the help of computer tools (e.g., symbol-manipulation programs), and to describe their methods of solution. Results demonstrated that CIA students had a significantly deeper conceptual understanding of algebra. In another related study, Koedinger, Anderson, Hadley, and Mark (1997) compared performance of ninth grade students using Practical Algebra Tutor (PAT) computer program in 20 nontraditional classrooms with

that of two other groups using a more traditional curriculum, five standard ninth grade

algebra classes, and two "Scholar" academic track algebra classes. Students using PAT

worked in cooperative teams on a National Council of Teachers of Mathematics (NCTM)

standards-oriented problem-solving curriculum, where teachers were free to provide more

individualized help to students. PAT is an intelligent computer program that presents

skills in the context of authentic, realistic problem-solving tasks. On two standardized

tests with basic skills objectives, PAT students scored as well or better than the standard

algebra classes (significantly higher on one test), even though this was not a primary

focus of the curriculum. On two NCTM-oriented tests, they significantly and

substantially out-performed the standard classes and equaled or exceeded the Scholars

classes. This included one test of students' abilities to translate between verbal

descriptions, graphs, and symbolic equations, where students using PAT scored

significantly higher than the Scholars students did. This set of findings attests to the

potential for using technology in a problem-solving curriculum without sacrificing basic

skills. This raises the issue for the identification of variables that explain the differences.

Several factors could affect the performance of the students. While studies have

indicated that the web can serve as a powerful learning tool, they also indicate that the

students in the online format require a certain level of computer literacy (Halsne & Gatta,

2002). Research cited by Irani (2001) found that those less experienced in distance

education courses may have a more challenging experience. The perception of online

class for students enrolled in each category of class is assumed to be different. As the

students become more experienced in online instruction, their attitudes toward e-learning

and blended approaches may change (Smart & Cappel, 2006). Overall, several studies cited by Gefen, Karahanna, and Straub (2003) suggest that computer users' prior experience with technology influence their attitudes about technology in general.

The Independent Variables in the Instructional Process

Student performance in the data listed in Table 1 on face-to-face (traditional) classroom and online instruction are probably influenced by several variables within the organizational framework of the instruction process. These variables could be observed in the interactions that take place as demonstrated in the following simplified organizational chart for a technical college. The vice president of academic affairs, dean of instruction, and the department chair along with his administrative staff, select the curriculum and the required resources to implement the curriculum in response to state standards.

A department chair supervises the faculty members in a department. A dean of instruction supervises the chairs of departments. The vice president of academic affairs supervises the dean of instructions and is responsible to the president. The college is responsible to the state and federal governments. As indicated in Figure 1, the line of authority from the president to the dean of instruction is concerned with mainly establishing, supporting, and re-enforcing the administration of the curriculum. It is the chair of the department that organizes and supervises the teaching process.

```
┌─────────────────────────────────┐
│ Technical College Systems of Georgia │
│              (TCSG)              │
└─────────────────────────────────┘
                 │
      ┌─────────────────────┐
      │      President       │
      │  Technical College   │
      └─────────────────────┘
                 │
      ┌─────────────────────┐
      │  Vice President of   │
      │  Academic Affairs    │
      └─────────────────────┘
                 │
                 │              ┌─────────────────────┐
                 ├──────────────│      Director        │
                 │              │ Distance Learning    │
                 │              └─────────────────────┘
      ┌─────────────────────────┐
      │  Dean of Instruction and │
      │ Director of Campus Operations │
      └─────────────────────────┘
                 │
      ┌─────────────────────┐
      │  Department Chair    │
      │  General Operations  │
      └─────────────────────┘
                 │
      ┌─────────────────────┐
      │       Faculty        │
      └─────────────────────┘
                 │
      ┌──────────┴──────────┐
┌─────────────┐      ┌─────────────────────┐
│ Online Student │   │ Face-to-Face Student │
└─────────────┘      └─────────────────────┘
       │                      │
       └──────────┬───────────┘
      ┌─────────────────────────────┐
      │ Student Demographic Variables │
      └─────────────────────────────┘
```
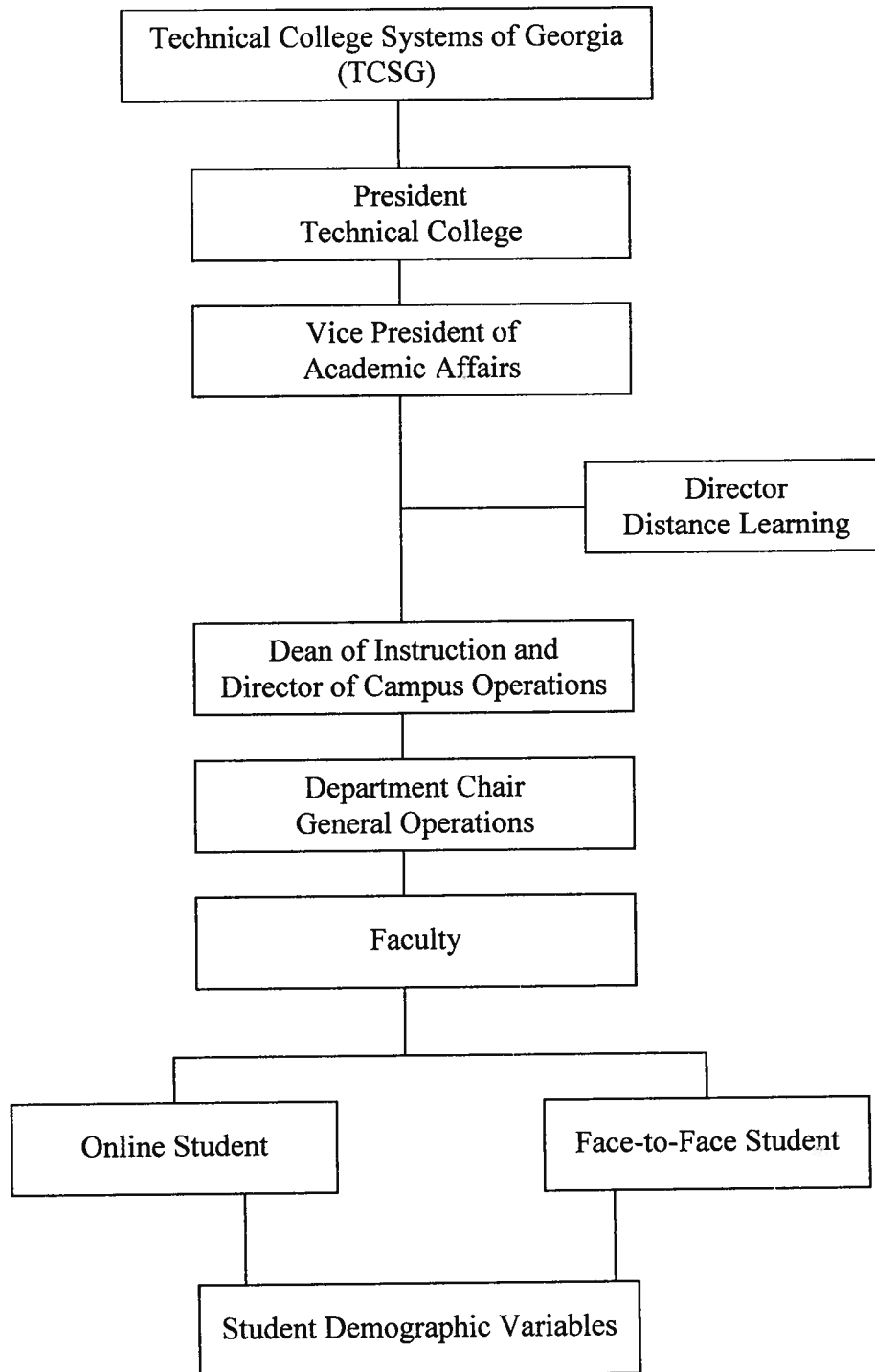
Figure 1. Line of Authority from the President to the Dean of Instruction

The instructor is expected to recognize what is essential for students in an online class as well as in face-to-face (traditional) class. There is no one between the student and instructor. The director of distance learning is responsible to create the initial template for the class, import course material from the publisher's web site, train the instructors and provide ongoing online support during the entire quarter. The director is also responsible for any upgrades in the platform, and address any technical issue for students and faculty. The instructor is given complete academic freedom in the classroom as well as in the online setting. An examination of the organizational chart indicates that the department chair needs to be aware of the classroom variables and take action during the evaluation process to ensure that instructors conduct teaching methodologies that align the curriculum to students' needs. Since the teaching faculty works directly under the supervision of department chair, it is the responsibility of the department chair to explain state standards to the instructors, assign appropriate classes to the instructors, and monitor the classroom teaching. Organizationally, the dean of instructions is not in the college on a daily basis, and the department chair is not in the classroom on a daily basis. For this reason, leadership is second to classroom instruction in impacting what students learn. Leightwood, Seashore Louuis, Anderson, and Wahistrom (2004) reviewed the literature and contend that the evidence suggests as follows: First, leaders set clear goals and develop understanding among staff members of the organization's goals and activities. This understanding becomes the basis for the staff to make sense of their work that enables the staff to find a sense of identity in the context. Second, instructional leadership consists of three dimensions—defining the college's

mission, managing the instructional program, and positive learning climate. Third, successful leaders resist high-stakes testing that encourage drill-and-practice, and financial incentives for achieving colleges that might erode teachers' intrinsic motivation to teach for all students to learn. Devaney (1987) provides a list of six ways in which teachers might provide leadership:

1 Continue to teach and to improve individual teaching proficiency and skill

2 Organize and lead peer review of teaching practices

3 Provide curriculum development knowledge

4 Participate in school-level decision making

5 Lead in-service training and staff development activities

6 Engage other teachers in collaborative action planning, reflection, and research. (http://www.ericfacility.net/databases/ERIC_igests/ed343196.html)

The college has a quarterly student evaluation process whereby the instructor is evaluated for his/her teaching in the classroom. There is also an annual faculty observation and evaluation by the department chair. The departnment chair observes the instructor and evaluates his/her teaching. The departmentchair enrolls in the online class as an online student to observe the instruction of the online instructor.

In collaboration with the Technical College Systems of Georgia (TCSG) and other technical colleges in the state, Metro Technical College has established curriculum standards with direct involvement of business and industry. The Technical Education Warranty states that:

If one of our graduates who were educated under a standard program and his/her employer agree the employee is deficient in one or more competencies as defined in the standards, the technical college will retrain that employee at no instructional cost to employee or employer. (http://www.tcsg.edu/our_guarantee. php)

The College has established an articulation agreement with few state colleges and universities such as Georgia Perimeter College, Southern Polytechnic and State University, Clayton College and State University, and Georgia Southern University. The agreement allows students to transfer all 1111 and 1113 level courses in mathematics, English, reading, humanities, physics, and economics to these institutions. One of the main requirements of these courses is that all 1111 and 1113 level courses must meet the standards of the above mentioned institutions, and they must be taught by the professors who hold a minimum masters degree in the field or related field and minimum 18 graduate hours of course work in the field they are teaching. The Southern Association of Colleges and Schools (SACS) also mandates this minimum requirement. The regional accreditation agency SACS requires the teaching faculty to have a minimum of a master's degree.

Overall, the critical aspect of the supervision of the instructor to ensure students' learning rests with the chairperson of the department. This supervision takes the form of reviewing the syllabi for conformation with standards, observing the teaching process, and reviewing grades. These supervisory acts are directly related to the delivery of teaching but do not account for how the interactions among the instructor, technology and

students might be influenced by the social characteristics of students. In the classroom, it is the interactions between the instructor and students that define what is to be learned, how it is to be learned and how it is to be graded and rewarded. These are the processes that define the learning outcomes. How they are implemented could make a difference. When technology is used in the instructional process, it is assumed that the instructor has not been able to enable all students to learn, and that probably, how the syllabi is taught is not in alignment with the students' needs for visual explanations and repeated practices. It is assumed that the computer software could do a more effective delivery.

The above scenario omits the social characteristics of the students such as gender, employment experiences and ethnicity. Further, the entry baseline performance might vary. The computer software could make adjustments for the entry level through pre-testing, and it is assumed that this step could make a difference. However, the instructor could also if skilled identify the characteristics of students who were not performing as expected and treat the students accordingly. For example, provide additional explanations followed by quizzes or tests to check if improvement occurred before advancing. In such an event, an instructor that uses experiential methods could be necessary in maximizing the effects of the computer. Therefore, a study is necessary to determine if face-to-face (traditional) teaching could be improved by instructional use of students' experience when teaching and if students would perceive the instructor's use of such a strategy would improve students' performance as compared to their perceptions about the function of the computer's program.

Problem Statement

It is proposed that students' performance in on-line class might be higher than in face-to-face class (traditional), and that this variation might correspond with the students' perceptions about the two types of classes.

E-learning represents an important, growing trend in the application of technology to facilitate student learning—especially in colleges where programs and curricula must evolve to meet the changing needs of a competitive global economy (Richardson, 2003). It is quite possible that students' academic performance in on line classes might be higher than those of traditional classes. Further, students' perception of online classes might be more highly positive than those of traditional class.

Instructors are encouraged to teach and assess achievement in ways that enable students to analyze, create, and apply their knowledge. Further, students who are taught analytically, creatively, and practically perform better on assessments, without regard of the form the assessment takes (Sternberg & Torff, 1998). Therefore, it should be possible for the traditional teaching situation to generate more interactions around these dimensions than the on-line instruction. If, therefore on-line instruction is perceived to be superior, then other factors might be operating to explain such variation such as gender, prior skills with computer technology, and work status. Also, it might well be that instructors in both types of classes are not conscious of learning theories. However, matching the instructors' teaching styles with the learning styles of the students suggests that educators need to become cognizant of how students learn so that they may create an environment that is conducive to optimal learning of all students (Dunn & Dunn, 1979).

Therefore, if differences are found between the two types of instructions, the variables that explain such variables will be identified as the basis for developing a treatment so as to enhance instruction and learning outcomes in the treatment context.

Research Questions

RQ1:   To what extent would the student gain score in the first year of college algebra class be influenced by each of the following independent variables are instructional techniques, student perception of an online class, employment, gender, experience with technology-based instruction, and ethnicity.

RQ2:   To what extent would the student final grade as dependent in the first year college algebra class be influenced by each of the following independent variables: instructional techniques, student perception of an online class, employment, gender, experience with technology-based instruction, and ethnicity.

Significance of the Study

It is assumed that the study would be significant for students, instructors, departments, and administrators. The college would have data to indicate:

1. How students perceive online instruction could have significant impact on student performance.

2. What instructional techniques are most effective in improving student performance.

3. Whether there is relationship between student performance and demographic variables, such as experience with online technology, gender, and age?

Summary

It is expected that the study would have significance for policy makers, instructors, and students. It would be possible for instructor to improve student performance in both forms of classes. Administrators such as the department chair could utilize the data to sensitize instructors to respond to the findings. Policy makers could utilize the data when making decisions about investing in technology versus investing in retooling instructors. Further, the departments could improve the retention of the students based on the findings. The college could improve enrollment by being more flexible in offering more web-based classes, if the data so suggest, thus allowing the students to take variety of courses. The Technical College Systems of Georgia (TCSG) could benefit financially by higher enrollment in technical colleges since the funding of technical colleges is tied to the enrollment.

CHAPTER II

REVIEW OF RESEARCH OF EMPIRICAL STUDIES

The review of the literature provides the findings of the researchers. These findings establish the relationship between independent variables and student performance. The review of the literature for this study was conducted for the following headings.

Communication Effectiveness in Learning Technologies

Online learning—for students and for teachers—is one of the fastest growing trends in educational uses of technology. The National Center for Education Statistics (2008) estimated that the number of K-12 public school students enrolling in a technology-based distance education course grew by 65% in the two years from 2002-2003 to 2004-2005. On the basis of a more recent district survey, Picciano and Seaman (2007) estimated that more than a million K–12 students took online courses in school year 2007–2008.

According to Kearns , Shoaf, and Sumney (2004), since communication, interaction, and learning can take place anytime, an online course offers possibilities that a traditional (face-to-face) course and more traditional distance learning technologies (e.g., interactive television) cannot match. If effectively managed, online education can be superior to the traditional delivery methods (Kelly, 2004; Singh & Pan, 2004).

Moore (1993) suggests that there are three types of interaction necessary for successful distance education: (a) learner-content interaction, (b) learner-instructor interaction, and (c) learner-learner interaction. Distance learning instructors need to ensure that all three forms of interaction are maximized in their course structure. Further, iinteractions between instructors and students and student to student remains the biggest barrier to the success of educational media (Freed, 2004). Bandwidth could be another major obstacle in any distance learning class. This is mostly a speed issue involving slow downloading time, which can be a clear disadvantage to students and course material delivery. As a result, "multi-media" distance learning systems blend computer based and TV materials with CD's and other devices. High-speed cable modems, digital and other speed technologies are and will continue to reduce the bandwidth or "speed" of downloading problem, but these technologies may not yet be available to all remote students scattered about the globe (Hunt, 2005).

Effectiveness Based on Student Perceptions

Watkins (2005) has recommended several e-learning techniques for instructors and students (e-learners). These techniques if implemented appropriately could enhance the capability of technology to make electronic learning exciting and rewarding. Kuchinke, Aragon, and Bartlett (2001) of the Department of Human Resource Education, University of Illinois at Urbana-Champaign and Kenneth Bartlett of the Department of Work, Family, and Community Education, University of Minnesota, conducted research on graduate students pursuing a degree in Human Resource Development at University of

Illinois, Urbana-Champaign. The majority of the students were mid-career professionals working in the field of Human Resource Development.

Several students were seeking change of career and some had retired from previous career. Altogether, the study included 58 students. At the beginning of the course, the instructor addressed issues of time management; scheduling; balance between work, home life, and time required for the course. Instructors provided instant feedback to the email and phone calls. They also provided individual support and encouragement, and technical support. This resulted in a high retention rate among the students and better performance among the students. The comfort level of the students increased significantly.

Technology integration has the potential to increase student motivation (Anderson, 2000). Heafner (2004) of the University of North Carolina at Charlotte in her study concluded that technology empowers the learning by engaging students in the learning process. The participants in the case study included a nationally board certified social study teacher in her high school with experience in integrating technology. The student sample consisted of 25 students selected from a local high school social study class. Data sources for this study included interviews, observations, field notes, and artifacts such as: technology work samples produced by the students, teacher curricula, and teacher lesson plans. The results showed that integration of technology had a positive impact on the students. Students exuded self-confidence in their abilities, not only to work with the technology, but also to master the content and successfully complete the task. Students were excited about learning and shared their work with other

students. Students enjoyed working on the project with technology because they viewed technology as more engaging and entertaining. Technology enabled the students to find more information about a topic and understand the concept better. Students found that working with technology refined their technology skills. Additionally, use of technology improved student interest due to students' familiarity with the technology. However, systematic testing was not conducted and the evidence provided to show the gain scores in a pre-post test analysis. This provides a gap in the teaching learning outcomes.

Howland and Moore (2002) examined the students' experience and perception of online class. They employed 12 questions related to computer competency (comfort level), internet-based course experience (number of courses), learning experience, learning strategies, communication with students and instructors, perceived difficulty or ease of Internet-based course, perceived differences between Internet-based and traditional courses. The survey included 48 students enrolled in three online courses: Introduction to Web Development, Web Design and Development, and Technology Leadership in the Schools. Almost all of these individuals were working professionals in the field of education, combining work, school, and family commitments. Students with the attitude of independent and proactive learner had positive opinion of online learning. These students reflected higher degree of independence and responsibility. Students who expressed negative feeling toward online learning expressed for more structured class setting and feedback from the instructor. They did realize that self-reliance increased their learning but they would prefer instructors to explain the content and provide

feedback. Again direct measurement based on testing of learning outcomes was not attempted.

Smart and Cappel (2006) conducted a study on student perception of online learning by taking a sample of 36 students from the required course and 18 students in elective courses at the Michigan Virtual University. Participants in the elective course rated use of the learning modules slightly positive while students in the required course rated them slightly negative.

The three most intriguing findings of the study involve the differences in respondents' attitudes toward the use of simulations in the online modules, differences in perceptions toward the online modules between those enrolled in the elective course versus those in the required course, and the apparent impact of the time required to complete the online modules on participants' perceptions of them. The results may suggest that students with more experience with technology and e-learning rate it more positively. Another notable finding of this study is that students in the elective course consistently rated the use of the online learning components more favorably than those in the required course. Participants in the elective course rated both the online and the classroom portions of learning more favorably than students in the required course on almost every measure.

Kidd (2005) conducted his research on student perception of online learning. 291 students participated in the survey. The results from this study indicated an overall positive response regarding the instructional quality of online courses. The findings of the report show that students found that the navigation, design of instruction, time needed

to download materials, web design aesthetics, and accessibility of the course information, were all important factors that affected the instructional quality of online and web based course. As a whole, the results obtained in this project were positive and encouraging. Students in general enjoy the online and web based learning environment.

Wee and Schubert (2001) conducted the research study at the Virtual School of Business (VBUS) of Temasek Polytechnic, Singapore on student perception of online learning. A total of 657 students majoring in various diplomas responded to the questions for the research purpose. Their perceptions regarding the effect of VBUS on enhancing learning, and, in particular, in improving test and examination grades for all subjects as well as the specific subject Computer Fundamentals, reveal that 39.7% (all subjects) and 37.5% (Computer Fundamentals) respondents felt the improvement was "somewhat," while 29.5% (all subjects) and 31.1% (Computer Fundamentals) indicated improvement was "not much." Up to as many as 11.4% and 14.2% of respondents thought that VBUS did not help at all. The general perception of VBUS appears to be the same, whether for all subjects or for a particular, singled-out subject. Respondents from the accounting and finance course (53.5%) appear to indicate a more positive response to VBUS than their counterparts in the hospitality course, who had the least positive response (29.2%) of all groups.

Students' Preference for Technology

Kishore, Tabrizi, Nassehzadeh, Erol, Shahnaz, and Carl (2009) conducted a survey of traditional and online classes offered to 1,876 students at 46 universities and some community colleges in the United States as well as some foreign universities.

Students were asked to give their preference between traditional and online classes. The results showed that 47.5% preferred traditional classes, 33.5% preferred online classes, and 19% had no preference. The authors hypothesized that students' preference for online classes had strong correlations with other variables in the survey. The purpose of the research is twofold, involving, first, the identification of these variables. The authors found that gender, student perception of an online class of pedagogical characteristics of online classes, frequency of use of certain online technologies, quality and reliability of the online course delivery system, number of online classes the student had taken, and speed of Internet connection were significantly correlated with preference for online classes. Second, the authors suggest how these online features should be implemented to improve current online course delivery systems.

Diaz and Cartnal (1999) compared student-learning styles of two online health education classes, with an equivalent on-campus class. Sixty-eight students participated in online classes and 40 students participated in on-campus classes. The Grasha-Riechmann Student Learning Style Scales (GRSLSS) was administered to determine student social learning preferences in six learning style categories. The online distance students were taught according to the same course outline, used the same textbook, covered the same lecture material, and took the same tests as the equivalent on-campus students. Three main differences between on-campus and online groups were the delivery mode for the lectures, the mode of teacher/student and student/student communication, and the mode for the assignments. The distance classes reviewed multimedia slides (Power Point presentations converted to HTML) and lecture notes

online while the equivalent classes heard instructor lectures and participated in face-to-face discussion. The distance class made heavy use of a class web site and used a list serve and e-mail for communication/discussion with other students and the instructor. The assignment load for the distance class students consisted almost entirely of internet-based, independent assignments while the equivalent class completed some online assignments but participated most frequently in classroom discussion assignments and other non-internet assignments. Students who enrolled in the distance education class were significantly more independent learners than students in the equivalent on-campus class. Students enrolled in the equivalent class were significantly more dependent learners than the distance group. Correlation analysis revealed that on-campus students displayed collaborative tendencies that were positively related to their needs to be competitive and to be good class citizens. Thus, on-campus students appeared to favor collaborative styles to the extent that it helped them to obtain the rewards of the class. In contrast, online students were willing and able to embrace collaborative teaching styles if the instructor made it clear that this was expected, and gave them form and guidance for meeting this expectation. Online students appeared to be driven more by intrinsic motives and clearly not by the reward structure of the class. Relatively larger differences in the average scores between the two classrooms occurred for the independent and the Dependent learning styles. Compared to those students enrolled in the traditional classroom, the students in the distance learning class had higher scores on the Independent learning style scale and lower scores on the dependent learning style scale.

Meyer (2003) compared experiences of students in face-to-face discussions with threaded discussions and evaluated discussion for higher-order thinking. This comparison of face-to-face and threaded discussions is drawn heavily from student evaluations of two graduate-level courses in educational leadership, each of which experienced both face-to-face and online discussions. Each course used threaded discussion. Students were asked at the end of the course to evaluate the threaded discussions as well as the in-class discussions and delineate similarities, differences, pros and cons for each discussion method. Almost every online student mentioned how much time it took to read others' postings, think about a response, prepare a response, and check back later to see others' contributions to the discussion. And while many students recognized this expansion as a drain on their time, many balanced this criticism with an appreciation that they got more from the discussion because it took time for them to recognize connections, understand others' ideas, and develop and convey a detailed response or posting. In favor of face-to-face discussions, students said they enjoyed its speed, spark, or energy, the way they could build upon each other's comments, collaborate on the spot, and benefit from the enthusiasm of others. The threaded discussions were "slow," and took more time to read.

Student Achievement and Instructional Technologies

Hyllagard and Burke (2002) compared online classes with the technology-enhanced classes. Eighteen online classes and 12 technology-enhanced classes were used in the study. Four types of data were collected: (a) Grade point average (GPA) and grades including number of incompletes and withdrawals, (b) Student demographics and

academic information, gender, race, full time /part time status, (c) Student survey data collected toward the end of the term providing information about students' perception and satisfaction of course related benefits, and (d) Faculty survey data providing information about the effect of course format on student engagement and learning. Overall GPA's are virtually identical, 2.68 vs. 2.61 in enhanced classes. More students scored A's, very few C's and a substantial share of F's in online classes. Online students had a significant incidence of course attrition, more than double that of students enrolled in enhanced courses (26% vs. 12%), similarly online students tend to receive a disproportionate number of incomplete grades (12% vs.3%). Students enrolled in online classes expressed greater satisfaction than the students enrolled in technology-enhanced classes. Students enrolled in online classes expressed that their ability to express themselves in writing improved significantly.

Agarwal and Day (1998) compared student achievement in principal-level economics class. They collected data from the students from Christopher Newport University, SUNY-Oswego and University of Maryland, Baltimore. For Christopher Newport University, the numbers were 31 face-to-face responses and 33 of 36 online responses for a total response rate of 89%. For SUNY-Oswego, 26 of 29 online students and 19 of 24 face-to-face students completed the survey, an 85% response rate. The response rate UMBC was almost 96%, with 35 of 37 online students and 34 of 35 face-to-face students having completed the survey.

The analysis revealed that self-selection into online classes is an important issue in the assessment of the effectiveness of online education in economics. Their model

also suggested that those who select a distance-learning course perform better than would a randomly selected individual with identical observable characteristics. There is also some evidence that underclassmen, freshmen and sophomores, are also especially vulnerable to under performing in online classes relative to how they would fare in a traditional (face-to-face) class.

Analysis

The review of the above studies indicate that there were an abundance of studies on students' perceptions about effectiveness and few on the measurement of students performance on tests in the subject areas. The gaps appear to be in terms of pretest/posttest comparison of gain scores in mathematics by a regular classroom instructor with respect top the use of technology. The studies reviewed also did not control for the influence of the demographic variables of students. This study is designed to include the gain scores in mathematics when using technology while controlling for selected demographic variables. Further, the perceptions of students about the benefits they derived in the use of a computer's software in mathematics were considered.

Summary

The review of literature suggests that student achievement was influenced by such variables as (a) Communication effectiveness in Learning Technologies (Kearns , Shoaf & Sumney 2004; Sing & Pan, 2004); (b) Effectiveness based on student perceptions (Kishore, Tabrizi, Nassehzadeh, Erol, Shahnaz, & Carl, 2001; Heafner, 2004; Howland & Moore, 2006; Smart & Cappel, 2006); (c) Students preference for technology (Kishore, Tabrizi, Ozan, Aziz, & Wuensch, 2009; Diaz & Cartnal, 1999; Meyer, 2003); and (d)

Student achievement and instructional technologies (Hyllegard & Burke, 2002; Agarwal & Day, 1998). Leadership skills in the supervision of instruction, student perception of technology-based instruction and various instructional technologies are included in the study.

CHAPTER III

THEORETICAL FRAMEWORK

It is proposed that students' performance in on-line class might be higher than in traditional (face-to-face) class, and that this variation might correspond with the students' perceptions about the two types of classes. Further, student performance variation between the two forms of instruction might be explained by (a) differences in the instructional techniques between the two types of instruction as observed or documented, (b) variation in students' perceptions about the two forms of instructions, and (c) variation in students background variables such as gender, age, experience/skills in use of technology, and work experience. These variables are stated in Figure 2 for definition purposes.

Definition of Variables

Dependent Variable

Student Performance in class is used as dependent variable. This may be measured by their grades in the class and gain score. Student performance is based on quizzes, tests, and final exam along with the gain score. Five quizzes were given in traditional format. Remaining eight quizzes were given online on EDUCOSOFT. Quizzes consisted of questions from individual sections from the textbook.
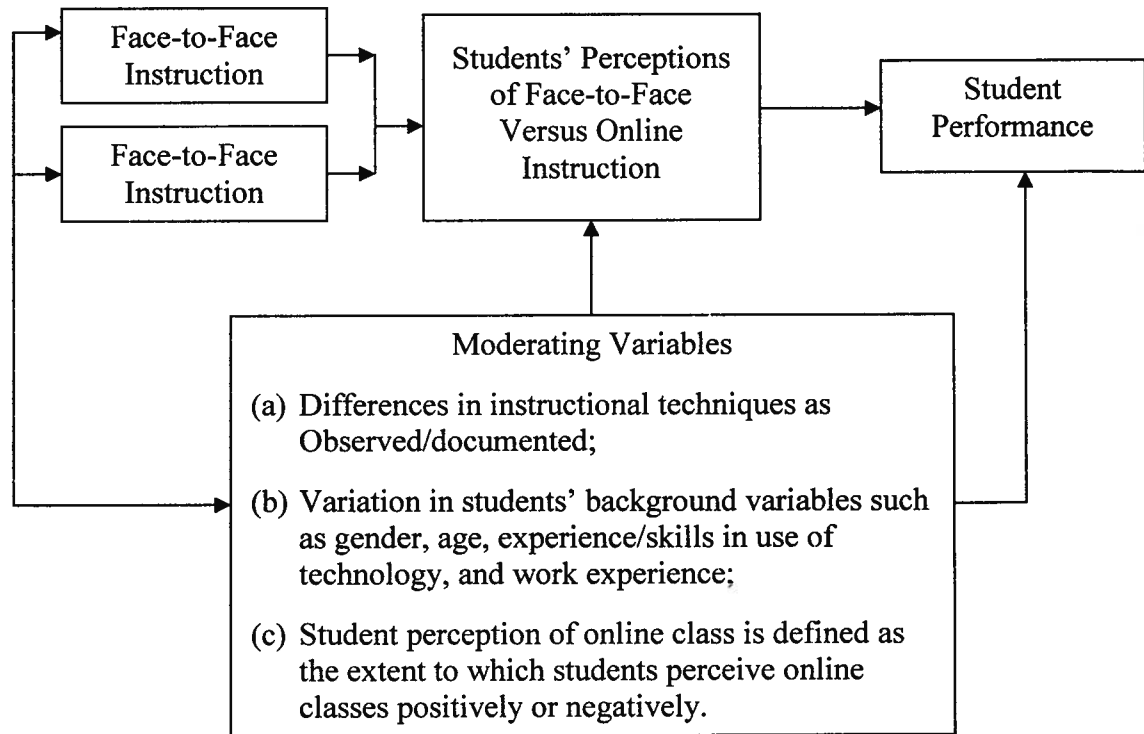
```
┌─────────────┐      ┌──────────────────┐      ┌──────────────┐
│ Face-to-Face│      │ Students' Perceptions │   │   Student    │
│ Instruction │      │  of Face-to-Face │      │ Performance  │
├─────────────┤      │  Versus Online   │      └──────────────┘
│ Face-to-Face│      │   Instruction    │
│ Instruction │      └──────────────────┘
└─────────────┘
```

Moderating Variables

(a) Differences in instructional techniques as Observed/documented;

(b) Variation in students' background variables such as gender, age, experience/skills in use of technology, and work experience;

(c) Student perception of online class is defined as the extent to which students perceive online classes positively or negatively.

Figure 2: Students' Performance in Relation to Technology and Students' Background Variables

Two tests were given in traditional format and remaining two tests were given online using EDUCOSOFT. Tests consisted of combination of sections from chapters. A comprehensive final exam was given at the end of the quarter online using EDUCOSOFT. A sample quiz, test, and final exam may be found in the appendix.

Independent Variables

Instructional Techniques in an online class is a measure of what is exactly conducted in the a class that incorporates web-based instructions, and to what extent students respond positively in terms of higher order-thinking skills to the delivery of web-based lectures materials and class assignments. The impact of employing

instructional techniques that would incorporate practical examples in the lecture, web-based quizzes, tests, assignments, multiple attempts in quizzes, and tests using EDUCOSOFT. (Items 1-20)

Student Perception of Online Class is defined as the extent to which students perceive online classes positively or negatively. The ability of EDUCOSOFT to facilitate learning algebraic concepts is an important component. The perception of the students toward the online/computer-based learning could have a strong impact on student performance. The ability of students to navigate the site and perform the task with ease is vital for students to perceive the program positively/negatively. A Cronbach Alpha Reliability coefficient would be good measure to determine the relationship between student perception and student performance. Items (21-39)

Experience with Web-based/Online Technology is defined as students' exposure to various web-based and online technologies. Technology has added new dimension to the way students learn and communicate. According to Ropp (1999), the less expertise people have with computers, the more computer anxiety they exhibit and they will perceive the online class differently. A Cronbach Alpha Reliability Coefficient would be an ideal measure to establish the relationship between experience with technology and student performance. Items (40-41)

Student gender is defined as male (coded 1) and female (coded 2). Item (42)

Age of the student is defined as age in years. Item (43)

Employment is defined as yes (coded 1) and no (coded 2). Item (44)

Number of years of experience with web-based technology is defined as years of experience a student has with web-based/online technology. Item (46-52)

Ethnicity is defined as the race of a student. Item (53)

Relationship among the Variables

Jupiter Communications, a market research firm, had reported that 72% of teenagers in the United States will be online by 2003 (Stanton, 2000). Online learning, for students and for teachers, is one of the fastest growing trends in educational uses of technology. The National Center for Education Statistics estimated that 37% of school districts had students taking technology-supported distance education courses during school year 2004–05 (Zandberg & Lewis, 2008). Enrollments in these courses (which included two-way interactive video as well as Internet-based courses), were estimated at 506,950, a 60% increase over the estimate based on the previous survey for 2002-2003 (Setzer & Lewis, 2005). Two district surveys commissioned by the Sloan Consortium (Picciano & Seaman, 2007) produced estimates that 700,000 K–12 public school students took online courses in 2005–2006 and over a million students did so in 2007–2008, a 43% increase. Most of these courses were at the high school level or in combination elementary-secondary schools (Zandberg & Lewis, 2008). This alone indicates that students will learn and communicate electronically more than any previous generation. At the same time, teenagers are not the only digital learners. With the growing number of online courses, the increasing accessibility of computers, and the increasing number of computer users, students of all ages are taking advantage of distance learning or are using computers to enhance the traditional classroom experience. Instructor for both forms of

classes is a leader and he/she can make a significant difference in student performance. Since the students enrolled in an online class do not physically interact with the instructor, it is the responsibility of the instructor to create sense of belonging among the students in the class. For this reason, an instructor needs to constantly communicate with the students either via email, chat room, discussion board, or by phone. This approach builds a healthy relationship between instructor and students. According to Maslow's hierarchy of needs, every individual has a need to feel belonged and recognized before they can feel disposed to self-actualize (Maslow, 1970). Instructional techniques combined with human relationship style of the instructor in both forms of classes, particularly online classes are very significant. According to Blake and Mouton (1978), the instructor as a leader ought to focus both on task and relationships if the instructor were to impact student positively.

Student performance might be influenced more by distance learning as compared to the classroom instructions when accounting for the instructional techniques, experience with online technology and student perception of online technologies. These three variables emerge as having a potentially significant impact on student learning in an online environment. The technological aspects of learning can describe one's perception about using computers and actual familiarity/experience with online technologies can directly affect student performance.

An experienced computer user might be more comfortable with publicly available and unfamiliar hardware than a non-user. In a review of a longitudinal study involving more than 800 university students, McMahon, Gardner, Gray, and Mulhern (1999)

reported that computer access accounts for 50% of the variance that exists among student attitudes toward online learning.

Students who use computers at home or in a work place generally have less computer anxiety because they are more familiar with the technology used in their courses. Focus groups have indicated that students view their lack of training in computers as the strongest inhibitor to computer use (McMahon et al., 1999). Inexperienced computer users can be intimidated in a lab. According to Ropp's (1999) review of the literature, most research concludes that the less experience people have with computers, the more computer anxiety they exhibit. Online experiences are as varied as individual learners. Some students, in fact, see computer technology as a way to connect with peers. For many young people, e-mail and chat represent the Internet's most enticing features. According to a Forester Research Study of high school students who use the Web, 28% say they are online for 20 or more hours each week (Stanton, 2000). In some large school settings, direct contact with the instructor is rare, unlike in distance learning situations. One student in a study by Roblyer (1999) said that the distance-learning environment afforded more opportunities for interaction with the instructor than traditional courses. Roblyer also reports that high school students' responses to online learning were generally positive, while community college students enrolled in traditional classes expressed a desire for a live instructor.

Students who prefer online courses place greater value on their control of the pace of the course than on face-to-face interaction (Roblyer, 1999). Roblyer has found that the capacity to choose when to complete activities is the most important factor in positive

student responses to online learning, because it grants students a measure of control over their learning.

Instructional techniques could play an important role in determining student performance. Modern technology offers instructors variety of instructional techniques for teaching. These techniques have profound effect on student performance. The online learning environment also embraces pedagogical use of technology (Ascough, 2002), integration of instructional design elements (Zheng & Smaldino, 2003), various types of medium and media (Palloff & Pratt, 2000), and diversified learning methods include deep learning, critical thinking, collaborative learning, and problem-based learning (Ronteltap & Eurelings, 2002). Several researchers (Ascough, 2002; Ronteltap & Eurelings, 2002; Rosie, 2002) have reported that online education can encourage students' deep learning and critical thinking skills when learned collaboratively or under problem-based scenarios. Ronteltap and Eureling's (2002) experimental study revealed that when students are learning in a problem-based practical learning, more interaction of students are caused, and students learn more actively. Therefore, integrating deep learning, critical thinking, collaborative learning, and problem-based learning methods into instruction is critical for instructors to improve the quality of online instruction (Yang & Cornelious, 2005).

Online instructors need to understand their students' experience using online technologies. Some students enroll in online courses because they have no other choice, and these students may become easily frustrated with initial failures in the use of the technologies. Hara and Kling (1999) found that online students do not always report the

full extent of their frustration to their teachers; with this in mind, then, teachers need strategies to help them discover problems students may be having. In addition, they can provide course orientations and study guides that include extensive coverage of how students should use the various technologies to access the course and interact with the teacher and with other students. Latent anxieties about using technology may also have an influence on learning via computers and the Internet, particularly for older students who have left more traditional artifacts behind.

An experienced computer user might be more comfortable with publicly available and unfamiliar hardware than a non-user. In a review of a longitudinal study involving more than 800 university students, McMahon, Gardner, Gray, and Mulhern (1999) reported that computer access accounts for 50% of the variance that exists among student attitudes toward online learning.

Students who use computers at home generally have less computer anxiety because they are more familiar with the technology used in their courses. Although most students become more adept users of technology and develop a more positive attitude about technology after a few weeks in an online course, initial difficulties can be so obstructive that students quit the online course (Hara & Kling, 1999).

Instructional Techniques

According to Hitz and Scanlon (2001), the educational experiences, which are relevant and meaningful, are the most effective pathways to learning. Various innovative instructional techniques can improve student learning. Modern technology based tools such as streaming videos, chat rooms, and various software have positive impact on the

student performance. Baker (1997), Hale (1977), and Gifford (1997) claim that a steady stream of studies since 1990 confirm that well-crafted computer-mediated instruction achieves increased learner effectiveness (increased test scores), increased learner efficiency (lessons learned in less time), greater learner engagement (greater student satisfaction with their classes), and greater learner interest (more positive student attitudes toward the discipline). Mayer (2001) has demonstrated in his research that computer-based multimedia instruction can have a positive impact on both student retention and transfer performance. Mayer's empirical research has revealed seven multimedia design principles that have been proven to improve learning outcomes. As technologies have become more advanced and sophisticated, more creative online and interactive applications have been developed that can utilize learning models such as Bloom's Taxonomy. The true measurement of technology-based education is directly related to the ability of Higher Education Institutions to convert theories to computer applications, and events to computer case studies. This conversion provides interactive online learning opportunities in the application level of Bloom's Taxonomy.

Experience with Online Technologies

A growing body of research suggests that computer users' prior experience with technology affects their attitudes about technology in general (Gefen, Karahanna, & Straub, 2003; Henry & Stone, 1994; Martins & Kellermanns, 2004; Stoel & Lee, 2003; Wober & Gretzel, 2000). Focus groups have indicated that "students view their lack of training in computers as the strongest inhibitor to computer use" (McMahon et al., 1999, p. 302). Also according to Ropp's (1999) review of the literature, most research

concludes that the less expertise people have with computers, the more computer anxiety they exhibit and they will perceive the online class differently. Many individuals introduced to computers on the job eventually acquire them at home, so jobs can represent an important step in technology adoption (NTIA, 2002).

Wenglinsky (1998) conducted a study on 6,227 fourth-graders and 7,146 eight-graders, and his study provided interesting results. He found that increase in the tendency of the teachers to use technology in professional development had positive impact on higher academic achievement.

Student Perception

Student Perception is expected to influence student performance. How students perceive online learning can have an impact on student achievement. Students' perception toward the technology-based learning does impact student performance in the class. Positive attitude results in better performance in the class than a student having negative attitude toward the technology-based learning. Students with attitudes of independent and proactive learning had positive opinions of online learning. These students reflected higher degree of independence and responsibility (Howland & Moore, 2002). Online classes provide a more viable option to non-traditional students such as working individuals with no fixed working hours, stay-at-home mothers, and individuals who travel for job assignments. Colleges need to address the issues of student learning and student perception of online classes if they want to be successful in maintaining standards. Perception of online class for students enrolled in each category of class is assumed to be different. As the students become more experienced in online instruction,

their attitudes toward e-learning and blended approaches may change (Smart & Cappel, 2006).

Gender of a student is a variable that could have an impact on student performance. Male students tend to do well in an online class due to their natural liking of technology; they are more likely to have an email address and home Internet access than females (Mossberger, Tolbert, & Stansbury, 2003).

Age of a student is a variable which could impact student's ability to learn in both forms of classes, it applies more to the web-based or online class as many older students tend to struggle with technology. According to Zigerell (1984), The ease with which modern communications technologies can link educational institutions to home, work-sites, and community centers has made adult education and lifelong learning matters of national policy.

Race of a student is a variable and do race and ethnicity matter for technology access and skill and do they have any influence on student performance? Surveys published by the National Telecommunications and Information Administration and the Pew Internet and American Life project show that African-Americans and Latinos have lower rates of home access to computers and the Internet (NTIA, 2002; Pew, 2000). Some market research has found the opposite case, that Latinos have higher rates of access than whites (Walsh, 2001).

<div align="center">Research Questions</div>

RQ1: To what extent would the student gain score in the first year of college algebra class be influenced by each of the following independent variables

are instructional techniques, student perception of an online class, employment, gender, experience with technology-based instruction, and ethnicity.

RQ2: To what extent would the student final grade as dependent in the first year college algebra class be influenced by each of the following independent variables: instructional techniques, student perception of an online class, employment, gender, experience with technology-based instruction, and ethnicity.

CHAPTER IV

RESEARCH METHODOLOGY

The research design consisted of a survey of questionnaire of students in the experimental group. Students were divided into two groups. Students enrolled in the online class formed control group and students enrolled in the traditional class form the experimental group. A quantitative analysis was conducted to compare the student performance and to determine the relationship among the independent variables and student performance in the class. The college would not release any personal information regarding the student due to the issue of confidentiality; therefore the data were collected from individual students. Quantitative analysis was conducted to arrive at an inference.

Description of the Setting

The study was conducted at Metro Technical College, which is located in Atlanta, Georgia. The college offers associate degree, diploma, and technical certificates in areas such as, Computer Information Systems, Electronic Technology, Industrial Technology, Paralegal Studies, Banking and Finance, Early Childhood Studies, Business Office Technology, Nursing, Medical Technology, and Surgical Technology. The student population is approximately 5000. Students' ages range from 18 years to 64 years. The average age of students is 27 years. The majority of them are either employed full time or part time. Almost 98% students are enrolled in at least one online

class each quarter. Most instructors have at least a master's degree in the field they teach. Every instructor who teaches online classes is required to undergo online instructor training given in-house by the department of Distance Learning.

Description of Population and Sample

The research was conducted on 87 students. The sample of the student was collected from two separate sections of college algebra classes. The sample included all students enrolled in two face to face (traditional) classes of college algebra. Students enrolled in both forms of classes were predominantly adults in the age group of 18 and 64 years. The majority of them are working either part time or full time. Demographics of students enrolled in online class included those who are working full time, live far from the college and cannot afford to commute long distance to attend the class, single parent, or non-availability of a traditional class. Students enrolled in the traditional classes are assumed to be adults, working part time, full time or unemployed, they do not feel comfortable with the online format of the classes, and they prefer to interact with the instructor. Primarily the sample consisted of an experimental group.

Method of Treatment

The selected college granted permission to the author to perform the study. The college's name has not been disclosed to ensure anonymity. Students were informed that they have the choice to opt out. Benefits to the students and the college are expected in terms of identifying strategies that might positively impact student performance.

Research Design

The research design consisted of one group treated traditionally and tested (pretest) followed by experiential treatment and testing (posttest). In this way, the same class of students functioned as a control traditional group (pretest) and an experimental group (posttest). The college did not permit the use of random sampling of the subjects. Therefore, the demographic variables of the students were used to account for their separate contributions to the gain scores. The use of the gain score by each student was expected to make adjustments in the statistical analysis for different baseline performance in the pretest. This facilitated the use of the treatment to account for gain in the posttest.

Population and Sample

Students enrolled in both forms of classes are predominantly adults in the age group of 18 to 64 years. The majority of them are working either part time or full time. Demographics of students enrolled in online class include those who are working full time, live far from the college and cannot afford to commute long distance to attend the class, single parent, or non-availability of a traditional class. Students enrolled in the traditional classes are assumed to be adults, working part time, full time or unemployed, they do not feel comfortable with the online format of the classes, and they prefer to interact with the instructor. Almost all of these students qualify for HOPE scholarship or HOPE grant. Some students do receive tuition reimbursement from their employer.

The treatment group was selected from the students enrolled in two sections of traditional (face-to-face) college algebra classes. Data were collected from these students over 10 quarters (Approximately 2.5 years). The author is assigned two face-to-face

(traditional) college algebra classes each quarter which runs for 10 weeks. Each class enrolled approximately 12 students. A total of 87 students participated in the survey over the period of two and a half years. These students formed the treatment group.

The treatment involved a variety of instructional techniques, web-based instruction, web-based testing, individualized tutoring and traditional lecture. The instructional techniques included problem solving in traditional lecture using the whiteboard, explanation of the solution provided by EDUCOSOFT, and individualized tutorial. A pretest was given to the class during the first week of the quarter to measure the competency in certain skills required in the class. A posttest was administered at the end of the quarter along with the final exam. The popular mathematics software, EDUCOSOFT, was integrated in the treatment and instructional techniques were modified to include the technology and web-based component. Typically the technology components add flexibility and ease to the students. Students tend to become more independent problem solver and more confident about themselves. According to Dunn and Dunn (1979), based on observations, interviews, and experimental studies conducted since 1967, it has become apparent that regardless of their age, ability, socioeconomic status, or achievement level, individuals respond uniquely to their immediate environment. This concept of learning was applicable in evaluating the treatment. EDUCOSOFT Learning System has the ability to integrate content with Learning Management System (LMS) features for teaching in face-to-face (traditional) classroom environment or distance learning environment (web-based or online). EDUCOSOFT contains the following features:

Online Content: Online content is compatible with the textbook, contains online lecture notes for the instructor, online tutorials for the students, study plans, ability to add your own questions, question bank with the solution, examples with several versions, homework with embedded tutorials, and quizzes for each topic.

Assessment: EDUCOSOFT has the ability to create online homework, quizzes and tests with multiple choice as well as free response questions, print assessments, ability to grade assessment online automatically, assign multiple attempts in quizzes, homework, and tests, randomize the questions, create password restrictions, assign time and date to each assessment, and assign different weight to each section.

Online Grade Book: The program preloads the grade book setting; an instructor may edit the default grade book, online assessment grades are recorded automatically, grades may be exported in to Excel and finally all grades may be edited manually, this feature is important in case of discrepancies with the student solution.

Performance Report: EDUCOSOFT can generate grade report and online activity report. The activity report is used to determine the amount of time a student has spent on a particular topic and his/her progress.

Productivity Tools: Productivity tools such as bookmark, notepad, and web links are included in the EDUCOSOFT.

Communication/Collaboration Tools: These tools include internal announcements, and live chat.

Teaching techniques included problem solving on the whiteboard. Students were given demonstration on how to solve a problem using step-by-step approach. The step-

by-step approach included breaking the large problem into small segments (Top Down Approach) and solving each segment individually. The hierarchy of Bloom's Taxonomy is the widely accepted framework if applied properly by the teachers could guide their students through the cognitive learning process. This Hierarchy of Bloom's Taxonomy was applied throughout the quarter. The Cronbach's Alpha Coeffiecient value for EDUCOSOFT teach for higher order thinking skills (EDUCOHOT), questions 27-32 of 0.76 suggests the items (27-32) have relatively high internal consistency. The levels of taxonomy are considered to be hierarchical which means learners must master lower level objectives first before they can build on them to reach higher level objectives. The levels of the Taxonomy and examples of activities at each level are given below:

Knowledge (Remembering the previously learned material): State the formula for the problem. The problem was discussed and the appropriate formula was explained to the students.

Comprehension (Understanding of the meaning of material): Given the algebraic formula, paraphrase it in your own words. Paraphrasing the formula included description of the known and unknown items in the problem.

Application: Apply the concept and perform the calculation using the formula. The calculation was performed to solve the problem.

Analysis (Breaking down problem into parts): Given an algebraic word problem, determine the strategies necessary to solve it. The word problems in algebra require a top down approach and this approach involves breaking down the problem into small parts. This approach was applied whenever students were given word problems.

Synthesis (Putting parts together): Apply and integrate different strategies to solve an algebraic problem. Integrating different strategies was part of the high orders teaching approach and students were allowed to use strategies for problem solving.

Evaluation (Judging the value of a product for a given purpose, using definite criteria): After completing the problem, determine the degree to which that problem was solved as efficiently as possible. Review of student solution revealed the apparent strong and weak areas, which were used to create the study plan.

During the first three weeks of the quarter, students took five section quizzes in traditional format. Students were asked to solve the problems traditionally without the use of EDUCOSOFT. Similarly, the first two chapter tests were given in traditional format. The quizzes and tests included combination of multiple-choice, matching, and free response questions. The performance of students in these assessments was recorded. Students with low overall average in these assessments were identified. Weak areas of each individual student were determined from the assessments. A study plan was developed for these students for the rest of the term. The study plan consisted of practice homework assignments with embedded tutorials on EDUCOSOFT. A regular tutoring session was assigned to the students on one-on-one bases outside the classroom with the instructor. Grades from the study plan generated home assignments were not included in the final grades. However, each student was required to score 70% in the study plan to move forward with the next section. If a student fails to score 70% or above in the EDUCOSFT generated study plan, then he/she is required to repeat the study plan and set up additional time for tutoring with the instructor. Tutorials are not designed for grading.

They are strictly designed for practice. Tutorials have the capability to display the solution to the individual problem by demonstrating steps and explaining them with audio. This feature allowed students to learn the concept independently without the help of an instructor/tutor. Web sites such as www.purplemath.com and www.math.com were introduced for additional resources. The Cronbach alpha coefficient for EDUCOSOFT Diverse Efficacious Methods (EDUCEFEC), questions 22-27, and question 33 is 0.8809, suggesting that the items have relatively high internal consistency.

An additional eight quizzes and two tests were developed on EDUCOSOFT and students were required to take them online. Each quiz was assigned one hour and each test was assigned two hours. Students were required to complete the assessment within the time limit. No additional time was provided. Each student was allowed two attempts in both quizzes and tests. EDUCOSOFT would generate different questions during each attempt. Each test, quiz, and assignment was timed and the system automatically stopped responding to the students once the time was up. EDUCOSOFT would place the highest score in the grade book. Students had a choice of repeating the attempts if he/she had not maxed out the number of attempts and/or if he/she wanted to improve scores. The posttest was given before the final exam and the score was recorded. A comprehensive final exam was given during the 10th week of the quarter. The final exam was given online using EDUCOSOFT and each student was allowed two attempts. Students were allowed two hours to complete the final exam. Performance of students was recorded in the grade book along with their pre and posttest scores.

Description of the Instruments

The Technology in Education Questionnaire consisted of 53 items and was

constructed by Persaud and Turner (2006) to measure the dimensions of the theoretical

framework. Each dimension was defined, and items were selected to match the

dimensions. The Cronbach Alpha Reliability Coefficient was calculated, and only items

with a high reliability were retained for statistical analysis: instructor's use of student

socio-economical experience (Q1-Q.4, and Q6-11) with Cronbach Alpha Coefficient

value of 0.9069, instructor's use of EDUCOSOFT program (Q12-Q.15, and Q.5) with

Cronbach Alpha Coefficient value of 0.6719, EDUCOSOFT, diverse efficacious methods

(Q22-Q27 and Q23) with a Cronbach Alpha Coefficient value of 0.8809, and

EDUCOSOFT teach for higher order thinking (Q27–Q32) with a Chronbach Alpha value

of 0.7016 were retained for statistical analysis.

Data Collection

The data were collected from the survey questionnaire. The experimental group

was asked to complete the questionnaire. The performance of the students was monitored

throughout the term and the mean score of ongoing tests and final exam will be recorded.

Method of Analyzing Data

Survey questionnaire were divided into two categories: true/false and multiple

choices. Each answer was assigned a number, with 5 being the highest and 1 being the

lowest. A statistical analysis was conducted to arrive at a conclusion. The research

questions or hypotheses were analyzed using the Pearson Correlation. The Pearson

correlation coefficients were used to determine the degree of relationship between the

variable in the research questions. A Factor Analysis was conducted to determine the pattern among the variables. A Regression Analysis was conducted to examine the relation of a dependent variable to specified independent variables.

Limitations

1. Though anonymity is guaranteed to the students, they might not feel secure and reliability of responses may be compromised.

2. Since random sampling was not conducted for data collection, the possibility of error due to selection is high (Larson & Faber, 2009). Therefore the result might not be applicable to other institutions.

3. A One group quasi-experimental method was used in which the group was treated traditionally followed by a treatment. The demographic variables were included to adjust for non-random selection through correlation analysis. However, a separate control group would have increased the validity of the outcome.

4. Since the demographics vary, therefore the result might not be applicable to another institution.

The total sample size consisted of 87 students. A validated questionnaire was administered anonymously to the students. The data showed variation with respect to teacher demographic variables. The Statistical Package for the Social Sciences (SPSS) was used to analyze the data through correlation analysis, factor analysis, and regression analysis.

CHAPTER V

DATA ANALYSIS

In this study, the independent variables—instructional techniques, student perception of an online class, experience with technology-based Instructions, employment, student gender, and ethnicity—were included. The study included students enrolled in first year of college algebra classes. The experimental study was conducted that included treatment. A quantitative data analysis was conducted to analyze the data collected from the students based on the questionnaire. The population consisted of 87 students and the technology component included web-based EDUCOSOFT software designed by a math professor of Clark Atlanta University. The students in the control group are enrolled in an online section of a college algebra class. The dependent variable, student performance in a college algebra class, was determined by the final grade in the class and the gain score was determined by the posttest minus the pretest score.

The following statistical analyses were performed: Pearson Correlation Analysis, Factor Analysis, and Regression Analysis. The Pearson Correlation Coefficient was utilized to provide data with respect to each research question. The factor analysis was performed to identify the independent groupings of the selected variables into components of similar characteristics. A regression analysis was utilized to identify the

variables that would affect the student performance. All statistical calculations were performed to determine the level of significance at 0.05.

Results of Pearson Correlation Analyses

Gains Scores and Final Grades with Listed Independent Variables

The correlation results are analyzed by framing two research questions: one on student gain scores and the other on student final grades as related to each of the listed independent variables: instructional techniques, student perception of an online class, employment, gender, experience with technology-based instruction, and ethnicity. The large number of independent variables forced the need for a holistic comparison.

RQ1: To what extent were the students' gain scores as the dependent variable in the first year of college algebra class influenced by each of the following independent variables: instructional techniques, student perception of an online class, employment, gender, experience with technology-based instruction, and ethnicity?

The data with respect to this research question are shown in the Table 2. In Table 2, students' gain scores are significantly related to computerized tests and quizzes (Comptsqz). The calculated Pearson r is .339, and is significant at .05 levels. Other variables are not significantly related. Considering that there is no control group in the study and not random sampling of the subjects, it was expected that some of the demographic variables might be related to the gain scores. It appears that students made gains irrespective of their backgrounds and that repeated tests and quizzes generated randomly by the computer were the critical.

Table 2

Results of Pearson Correlation Analyses: Gains Scores and Final Grades of Students

Enrolled in the First Year of the College Algebra Class as Dependent with Listed

Independent Variables

	Gain Score	Final Grade
Gain score	1.000	.205
Final grade	.205	1.000
TSOCEXP (Q1- Q4, Q6 - Q11)	.056	.216*
Teacher use of student socioeconomic experience		
TUSEDUCO (Q12 – Q15, Q5)	068	.337*
Teacher use of EDUCOSOFT math program		
EDUCOSTD (Q16 – Q21)	-.112	.127
Use of EDUCOSOFT standard procedure		
EDUCEFEC (Q22 – Q27, Q33)	-.179	.236*
EDUCOSOFT diverse efficacious methods.		
EDUCOHOT (Q27 – Q32)	-.221	.046
EDUCOSOFT teach for higher order thinking skills		
EDUCOTCH (Q34 – Q41)	-.090	.223*
EDUCOSOFT supported by teacher		
TRADTSQZ (Test1, Test 2, and Quiz1 – Quiz5) Traditional Quiz	-.022	.807*

Table 2 (continued)

	Gain Score	Final Grade
COMPTSQZ (Test3, Test 4, Quiz6, Quiz7, Quiz8, Quiz9, Quiz10, Quiz11, Quiz12, Quiz13) - (Computerized quizzes)	.339*	.803*
Gender	-.143	.036
Age	.120	.347*
Employment	.135	.212
Ethnicity	.151	.133
Grade	.205	1.00

Teachers' perceptions about the design of the program and teacher methodology were also not related to the gain score. The findings support the Learning Outcome Analysis by Abdulrasool and Mishra (2006) that indicates the relationship between computerized instructions and student achievement. On the questionnaire, most students rated the computer program highly and whatever variation occurred was not related to the gain score. The gain scores were not related to the final grades meaning that everyone made gains and that the gains did not follow the pattern of the distribution of the final grades.

The gain score in mathematics is loaded in Factor II. The following independent variables are loaded inversely with gain score in mathematics: EDUCOSOFT teaching for higher order thinking skills (EDUCHOT), EDUCOSOFT diverse efficacious methods (EDUCEFEC), and use of EDUCOSOFT standard procedure (EDUCOSTD). The inverse

relationship indicated that students who made low gain scores viewed the EDUCOSOFT program high on teaching for higher order thinking skills (EDUCOHOT) by diverse and effective strategies (EDUCEFEC) and use of standards (EDUCOSTD). It should be observed that the review of the research literature indicated that students and advocates of technology claim that students tend to view technology positively and perceived them themselves as learning effectively. The positive observations by students and advocates of the program provide the rationale for increase expenditure in technology. However, the results in this study indicate that the students' positive feeling of efficacy relates inversely to their gain scores. The results of the factor analysis are stated in Table 3.

The listed variables are loaded in five factors as follows:

Factor 1 consists of the final grade (FINGRADE) with a factor coefficient of 0.919; computerized test score (COMPTSQZ) with a factor coefficient of 0.897, and traditional test score (TRADTSQZ) with a factor coefficient of 0.892 in that order, indicating that both types of quizzes influenced the final grades (FINGRADE) and the influence was more than those variables placed in separate and independent components. This would suggest that instructors ought to test student on an on-going basis to ensure that students learn the algebraic concepts incrementally and for instructors to re-teach and make adjustments incrementally to improve those lagging. There ought to be a feedback process both on the part of students and instructors

Table 3

Results of VARIMAX Rotation Analysis: Final Grade and Gain Score of First Year College Algebra Class and Selected Independent Variables

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
FINGRADE	.919				
COMPTSQZ	.897				
TRADTSQZ	.892				
EDUCOHOT		.857			
EDUCEFEC		.783			
EDUCOSTD		.635			
GAINSCOR		-.500			
GENDER			.831		
TUSED			.598		
UCO					
AGE			.471		
EMPLOY				.704	
TSOCEXP				.604	
EDUCOTCH				.593	
ETHNIC					.879
Variance explained	20.641	17.624	11.193	10.627	8.896

Factor 2 consists of EDUCOSOFT teaching for higher order thinking skills (EDUCOHOT) with a factor coefficient of 0.857, EDUCOSOFT diverse and effective methods (EDUCEFEC) with a factor coefficient of 0.783, use of EDUCOSOFT standard

procedure (EDUCOSTD) with a factor coefficient of 0.635, and posttest less pretest score (GAINSCOR) with a factor of coefficient of -0.500. The inverse the relationship (indicated by the negative sign in gain score) indicates that students with low gain score viewed the EDUCOSOFT program high as compared with students high on gain score who viewed the program low.

Since EDUCOSOFT teach for higher order thinking skills (EDUCOHOT), EDUCOSOFT diverse efficacious methods (EDUCEFEC), and EDUCOSOFT standard procedure (EDUCOSTD) are in the same component (Factor II) with gain score, they were combined to form the new variable: EDUCOSOFT capability (EDUCOCAP) for use in the regression analysis.

Factor 3 consists of gender, use of technology and age indicating the variation of the use of technology is associated with the gender and age of the student.

Factor 4 consists of employment, teacher use of students' socioeconomic experiences (TSOEXP), and EDUCOSOFT-based teaching indicating the variation in EDUCOSOFT-based teaching is associated with teacher use of student social experiences (TSOEXP) and employment.

Factor 5 consists of ethnicity and it is not associated with any other factor.

<div align="center">Results of Analysis of Variance with Gains Scores</div>

<div align="center">by Ethnicity</div>

Ethnicity was coded by their order as a percentage of the population, and it was not significantly related to both gain score and final grade in the correlation analyses. However, ethnicity is generally considered as a nominal variable meaning that there is no

order among the categories. Therefore, an ANOVA was conducted with the mean gain scores to determine if there were significant differences among the various ethnic groups. The results on the mean scores are shown in Table 4. In the table, there are differences in the mean scores among the social groups. White/Caucasian and Middle Eastern students gained than African American and Hispanic students. However, the F ratio is only 1.992 and the calculated probability level is .122 and this is higher than the required .05 level. Therefore, the differences are not significant at 0.05. The data were re-run several times with the same results. It should be observed that the standard deviations are high (ranging from 19 to 33) indicating that there are too many outliers that influence the mean score in each case. That is to say a few high scores in each category probably influence the gain score, thereby accounting for the result of no significance when the ANOVA program made adjustments for such extreme influences (Table 5).

Table 4

Mean Gains Scores by Ethnicity

Social Groups	N	Mean	Std. Deviation	Std. Error
White/Caucasian	23	10.0000	33.8781	7.0641
African American	48	1.9792	23.0803	3.3314
Hispanics	5	1.0000	26.0768	11.6619
Middle Eastern	7	26.4286	19.7303	7.4574
Total	83	6.2048	26.9438	2.9575

Table 5

ANOVA Gains Scores by Ethnicity

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4186.825	3	1395.608	1.992	.122
Within Groups	55342.693	79	700.540		
Total	59529.518	82			

Note: .122 is higher than .05 and therefore it is insignificant

The higher mean score could be attributed to higher socio-economic background of these students. Coleman's (1966) landmark study on *Equality of Educational Opportunity*, socioeconomic status has been seen as a strong predictor of student achievement. Coleman asserted that the influence of student background was greater than anything that goes on within schools. Apparently, the EDUCOSOFT in computer algebra program was not able to counteract the social background effects of students.

Results of Factor Analysis

The correlation coefficient relates several independent variables to each dependent variable on a one by one basis. If a dependent variable were significantly related to several independent variables, it would be necessary to determine the separate effects of each independent with the dependent. This would be especially necessary if the independent variables are also related among themselves. In this situation, a factor analysis is a mathematical tool for combining variables that are highly related among themselves and placing them is separate communes, factors, or components such that the variables in one factor or component are independent of all other factors or components.

In this way the large number are reduced into a fewer components or factors. The variables in a factor or component are highly interrelated among themselves when interacting simultaneously and are in this sense independent of variables in other factors or components. According to Darren and Mallery (2001), SPSS calculates the inter-correlations among all variables and develops a matrix of all correlations. The variables are sorted from highest to lowest based upon their relationships as indicated by their factor coefficients. The highly interrelated variables as indicated by their factor coefficients are loaded into Component I. The next set of related variables is loaded in Component II, followed by Component III, IV, and V. A variable is loaded into a component if its factor coefficient is highest in that component as compared with other components. VARIMAX rotation is utilized in this study to rotate the initial component to get the best possible fit and relationship. VARIMAX rotation results in five factors as shown in Table 4.

Results of Regression Analysis

The purpose of the regression analysis is to provide a "best fit" mathematical equation that determines the relationship between several independent variables and dependent variable. According to Darren and Mallery (2001), when the dependent variable is related to several independent variables, it is necessary to establish the order of the relationships. Regression analysis is used to determine the order in which each independent variable influences the dependent variable. This procedure allows the statisticians and researchers to determine the independent variable(s) that are most significant in impacting the dependent variable. While correlation analysis measures the

strength of the relationship between two variables only, the regression analysis is used to determine the relationships between two variables when excluding or taking out the effects of the other variables. In this way, the resulting relationship between two variables becomes independent of the effects of other variables that have been excluded or held constant. In this study, the stepwise regression analysis is utilized. The process involves entering each independent variable in the equation according to its order of the relationship with the dependent variable. All other independent variables are kept constant. Calculation of the beta coefficient is performed between each independent variable and the dependent while keeping all the other independent variables constant. The beta coefficient is the amount of change in dependent variable for every unit change in independent variable. The results of regression analysis are shown in the Table 6. In order to make the interpretation of the data meaningful, the data are analyzed in terms of the stated research question.

Table 6

Results on Stepwise Regression Analysis: Selected Independent Variables with Gains Scores as Dependent (N = 87)

	Std. Error	Std. Beta Coefficients	T	Sig.
(Constant)	26.143		.124	.901
COMPTSQZ	.279	.490	3.042	.003
EDUCOCAP	1.484	-.308	-2.522	.014
TSOCEXP	4.011	.175	1.400	.166

Table 6 (continued)

	Std. Error	Std. Beta Coefficients	T	Sig.
TUSEDUCO	5.502	-.030	-.213	.832
EDUCOTCH	4.885	.085	.654	.515
TRADTSQZ	.320	-.285	-1.608	.112
GENDER	7.051	-.185	-1.604	.113
AGE	1.835	.199	1.645	.105
EMPLOY	6.248	-.043	-.372	.711
ETHNIC	2.099	.175	1.631	.107

Total R Square change = .187; F Ratio = 2.791 and significant at .006

In Table 6, the results of the regression analysis using the stepwise procedure indicated that both Computerized quizzes (COMPTSQZ) with a beta contribution of .490 and EDUCOSOFT's capability (EDUCOCAP) with a beta coefficient of -.308 in that order made significant contributions. The other selected variables had no significant effect.

It should be observed that in the correlation analysis, computerized quizzes are related to gain score, and in regression analysis too, the computerized quizzes with a beta value of 0.490 made a significant contribution. However, in the factor analysis, the final grade with a factor coefficient of 0.919, computerized test score with a factor coefficient of 0.897, and traditional test score with a factor coefficient of 0.892 in that order, indicating that both types of quizzes influenced the final grades.

RQ2: To what extent were the student final grades as dependent in the first year college algebra class influenced by each of the following independent variables: instructional techniques, student perception of an online class, employment, gender, experience with technology-based instruction, and ethnicity?

Teacher use of student socioeconomic experience (TSOCEXP) with a correlation coefficient of 0.216, teacher use of EDUCOSOFT program (TUSEDUCO) with a correlation coefficient of 0.337, EDUCOSOFT's diverse efficacious methods (EDUCEFEC) with a correlation coefficient of 0.236, EDUCOSOFT support by the teacher (EDUCOTCH) with a correlation coefficient of 0.223, traditional Quiz (TRADTSQZ) with a correlation coefficient of 0.807, computerized quizzes (COMPTSQZ) with a correlation coefficient of 0.803, and AGE with a correlation coefficient of 0.347 are all significantly related to FINGRADE. However, the age of the student appeared also to influence learning of algebra since older students tend to rate these dimensions favorably as compared to younger students. Older students tend to be more responsible and more dedicated to perform well in the classroom.

A breakdown of the mean final grade by age indicates that direction of older students obtaining higher final grades. The oldest students represent the group of students with 51 plus years of age. The lowest achievers tend to be the students between the age group of 20-25 years (Table 7). The differences are significant as indicated in the ANOVA in Table 8.

Table 7

Mean Final Grade by Age

Age Groups	N	Mean	Std. Deviation	Std. Error
1. Under 20	17	2.53	1.18	.29
2. Between 20 – 29	27	1.96	1.32	.25
3. Between 30 – 39	9	2.78	1.30	.43
4. Between 40 – 49	5	3.20	1.30	.58
5. Between 50 – 59	16	3.00	1.03	.26
6. 60 or above	8	3.38	.74	.26
7. Age undefined	2	4.00	.00	.00

Table 8

Results of ANOVA on the Distribution of the Mean Final Grade by Age

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	24.381	6	4.063	2.912	.013
Within Groups	107.429	77	1.395		

Based on the data, the EDUCOSOFT program was not effective in helping younger students to learn algebra as compared with older students. The wider experiences, maturity and self responsibility of the older students tend to enhance their capabilities to apply themselves to learning to a greater extent than the younger students.

CHAPTER VI

SUMMARY AND RECOMMENDATIONS

Problem Context

The student achievement was an issue in the college level face-to-face college

algebra class in the college. This issue was addressed with the treatment that included

blending the traditional classroom instructions with computer assisted instructions using

EDUCOSOFT software. Computerized tutorials, quizzes, and tests were created to

achieve higher level of student achievement and learning. A quantitative data analyses

was conducted to analyze the data collected on the basis of each research question. Data

were requested from approximately 130 students. However, only 87 students volunteered

to respond to the survey, therefore the population consisted 87students who were enrolled

in the college algebra class. The dependent variable, student achievement in

mathematics, was defined as the student score in the posttest.

Review of Literature

Several research findings have identified various independent variables that

influence the student achievement. Student achievement is influenced by variables such

as (a) Instructional techniques (Baker, Hale, & Gifford, 1997; Mayer, 2001),

(b) Experience with Online Technologies (Gefen, Karahanna, & Straub, 2003; Henry &

Stone, 1994; Martins & Kellermanns, 2004; Stoel & Lee, 2003; Wober & Gretzel, 2000),

(c) Student perception of technology-based education (Howland & Moore, 2002; Smart

& Cappel, 2006), (c) Gender, Age, and Race of the student (Mossberger, 2003; Zigerell, 1984; NTIA, 2002; Pew, 2000; Walsh, 2001).

Theoretical Framework

It is proposed that students' performance in on-line class might be higher than in face-to-face class, and that this variation might correspond with the students' perceptions about the two types of classes. Further, student performance variation between the two forms of instruction might be explained by (a) Differences in the instructional techniques between the two types of instruction as observed or documented, (b) variation in students' perceptions about the two forms of instructions, and (c) Variation in students background variables such as gender, age, experience/skills in use of technology, work experience. These variables are stated in the following diagram for definition purposes.

Research Methods

The research design consisted of a survey of questionnaire of students in the experimental group. Students were divided into two groups. Students enrolled in the online class formed control group and students enrolled in the face-to-face class formed the experimental group. The total population size consisted of 87 students enrolled in the face-to-face class of college algebra. A correlation design was used to identify the critical relationships between the dependent and selected independent variables.

Main Findings

In the Pearson correlation analyses, students' gain score is significantly related to computerized tests and quizzes (COMPTSQZ). The calculated Pearson *r* is .339, and is

significant at .05 levels. Other variables are not significantly related. It was expected that some of the demographic variables might be related to the gain scores. It appears that students made gains irrespective of their backgrounds and that repeated tests and quizzes generated randomly by the computer were critical to their performance. The results from factor analysis indicate the factors that influence the final grades are computerized quizzes, and traditional quizzes. Computerized test score, and traditional test score influenced the final grade (FINGRADE). Factors that influenced the gain score are EDUCOSOFT teach for higher order thinking skills (EDUCOHOT), EDUCOSOFT's diverse efficacious methods (EDUCEFEC), and EDUCOSOFT standard procedure (EDUCOSTD) indicating the relationship between gain score and EDUCOSOFT use.

Conclusions

In this study, the results indicate that though several independent variables are significantly related to student performance, the most significant independent variables that affected student performance are EDUCOSOFT-based computerized exercises, tests and quizzes. Students benefited significantly from blended format of the class. EDUCOSOFT generated tutorials and randomly generated quizzes and tests by EDUCOSOFT program made significant impact on students' learning.

It is quite possible that randomly generated quizzes and EDUCOSOFT provided challenge to the students and that challenge resulted in better performance from the students. Many students equated computerized test with playing computer game and older students with little or no experience of this format benefited significantly and

gained confidence from this format. Enrollment of older students has increased significantly in the hybrid face-to-face classes.

<div align="center">Recommendations</div>

Recommendations are provided for the classroom instructor, lead instructors, and department chair.

Classroom Instructor

The recommendation is based upon the findings from the data. The essential finding is that the instructor's assessment of students' learning through quizzes is an important variable that explains students' gain scores. In this study, the instructor provided additional explanations utilizing students' experiences and providing one-on-one instruction for low performing students. It is advised that instructors might need to do likewise, and that staff development might be required to aid this process. According to high definition teaching strategies (Persaud, Turner, & Persaud-White, 2002), a teacher should identify the range of students' performances and target low achievers for improvement by identifying the social characteristics of students, their learning styles and interests, and utilize such experiences in teaching for higher order thinking skills in relation to the curriculum.

Since instructors are in the classroom, it is very important that they are proficient in technology-based instructions. Instructors must be required to undergo training in technology-based instructions to become proficient and to keep up with the current trend. Although all full time instructors who use EDUCOSOFT did attend training before they began using EDUCOSOF, this training should be extended to all part time faculty

members. All new faculty members (full time and part time) must be required to undergo training for technology-based instructions before they are assigned a teaching assignment.

It is recommended that technology use by the instructor must be incorporated in a collaborative environment to be effective. The collaboration of students with technology improves student achievement more than individual use. Kulik (2003) in his research has found that student collaboration increased the information available to students through a process augmented critical-thinking skills as students worked to assimilate a range of ideas and information from online sources, software, and their peers.

The college offers several math classes and each instructor uses his/her unique teaching techniques. Some instructors do not use any computerized instruction and some use minimal, which causes confusion among the students. Students' disliking of mathematics is a well known fact. Students have a feeling of helplessness. They feel that a brick wall has come down and they will never do better and have reached their limit in math (Yenilmez, Girginer, & Uzun, 2007). It is even more difficult for adult learners to recall mathematical concepts they learned several years back. These students are at the receiving end. Therefore, the instructors need to streamline the curriculum, include computerized instructions along with computerized assessments and tutorials recommended by the lead instructor. Staff development is necessary to aid this process. Online learning is a two-way partnership between students and courseware providers (lecturers). Students need to take responsibility for their own learning and expend the effort to utilize regularly the courseware for their advantage and benefit. At the same

time, the courseware providers need to ensure that courseware materials exhibit relevance, conciseness, currency, and appropriateness coupled with effective modes of presentation and interaction (Wee & Shubert, 2001).

Lead Instructor

The lead instructor for each math class needs to (a) work with all math instructors and design a uniform curriculum for math classes college-wide, (b) convert all face-to-face (traditional) math classes into hybrid format, (c) include computerized assignments, tutorials and assessments in all math classes, and (d) monitor student performance for each section and make recommendation for improvement.

Department Chair

Currently math classes are held in various settings. Some are held in the computer labs and some classes are offered in a classroom without any computers. Department chair needs to create additional computer classrooms to accommodate all math classes. The goal is to have one computer per student in the classroom. It is also recommended that hard cover math textbooks need to be replaced with e-books to assist students with low socioeconomic background. E-books are generally cheaper and more affordable. The department chair should pursue aggressively to promote the use of e-books, allow instructors to explore additional computerized resources to improve student achievement. Student survey must be administered every quarter to learn about student perception.

Policy Makers

Policy makers have a very important role to play in ensuring improved student performance and better retention rate. Therefore, it is recommended that college set aside a dedicated funding stream for educational technology that is tied to high-quality professional development as well as investment in hardware, software, and infrastructure. Additionally, the policymakers must ensure that technology investments and professional development are aligned to curriculum standards. Data on student performance can help in identifying the gaps where students are not meeting curriculum standards. By identifying instructors' needs for classroom, technologies and for professional development, administrators can ensure that funding is targeted where it is most effective.

Additionally, universities around the country should encourage faculty members to train in various instructional technologies to improve student learning. The current generation of high-school graduates is highly knowledgeable and savvy in technology-based instruction. It is, therefore, very important for the university professors to become knowledgeable with instructional technologies to keep up with these high-school graduates. Teachers, not technology, are the key to unlocking student potential. A teacher's training in, knowledge of, and attitude toward technology and related skills are central to effective technology integration (Waddoups, 2004).

APPENDIX A

Questionnaire

Dear Student:

I am conducting a research for a degree program, and seek your help in completing this questionnaire as frankly as possible. Your responses are anonymous, as you do not have to provide your name. The data will be treated as group data and you cannot be identified. The data are required for research only and offer benefits in the improvement of instruction. The completion of this questionnaire is voluntary and you can withdraw at any time.

Amit Dave

Directions: Please circle only one response for each item from the following possible responses.

1 = Strongly disagree   2 = Disagree   3 = Neither agree or disagree

4 = Agree   5 = Strongly agree

	Instructional Techniques employed by the instructor					
1	Electronic Tutorials in the program are useful to me.	1	2	3	4	5
2	My instructor uses practical examples to teach the class	1	2	3	4	5
3	I like the opportunity to be able to take quizzes and tests on the web	1	2	3	4	5
4	The tutorial and homework for self-study purpose are very helpful.	1	2	3	4	5
5	Choosing the best score out of three attempts for quizzes was very helpful in improving my performance in the class	1	2	3	4	5

Appendix A (continued)

	Instructional Techniques employed by the instructor (continued)					
6	Choosing the best score out of two attempts for tests and final exam was very helpful in improving my performance in the class	1	2	3	4	5
7	EDUCO program is friendly and easy to understand	1	2	3	4	5
8	I recommend EDUCO-based instruction for all mathematics classes	1	2	3	4	5
	Experience with Online Technology					
9	I work in the field of Information Technology and use web-based material for job related issues	1	2	3	4	5
10	My work requires me to use online resources and even though I do not work in the Information Technology field	1	2	3	4	5
11	I do not work in the Information Technology field and have no prior experience with computer, computer and web-based technology	1	2	3	4	5
12	I do not work in the Information Technology field but I have experience with web-based technology, and computer assisted instructions.	1	2	3	4	5
	Student Perception of Web-based Learning					
13	I feel very comfortable with web-based class format	1	2	3	4	5
14	I believe web-based instruction is as effective as face-to-face classes	1	2	3	4	5
15	Web-based class has given me the opportunity to take classes which was not possible for me otherwise due to factors beyond my control	1	2	3	4	5
16	Web-based class will improve my marketability when I look for the employment	1	2	3	4	5
17	More employers are providing online training to their employees; therefore employees need to become familiar with this format	1	2	3	4	5

Appendix A (continued)

	Student Perception of Web-based Learning (continued)					
18	I believe distance education has bright future	1	2	3	4	5
19	It is possible for an instructor to be creative and impart quality instructions using web-based teaching methods	1	2	3	4	5
20	Technology based learning has limitations	1	2	3	4	5

21. Age: Under 20   _____

    20 - 29   _____

    30 – 39   _____

    40 – 49   _____

    50 – 59   _____

    60 or above   _____

22. Employed: [1 = Yes]   or   [2 = No]

23. Gender: [1 = Male]   or   [2 = Female]

24. Number of years of experience with technology-based instruction:

    5 years or less   _____

    Over 5 years   _____

25. Race: 1 = White/Caucasian

    2 = African American

    3 = Asian/Pacific Islander

    4 = Hispanic

    5 = Middle Eastern

    6 = Other

Pre/Post Test

Time = 30 Minutes

Name: _____

1

Factor completely : $x^3 + 5x^2 - 4x - 20$
a) $(x - 4)^2 (x + 5)$

b) $(x - 4) (x^2 + 5)$

c) $(x - 2) (x + 2) (x + 5)$

d) $(x^2 + 4) (x - 5)$

e) None of the above

2

Factor completely : $x^2 - (x + h)^2$
a) $h(2x + h)$

b) $-h(2x - h)$

c) $-h^2$

d) $(x - h)(x + h)$

e) None of the above

Appendix B (continued)

3

If f(x) = 2x + x², find f(-2).

a) -8

b) 8

c) 0

d) 4

e) None of the above

4

Find the domain of the function f(x) = $\dfrac{3x^2 - 1}{x^2 + 1}$ **.**

a) $\{x : x \neq \frac{1}{3}\}$

b) $\{x : x > 1\}$

c) $\{x : x \neq -1\}$

d) $\{x : x \in R\}$

e) None of the above

Appendix B (continued)

5

Find the domain of the function g(x) =
$\sqrt{5 - 10x}$.

a) $\left\{ x : x \geq \frac{1}{2} \right\}$

b) $\left\{ x : x \geq \frac{-1}{2} \right\}$

c) $\left\{ x : x \leq \frac{-1}{2} \right\}$

d) $\left\{ x : x \leq \frac{1}{2} \right\}$

e) None of the above

6

The domain and range of the function f(x)
$= \sqrt{1 - x^2}$ **are:**

a)
Domain : $(-\infty, 1] \cup [1, \infty]$
Range : $(-\infty, -1] \cup [1, \infty]$

b)
Domain : $(-1, 1)$
Range : $[-1, 1]$

c)
Domain : $(-\infty, -1] \cup [1, \infty]$
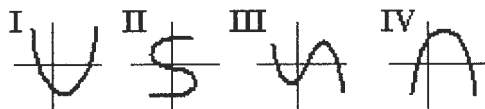Range : $(-\infty, 1] \cup [2, \infty]$

d)
Domain : $[-1, 2]$
Range : $[0, 0]$

e) None of the above

Appendix B (continued)

7

Which of the following graphs represent a function?

a) I only

b) II only

c) I and III only

d) I, III and IV only

e) None of the above

8

Given f(x) = 3x - 1 and g(x) = $\sqrt{12 - 2x}$, then f[g(-2)] =

a) - 7

b) 11

c) - 28

d) $\sqrt{26}$

e) None of the above

Appendix B (continued)

8

Given f(x) = 3x - 1 and g(x) = $\sqrt{12 - 2x}$,   4
then f[g(-2)] =

a) - 7

b) 11

c) - 28

d) $\sqrt{26}$

e) None of the above

9

If F(x) = $\sqrt{x - 1}$ and G(x) = 3x + 2 then a
formula for (FoG)(x) is :

a) $\sqrt{3x + 1}$

b) $\sqrt{4x + 1}$

c) $\sqrt{3x - 2}$

d) $\sqrt{4x - 1}$

e) None of the above

Appendix B (continued)

10

Solve for x : $\dfrac{3 + x}{2} = \dfrac{4 + x}{3}$

a) 3

b) - 3

c) 1

d) - 1

e) None of the above

11

Solve for x : -2(3x + 7) - 3 = 8(2x - 1) - 9

a) $\dfrac{1}{4}$

b) $- \dfrac{1}{4}$

c) 0

d) $\dfrac{3}{5}$

e) None of the above

Appendix B (continued)

12

Solve for P : $\dfrac{P + 2}{4} + \dfrac{P}{2} = \dfrac{P - 1}{3}$ 3

a) 2

b) 12

c) - 2

d) $\dfrac{1}{2}$

e) None of the above

13

Solve for x, in terms of y in 3y = 4x - 5 :

a) $\dfrac{5 - 3x}{4}$

b) $\dfrac{5 - 3y}{4}$

c) $\dfrac{3x + 5}{4}$

d) $\dfrac{3y + 5x}{4}$

e) None of the above

Appendix B (continued)

14

Solve the equation : $x^2 - 5x - 6 = 0$

a) 1, 6

b) 1, -6

c) -1, 6

d) -1, -6

e) None of the above

15

The solution set of the quadratic equation $x^2 - 4x - 12 = 0$ is:

a) {6, -2}

b) {6, 2}

c) {3, 6}

d) {2, 3}

e) None of the above

Appendix B (continued)

16

Find all zeros of the function f(x) = $\dfrac{5}{x^2 + 4}$.

a) - 4

b) 4

c) 0

d) No zeros

e) None of the above

17

Solve : -10x > 4x + 7

a) $\left[-\dfrac{1}{2} , -\infty \right]$

b) $\left[-\infty , -\dfrac{1}{2} \right]$

c) $\left[\dfrac{1}{2} , \infty \right]$

d) $[2 , \infty]$

e) None of the above

Appendix B (continued)

18

Find the domain of the function $f(x) = \dfrac{x + 3}{x - 4}$.

a) {x : x ≠ 4}

b) {x : x > 4}

c) {x : x = 4}

d) All x

e) None of the above

19

Find an equation of the line that passes through (0, 0) with a slope of -2.

a) y = -x

b) y = -2x

c) y = 2x

d) y = -2x + 1

e) None of the above

Appendix B (continued)

20 Slope of a Line

What is the slope of the line with equation 2x - 3y = 5 ?

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

b) $\frac{1}{3}$

c) $- \frac{2}{3}$

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

e) None of the above

REFERENCES

Abdulrasool, S. & Mishra, R. (2006). Computer assisted laboratory instructions:

   Learning outcomes analysis. *Current Developments in Technology-Assisted*

   Education, 14(8), 208.

Agarwal, R., & Day, A. E. (1998). The impact of the internet on economic education.

   Journal of Economic Education, 29(2), 99-110.

Alexander, K. L., & Entwisle, D. R. (1988). Achievement in the first two years of

   school: Patterns and processes. *Monographs of the Society for Research in Child*

   Development, 53, 218-234.

Anderson, M. A. (2000). It's in the research. *Library Talk, 13,* 31-33.

Ascough, R. S. (2002). Designing for online distance education: Putting pedagogy

   before technology. *Teaching Theology and Religion, 5*(1), 17-29.

Baker, W. (1997). From theory to implementation: The mediated learning approach to

   computer mediated instruction, learning and assessment.. *Educom Review, 35*(5),

   42-44.

Blake, R. R., & Mouton, J. S. (1978). The new managerial grid. Houston, TX: *Gulf*

   Publishing Company.

Coleman, J. S. (1966). *Equality of educational opportunity* (Report No. OE-3800).

   Washington, DC: National Center for Educational Statistics.

Daren, G., & Mallery, P. (2001). *SPSS for Windows*. Needham Heights, MA: Allyn & Bacon.

Devaney, K. (1987). *The lead teacher: Ways to begin.* New York: Carnegie Forum on Education and the Economy.

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

Dunn, R., & Dunn, K. (1979). Learning styles/teaching styles: Should they...can they...be matched. *Journal of the Association for Supervision and Curriculum Development, 36*(4), 239.

Freed, K. (2004). A history of distance learning. Retrieved June 25, 2004, from http://www.media-visions.com/ed-distlrn.html

Gefen, D., Karahanna, E., & Straub, D. W. (2003). Inexperience and experience with online stores: The importance of TAM and trust. *IEEE Transactions on Engineering Management, 50*(3), 307-321.

Gifford, B. (1997). From theory to implementation: The mediated learning approach to computer mediated instruction, learning and assessment. *Educom Review, 32,* 5.

Hale, T. (1997). *Findings from the teaching, learning, and computing survey: Is Larry Cuban right?* Paper delivered at the School Technology Leadership Conference, Washington, D.C.

Halsne, A., & Gatta, L. (2002). Online versus traditionally-delivered instruction: A descriptive study of learner characteristics in a community college setting. *Online*

Journal of Distance Learning Administration, 5(1). Retrieved March 12, 2009, from http://www.westga.edu/%7Edistance/ojdla/spring51/ spring51.html

Hara, N., & Kling, R. (1999). Students' distress with a web-based distance education course. *Information, Communication & Society, 4*(1). Retrieved Kamiaru 2007, from https://scholarworks.iu.edu/dspace/bitstream/handle/2022/1092/wp00-01B.html

Heafner, T. (2004). Using technology to motivate students to learn social studies. *Contemporary Issues in Technology and Teacher Education, 4*(1), 1528-58.

Hitz, W. H., & Scanlon, D. C. (2001). *Effects of instructional methodologies on student achievement, attitude and retention.* Paper presented at 28th Annual National Agricultural Education Research Conference, New Orleans, LA.

Howland, J., & Moore, J. L. (2002). Student perceptions as distance learners in internet-based courses. *Distance Education, 23*(2), 183-185.

Hunt, D. M. (2005). Web-based distance learning: Substitute or alternative to the traditional classroom: Making the delivery method decision. *Journal of Teaching International Business, 8*(3), 4.

Hyllagard, D., & Burke, D. M. (2002). *Online and technology-enhanced classroom instruction: A comparative study of student achievement.* Paper presented at the American Education Research Association Conference, New Orleans.

Irani, T. (2001). Targeting distance education to undergraduate students: Influences on traditional-aged students intent to enroll in a distance education course. *USDLA*

Journal, 15(11). Retrieved June 2007, from http://www.usdla.org/html/

journal/NOV01_ssue/article04.html

Kearns, L. E., Shoaf, J. R., & Summey, M. B. (2004). Performance and satisfaction of

second-degree BSN students in web-based and traditional course delivery

environments. *Journal of Nursing Education, 43*(6), 280-4.

Kelly, H. (2004). Enhancing interpersonal interaction in online courses. *Educational*

Technology, 44(1), 53-6.

Kidd, T. (2005). Key aspects affecting students' perception regarding the instructional

quality of online and web based courses. *International Journal of Instructional*

Technology and Distance Learning, 2(10), 183.

Kishore, M., Tabrizi, M. H., Nassehzadeh, O., Erol, A., Shahnaz, W., & Carl, L. (2009).

Correlates of student preference for online instruction over face-to-face

instruction. *E-Learning, 6*(4), 400-415.

Koedinger, K. R., Anderson, J. R., Hadley, W. H., & Mark, M. A. (1997). Intelligent

tutoring goes to school in the big city. *International Journal of Artificial*

Intelligence in Education, 8(1), 30-43.

Kuchinke, P. K., Aragon, S. R., & Bartlett, K. (2001). Online instruction: Lessons from

the instructor's perspective. *Performance Improvement, Human Resource*

Education, 40(1), 19-27.

Kulik, J. (2003). *Effects of using instructional technology in elementary and secondary*

schools: What controlled evaluation studies say. Arlington, VA: SRI

International.

Larson, R., & Faber, B. (2009). *Elementary statistics* (4th ed.). Upper Saddle River, NJ: Prentice Hall.

Leightwood, K., Seashore Louuis, K., Anderson, S., & Wahistrom, K. (2004). *How leadership influences student learning.* New York: Wallace Foundation.

Martins, L. L., & Kellermanns, F. W. (2004). A model of business school students' acceptance of a web-based course management system. *Academy of Management Learning & Education, 3*(1), 7-39.

Maslow, A. H. (1970). *Motivation and personality* (2nd ed.). New York: Harper & Row.

Mayer, R. (2001). *Multimedia Learning.* Cambridge, MA: Cambridge University Press.

McMahon, J., Gardner, J., Gray, C., & Mulhern, G. (1999). Barriers to computer usage: Staff and student perceptions. *Journal of Computer Assisted Learning, 15*, 302.

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

Mossberger, K., Tolbert, C., & Stansbury, M. (2003). *Virtual inequality: Beyond the digital divide.* Washington, DC: Georgetown University Press.

Moore, J. L., Kim, K. Y., & Esser, L. (2002). Aiming for effective student learning in web-based courses: Insights from student experiences. *Educational Media and Technology Yearbook, 27,* 204–208.

National Center for Education Statistics (NCES). (2008, April). Retrieved February 10, 2010, from http://nces.ed.gov/pubs2008/2009008.pdf

National Telecommunications and Information Administration (NTIA), U.S. Department

    of Commerce. (2002). *A nation online: How Americans are expanding their use*

    of the internet. Retrieved October 25, 2008, from www.ntia.doc.gov/ntiahome/

    dn/anationonline2.pdf/

O'Callaghan, B. R. (1998). Computer-intensive algebra and students' conceptual

    knowledge of functions. *Journal for Research in Mathematics Education, 29*(1),

    21-40.

Palloff, R. M., & Pratt, K. (2000). *Making the transition: Helping teachers to teach*

    online. Paper presented at EDUCAUSE: Thinking It Through. Nashville, TN

Persaud, G., & Turner T. (2006). *School description questionnaire as validated in a*

    sample of metro Atlanta schools: School cohort project. Atlanta, GA: Clark

    Atlanta University.

Persaud, G., Turner, T., & Persaud-White, T. (2002). High definition planning for

    teacher effectiveness. *Educational Planning, 14*(2), 40-57.

Pew Research Center. (2000). *African-Americans and the internet.* Retrieved

    April 24, 2008, from www.pewinternet.org/reports/.

Picciano, A. G., & Seaman, J. (2007). *K-12 online learning: A survey of U.S. school*

    district administrators. Boston: Sloan Consortium.

Richardson, L. (2003). A challenge to change business education. *Mid-American*

    Journal of Business, 18(1), 5-6.

Roblyer, M. D. (1999). Is choice important in distance learning? *Journal of Research*

    on Computing in Education, 32(1), 157.

Ronteltap. F., & Eurelings, A. (2002). Activity and interaction of students in an

electronic learning environment for problem-based learning. *Distance Education,*

23(1), 12.

Ropp, M. M. (1999, Summer). Exploring individual characteristics associated with

learning to use computers in preservice teacher preparation. *Journal of Research*

on Computing in Education, 31(4), 402-425.

Rosie, A. (2002). Online pedagogies and the promotion of "deep learning."

Information Services & Use, 20(2/3), 109-116.

Singh, P., & Pan, W. (2004). Online education: lessons for administrators and

instructors. *College Student Journal, 38*(2), 302-8.

Setzer, J. C., & Lewis, L. (2005). *Distance education courses for public elementary and*

secondary school students: 2002–03. NCES No. 2005-010. Washington, DC:

National Center for Education Statistics.

Smart, C. L., & Cappell, J. J. (2006). Students' perceptions of online learning. A

Comparative Study. *Journal of Information Technology Education, 5,* 18-20.

Software Information Industry Association. (2000). *2000 Research report on the*

effectiveness of technology in schools (7th ed.). Washington, DC.

Stanton, T. (2000, March 26). Wired for the future. *The Tampa Tribune* [Access

section], pp. 6-8.

Waddoups, G. L. (2004). *Technology integration, curriculum, and student achievement:*

A review of scientifically-based research and implications for EasyTech

(executive summary). Portland, OR: Learning.com.

Walsh, E. O. (2001). The truth about the digital divide. In Compaine, B. M, (Ed.), *The digital divide: Facing a crisis or a myth?* (pp. 279-84). Cambridge, MA: MIT Press.

Watkins, R. (2005). Developing e-learning activities. *Distance Learning, 2(*35), 5.

Wee, L. P., & Schubert, F. (2001). Students' perceptions of online learning: A case study of Singapore Temasek Polytechnic's virtual school of business project. *Library and Information Science Research Electronic Journal, 11*(2), 10.

Wenglinsky, H. (1998). The relationship between educational technology and student achievement in mathematics. *Education Testing Services, 5,* 4.

Yang, Y., & Cornelious, L. F. (2005). Preparing students for quality online instruction. *Online Journal of Distance Learning Administration, 7*(1). Retrieved Novermber 2009, from http://www.westga.edu/%7Edistance/ojdla/spring81/yang81.htm

Yenilmez, K., Girginer, N., & Uzun, O. (1997). Mathematics anxiety and attitude level of students of the faculty of economics and business administrator: The turkey model. *International Mathematical Forum, 2*(4), 2007.

Zandberg, I., & Lewis, L. (2008). *Technology-based distance education courses for public elementary and secondary school students: 2002-03 and 2004-05.* Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Zheng, L., & Smaldino, S. (2003). Key instructional design elements for distance education. *The Quarterly Review of Distance Education, 4*(2), 153-166.

Zigerell, J. (1984). *Distance education: Information age approach to adult education.* Washington, DC: ERIC Clearinghouse on Adult, Career, and Vocational Education.