THE EFFECTS OF TECHNOLOGY ENRICHED MATHEMATICS INSTRUCTION ON AT-RISK SECONDARY SCHOOL STUDENTS

by

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ABSTRACT

An obstacle to student learning with many at-risk students is not the lack of ability of the student, but rather the inability of the school system to design and implement options suited to their unique learning styles. This study examined the effectiveness of a computer-based instruction (CBI) system to teach Algebra I in an alternative high school serving at-risk students. The study focused on student achievement, attitudes toward mathematics, school climate, attendance and discipline referrals.

Investigators found that CBI can be effective in improving learning with at-risk students. Studies, including those of Tobin & Sprague, Craik, & Kreil, Griffin and Raywid found improvement in academic performance, self-esteem, and reducing behavior problems and dropout rates among students in alternative settings using technology-enhanced instruction.

The study examined 30 at-risk high school students using CBI and 40 students using textbook-based instruction to cover the same Algebra I concepts. The investigator administered an online survey from Tapia's Attitudes Towards Mathematics Inventory, and Gottfredson's survey on school climate. The investigator also collected course grades, state assessment scores, attendance and discipline records over a two-year period following the initial implementation of CBI.

This investigation used analysis of variance with pairwise comparisons and post-hoc analysis. Results found a significant increase in grades for at-risk students in the CBI group from a D+ to a C+ between year one ($M=4.07$) and year two ($M=6.53$); $t(29)=-.321$, $p<.05$. The CBI students also had a significant increase in mathematics scores on state assessments between year one ($M=1.63$) and year two ($M=1.87$); $t(29)=-2.04$, $p<.05$. CBI students reported more positive attitudes toward mathematics ($M=3.62$) than did the students in the traditional class ($M=3.21$); $F(1,68)=14.52$, $p<.001$.

CBI programs can be an effective option in improving student achievement and attitude in at-risk settings. The fact that the CBI students placed in an at-risk school for behavioral issues had better attitudes toward mathematics than those in a traditional school is encouraging. Further studies are needed to determine if the benefits of this CBI instructional approach might extend to other at-risk settings and across other content areas.

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I hope that now that I'm coming to the end of this journey, I'll have the time to enjoy life more deeply and the opportunity to use the knowledge learned at KU to assist others as they go down this worthwhile, albeit bumpy, road.

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CHAPTER I

INTRODUCTION

Introduction to the Study

With many at-risk students, some of the greatest obstacles to student learning and achievement relate not to the lack of ability of the student, but rather to the inability of the school system to design and implement an instructional climate best suited to their unique learning styles. Traditionally, schools have had lower expectations for at-risk students. Teachers have emphasized the acquisition of basic skills for at-risk students, often in special pullout programs or in lower level tracks. Hixson and Tinzmann (1990) noted that school factors such as narrow curricula, rigid instructional strategies, tracking, and pull-out programs hinder the academic achievement of many at-risk students.

Recent findings indicated that by not challenging at-risk students or not encouraging them to use complex thinking skills, schools underestimate students' capabilities, postpone interesting and meaningful work they could do, and deprive them of a meaningful context for learning and using the skills taught (Means & Knapp, 1991). Schools are not in a position to prevent or alleviate the socioeconomic and cultural conditions making such characteristics risky for persons in society (Means, 1997). Thus, school personnel see their function as that of an intervening treatment (Richardson, Cassanova, Placier, & Guilfoyle, 1989)

Often, the current structure and approach of schools do not meet at-risk students' physical and emotional needs. For these students, education must change from a one-size-fits-all experience to one offering a variety of options designed to better meet the spectrum of educational and emotional needs of these students. Alternative schools are important for the dramatic turnarounds in academic performance they often bring to the lives of individual students whose previous school performance has been filled with failure and disappointment. Until recently, well-substantiated evidence and data was difficult to document, but studies have begun to show improvement in academic performance and self-esteem, and reductions in behavior problems and dropout rates among students in alternative settings (Griffin 1994; Raywid, 1994; Tobin & Sprague, 2000; Wiest, Wong, Cervantes, Craik, & Kreil, 2001).

In 2000-01, 39% of public school districts had alternative schools and programs serving approximately 613,000 at-risk students, or about 1.3% of all students enrolled in public elementary and secondary schools (National Council on Education Statistics [NCES], 2004). Despite the extensive research on diverse instructional strategies with students at risk of failure, some educators have neither altered their classrooms or their teaching practice and continue to encounter difficulties in teaching students most at risk of failure.

To prepare for careers in virtually any industry, and especially for changing careers during a lifetime, secondary school students need to learn a substantial core of mathematics (Forman & Steen, 2000). Educators must realize that mathematics literacy is the goal of all students, not just those aspiring to continue their educational careers beyond high school graduation. To prepare students for future success, many school districts and state legislatures now make algebra a graduation requirement for all high school students (Choike, 2000).

Technology has become a significant tool for assisting students in mathematical problem solving, reasoning, and exploration (Burton, 1995, Pugalee, 2001, National

Council of Teachers of Mathematics [NCTM], 2000). Studies about mathematics reform rarely have involved students with a history of inadequate performance or those students outside the mainstream of most mathematics programs (Jitendra & Xin, 1997). The belief that technology can positively affect student learning has led many governments to create programs for the integration of technology in their schools. In the United States, school districts reportedly spent $7.87 billion on technology equipment during the 2003-2004 school year (Quality Education Data, 2004). The student-per-instructional computer ratio dropped to 3.8:1 in 2004, whereas the student-per-Internet-connected computer ratio dropped to 4.1:1 (”Capacity to Use Technology,” 2005).

Measuring the effectiveness of computer-assisted instruction is important not only because of cost and time invested by school districts, but also for the potential for increased student learning if shown effective. As computer-based instruction has become an acceptable method of delivering subject matter content, particularly with remedial students, the intent of the current study was to evaluate the effectiveness of this method on mathematic achievement levels of at-risk high school students. The study findings added to the body of knowledge about students who had not historically been successful with the one-size-fits-all model of mathematics instruction.

Researchers have performed numerous comparative studies indicating a technology-enriched curriculum improved academic achievement in contrast to traditional delivery methods of instruction (Elliot & Hall, 1997; Fletcher, Hawley, & Piele, 1990; Gardner, Simmons, & Simpson, 1992; Kulik, 1994). However, other studies have shown evidence that technology (or other media formats) can deliver instruction, but do not directly influence learning (Baker, Gearhart, & Herman, 1994; Clark, 1983;

Dixon & Judd, 1977; Fletcher-Finn & Gravatt, 1995). Several previous studies indicated computer-assisted math instruction was more effective than traditional instruction (e.g., Elliot & Hall, 1997; Gott, 1995; Hannafin & Sullivan, 1995; Kinzie, Sullivan, & Berdel, 1992; Wood, 1991), while others showed no difference (e.g., Shute & Gawlick-Grendel, 1996). Research results are too mixed to permit any firm conclusion.

Some inquiries have found computer-based instruction (CBI) superior, several have found conventional instruction superior, and still others have found no difference between the two types of instruction (Cotton, 1991; Rapaport & Savard, 1980). Little empirical evidence was found to determine whether specific technology-enriched programs actually improve educational outcomes in the area of mathematics by themselves or whether teacher attitudes, specific teacher-led instructional strategies, or other variables, in addition to the programs, have positive educational impact on students at-risk. Schmidt and Vandewater (2008) examined the role of various media formats and concluded the most important element was how teachers chose to use, present, and teach with the technology, and such choices largely arose from individual comfort and familiarity with the technologies. Roberts and Madhere (1990), in a study involving elementary and junior high schools, stated: “Findings indicate marginal successes in academic gains in reading and mathematics and an overwhelming positive student attitude toward the computer assisted medium of instruction and learning" (p. 45).

Clark (as cited in Fletcher-Flinn & Gravatt, 1995) cautioned against research studies claiming student achievement gains from computer-based instruction (CBI) and determined much of the success was due to uncontrolled effects of instructional practices and the novelty of the medium. Clark suggested differences between CBI and conventional instruction was minimal in studies utilizing the same materials and teacher in both the treatment and control groups. Lowe (2001) agreed, concluding: "When instruction is delivered in computer-based education (CBE) and conventional classrooms by the same person, the learning advantage for CBE is reduced to insignificant levels (p. 170). Jenks and Springer (2002) observed: "When studies control for internal validity issues such as instructional equivalency and instructor equivalency, differences between CBI and conventional instruction appear to be insignificant" (p. 54).

Indications are that the teacher, in both CBI and conventional classrooms, is an important variable in determining student achievement. No single measure of effective instruction exists, but student learning, changes in student behaviors, teacher self-evaluations, peer/administrative evaluations, frequency of specific behaviors observed by trained observers, and experimental manipulation effects are all accepted criteria of effective instruction (Marsh, 1984). Teachers most effective in producing learning are clear in the expression of their ideas, variable and flexible in their approaches to teaching, enthusiastic, and task-oriented (Travers, 1981).

Electronic tools to support the teaching of mathematics can be an important part of teachers' resources for promoting student learning of mathematics (Zbiek & Heid, 2009). In the area of mathematics, research has found many students experience difficulties making the transition from school arithmetic to school algebra, with its symbolism, equation solving, and emphasis on relationships among quantities. Researchers have investigated various innovative approaches to algebra, many using computational tools, and these new approaches offer considerable promise for avoiding the difficulties many students now experience (Beatty, 2005). Interactive tools provide experiences to help students discover and verify the relationships among symbols and representations of algebraic operations (Cavanaugh, Gillan, Bosnick, Hess, & Scott, 2008).

Hai-Jew (2008) examined several research studies. He concluded from the findings that, to achieve a successful learning process using multimedia technologies, students must use (a) a system containing meaningful interaction with academic materials (Moreno, Mayer, Spires, & Lester 2001), (b) a selection of relevant verbal and non-verbal information (Paivio 1986), (c) organization of information into corresponding mental models or representations (Mayer & Moreno 2002; Moreno & Mayer 2002), and (d) integration of new representations with existing knowledge (Pressley, Wood, Woloshyn, Martin, King, & Menke, 1992).

Johnson and Aragon (2002) hypothesized that educators should base quality learning environments on instructional principles derived from multiple learning theories. Johnson and Aragon developed a framework for instructional strategies to use in the computer learning environment and suggested their challenge was to devise ways to create pedagogically sound content for delivery by the computer. Their framework recommended that the information taught should address variability in learning styles, provide motivation, and promote interactivity. Most literature provided anecdotal comments on experiences with online courses in empirical research comparing face-to-face and online delivery methods. Johnson and Aragon (2002) considered these as two dissimilar learning environments and suggested future studies should empirically test the effectiveness of different instructional techniques to maximize learning opportunities and achievement in online learning. Lowe and Holton (2005) proposed five conclusions drawn from the theory.

- The characteristics of self-directedness and computer self-efficacy play an important role in designing CBI;
- CBI design is interwoven with the units of self-directedness, computer self-efficacy, learning level, instructional design, and external support;
- Learning goal level affects instructional design strategy in the instructional control component of CBI design;
- External support and instructional support are necessary to provide a positive CBI experience; and
- The theory draws together the isolated variables researchers consider important in the learning process and aligns them to provide effective CBI.

Teachers rely on experts to produce quality instructional materials for classroom use while assuming such commercial products have had proper design, development, and evaluation (Williams, Boone, & Kingsley, 2004). While textbooks and other traditional materials commonly used in classrooms may or may not have undergone an instructional design process classroom teachers often determine how to adapt and modify the materials to make them more effective and to fit the student needs (Gagné, Briggs, & Wagner, 1992; Joyce & Weil, 1986; Williams et al., 2004). Much of the commercial software, including CBI software packages, claim to have undergone a rigorous evaluation process, including studies which have shown their effectiveness. Boone, Higgins, and Williams (1997) suggested commercial educational software publishers are generally unwilling to talk when asked about the instructional design process of evaluation procedures. Only a few have had teachers or students evaluate their software prior to marketing (Higgins, Boone, & Williams, 2000; Mills, 2001).

Procedures in the current study investigated specific components of one software program used by students in the Belton Alternative Academy, analyzed the specific types of media used for each algebraic concept introduced, and examined the presentation of the concepts. Additional analysis centered on the components contained in materials used by students in classrooms with direct teacher instruction. The teachers applied traditional materials to determine which components of each program had the greatest positive causal effects on student academic achievement. Little published evidence was found to determine the impact of teacher attitude, teacher experience, and teacher knowledge of the subject area on student performance, not only in academic gains, but in motivation, improved attendance, and a decrease in discipline incidences among secondary at-risk students.

Purpose of the Study

The main purpose of this quantitative study was to examine the effects of a commercial, computer-based instruction mathematics program (A+dvanced Learning Systems) on algebraic achievement scores of secondary school at-risk students enrolled in a district alternative high school. This examination included reviewing the algebraic concepts in both instructional methods, comparing learners participating in a computer-based instructional program with learners who did not use CBI, and combining the findings with qualitative data to help explain effects on achievement. Quantitative analysis of the effectiveness of a computer-assisted instructional program (A^+dvanced Learning Systems) as a strategy to improve mathematics achievement scores among at-risk secondary school students took place, as well as analysis of traditional textbook math instruction, to determine how each affected student achievement based on state end–of-course (EOC) Algebra I assessment scores. Student grades underwent evaluation to determine whether a correlation existed between either of the two instructional methods and student grades in algebra in relation to state assessment results of both groups. Examinations in the study included,

- Whether any specific variable affected student motivation toward algebra in both control and treatment groups,
- How student attitudes toward Algebra I affected achievement,
- Group attitudes toward school climate,
- The effects of teacher educational background,
- Teacher attitude toward each program, and
- Effects of each program on discipline and attendance.

The findings of this research provide public school educators, educational leaders, and policymaker’s information with which to make informed decisions regarding the application of using enhanced computer-based applications to their schools to serve their at-risk population in remedial mathematics. The study represents additional research in the field of computer-based software effectiveness on secondary school students. As educational leaders make decisions to implement No Child left Behind (NLCB) and meet adequate yearly progress (AYP), quantitative data such as this research will benefit the public education community. The research supplements evidence already in existence.

Research Questions

The current research involved a longitudinal study comparing heterogeneous, at-risk high school students in credit recovery and general education high school students. An analysis of variance (ANOVA) with pairwise comparisons and necessary post-hoc tests and *t* tests were the measurement tools for analysis of data. The Missouri Assessment Program (MAP), EOC Algebra I exam took place for the students involved in the study to examine individual variable effects, as well as between-subjects effects.

Significant factors related to student achievement of the treatment group were analyzed for their potential impact on educational policy, staff development, instructional materials, and instructional practice. Results of the study provided the necessary data to determine whether a significant effect was present on at-risk high school students in credit recovery and academic achievement using CBI as determined by analyzing test data over a two year period.

The research questions developed for the study focused on Algebra I achievement scores of at-risk, credit recovery students in an alternative setting using computer-based instructional program in Algebra I. The study also analyzed data on general education students who received Algebra I textbook instruction not for comparison but to generalize data outcomes of the two groups of students. The groups are fundamentally different and cannot be directly compared without having had some common treatment/instruction. The analysis is based on two different years within each classroom.

RQ1: Is there a difference on mathematical scores on the state assessment examination (MAP) for two consecutive years for students enrolled in a computer-based instructional system and students enrolled in an Algebra I direct textbook-based instruction?

RQ2: Is there a relationship between state assessment scores and student mathematics grades of the studied groups over the course of the study?

RQ3: Is there a difference in attitude toward mathematics and school climate between students who receive CBI in Algebra I and students who receive direct instruction in Algebra I courses?

RQ4: Does a positive instructor attitude toward Algebra and school climate play a role in student motivation in CBI classes?

RQ5: Does enrollment in computer-based instruction influence student discipline incidents?

RQ6: Does enrollment in computer-based instruction influence student attendance?

The current research involved a longitudinal study of students enrolled in Algebra I classes in a single school district and included students from grades 9 through 11. The assessment measured comprised analysis of variance (ANOVA) and *t* tests of the statistics compiled using the Missouri Assessment Program (MAP), EOC Algebra I scores, student grades, attendance data, discipline referrals, and teacher/student survey data.

Hypotheses

H1: There are no differences on mathematical raw-score points on mathematical scores on the Missouri state assessment examination for students enrolled in a computer-based instructional system across testing years.

H2: There are no relationship between state assessment achievement levels and student mathematics grades for students enrolled in a computer-based instructional system across testing years.

H3: There are no differences between students enrolled in a technology-enhanced instructional system as compared to students enrolled in textbook-based direct instruction based upon student attitude toward mathematics.

H4: There are no differences between students enrolled in a technology-enhanced instructional system as compared to students enrolled in textbook-based direct instruction based upon student perceptions of school climate.

H5: There are no differences between student attitude toward Algebra and school climate based on instructor attitude.

H6: There are no relationships on the number of discipline referrals for students enrolled in a computer-based instructional system across testing years.

H7: There are no relationships on attendance for students enrolled in a computer-based instructional system across testing years.

Significance of the Study

The intent of the current study of the effects of computer-assisted math instruction on at-risk, secondary school students was to provide useful research evidence for school districts in their consideration of technology options and in their design of alternative high school curriculum. Over the last decade, American schools have dramatically increased spending on classroom technology to more than $6 billion annually. This increase was due, in part, to the widely held belief of governmental, business, and educational leaders that "Wiring schools, buying hardware and software, and distributing the equipment throughout will lead to abundant classroom use by teachers and students and improved teaching and learning" (Cuban, Kirkpatrick, & Peck, 2001). Educational stakeholders want to see an obvious return on the investment in classroom technology. The return seems questionable and may demonstrate fiscal irresponsibility when parents, policymakers, and educators look for evidence of the impact of technology on student achievement. Few studies or bodies of research have addressed the effectiveness of computer-assisted math instruction at the secondary level used for credit recovery. The current study supplemented that body of knowledge, posing additional variables that could affect student achievement for students participating in a CBI program.

Definition of Terms

The following terms appear throughout the study and provide understanding and meaning of the text.

At-risk student. The term *at-risk* first appeared in the "Nation at Risk" report of 1983. Scholars use the term quite loosely, with some offering up to 34 different characteristics to place and identify students as being at-risk (Hammons-Bryner, 1995). What defines the student who is at-risk? In educational research, the answer most often is certain identifiable students are at risk for failure or dropping out of school, in comparison to students who succeed or stay in school (Richardson et al.. , 1989).

Commonalities associated with the definition of an at-risk student are well documented. In the educational setting, the term can describe students from a range of social, economic, or environmental conditions frequently associated with school failure (Anderson-Inman & Horney, 1998; Pallas, 1989; Samsonov, Pedersen, & Hill, 2006). Often, at-risk describes students whose instructional and social interactions in schools are not successful (Hodgkinson, 1994) and possibly the result of a wide variety of physical, cognitive, personal, financial, familial, social, behavioral, or academic circumstances (Bigge, 1991; Center & Ward, 1984) causing school failure or other unwanted outcomes unless interventions occur to reduce the risk factors. The risk factors or predictors most often associated with school failure or dropping out include student background characteristics such as minority status, poverty, and language differences.

The term “at-risk” can also mean having one or more factors of family background or other factors found to predict a high rate of school failure. Researchers have suggested the content of school activities is so different from the students’ everyday experiences that it is irrelevant (Ladson-Billings, 1994; Tate, 1995).

The Missouri State Department of Elementary and Secondary Education in Missouri Revised Statute 161.800.1, qualifies the definition of an at-risk student: A student deemed to be at-risk of dropping out of school shall be any student who is still school age, but whose continued education is in jeopardy because they are experiencing academic deficits, or have characteristics identified as indicative of at-risk students (Missouri State Department of Elementary and Secondary Education, 2009).

Terminology varies from author to author as Bangert-Drowns, Kulik, and Kulik pointed out in their 1985 research summary: "The terminology in the area is open to dispute" (p. 59). The following definitions are a composite based upon characteristics described by Kulik (1994), Hoska (1993), Wang and Sleeman (1993), Locatis and Atkinson (1984), Brown (1997), Osciak and Milheim (2001), and Mahmood (2004). Students may experience academic deficits if they:

- Are one (1) or more years behind their age or grade level in mathematics or reading skills through eighth grade, or three (3) or more credits behind in the number of credits toward graduation from the ninth grade through twelfth grade
- Have low scores on tests of academic achievement and scholastic aptitude

- Have low grades and academic deficiencies
- Have a history of failure and being held back in school
- Have language problems or come from a non-English speaking home
- Are without access to appropriate educational programs.

Computer-assisted instruction (CAI). Computer-assisted instruction is the process by which written and visual information is presented in a logical sequence to a learner through a computer. Quyang (1993) used the term as any program that augments, teaches, or simulates the learning environment used in the traditional classroom.

Computer-based instruction (CBI). Computer-based instruction has traditionally contained four main components: drill and practice, tutorials, games and simulation, and modeling. Modern technologies have added to these hypertext, hypermedia, and multimedia.

Missouri Assessment Program/End of Course (MAP/EOC). The Missouri Assessment Program assesses students' progress toward mastery of the Show-Me Standards, the educational standards used by the state. The Missouri Assessment Program includes required end-of-course (EOC) assessments in the subject areas of Algebra I, biology, English II, and government. Additional EOC assessments are available in American history, English I, Algebra II, and geometry. Students take EOC assessments when he or she has received instruction on the course-level expectations for an assessment, regardless of grade level. All EOC assessments are available both online and in paper/pencil formats. The MAP/EOC assessments incorporate three types of test questions: multiple-choice, short-answer or constructive-response items requiring students to supply an appropriate response, and performance events requiring students to work toward complicated problems or issues.

Missouri Department of Elementary and Secondary Education (DESE). The Missouri Department of Elementary and Secondary Education (DESE) is the regulatory agency that oversees all aspects of teacher education and school governance for Missouri's public schools and the State Board of Education. The agency keeps extensive databases of school statistics, certification issues, school program guidelines, and legal issues in Missouri schools.

No Child Left Behind Act (NCLB). Congress passed the No Child Left Behind Act in January 2002 under President George W. Bush. The act reauthorized the existing Elementary and Secondary Education Act of 1965 (ESEA), set new accountability measures for all public schools, and is at the core of the principle that all children will be proficient in reading and math by the year 2014. Authorities consider this reform as the most sweeping federal law regarding public schools in over 40 years. Another provision of the law requires all children to be taught by highly qualified teachers. To be deemed highly qualified, teachers must possess a bachelor's degree, hold a full state certification or licensure, and pass an exit exam to demonstrate they know each subject they teach (U.S. Department of Labor, 2006).

Limitations of the Study

The limitations of the current study included a population limited to secondary students enrolled in the Belton, Missouri school district: 30 Belton Academy students in the treatment group and 40 randomly selected students from the Belton High School in the control group. The researcher had no control over the student gender distribution across groups nor several of the other internal and external variables encountered during the course of the study. Students enrolled in the computer-assisted instructional classes came from diverse backgrounds and varied educational histories. This factor was addressed in the statistical ANOVA tests of the results. The limitations of the study population included only high school students in a single district who had, or were in the process of, completing the Algebra I requirement for graduation. A future study utilizing several districts could provide expanded results with greater reliability as to the effectiveness of computer-based instruction for students seeking credit recovery or placed in an alternative school setting.

CHAPTER II

REVIEW OF LITERATURE

Historical and Legal Influence

Numerous educational initiatives have had the main objective of involving technology in the development of student skills. The necessary computer skills required of students by the end of the millennium appear in the Goals 2000: Educate America Act (1994) and continued with the Technology Literacy Challenge Fund (1997). The Technology Literacy Challenge Fund invested $5 billion into teacher/parent training and the integration of computers and Internet technology into schools and classrooms throughout the nation.

Researchers have noted only a few empirical studies address the effectiveness of these new tools as compared to traditional approaches to teach academic skills to at-risk students (Christmann, Badgett, & Lucking, 1997, Kulik & Kulik, 1991). Even a smaller number of studies address mathematics specifically (Ash, 2001; Confer, 1971; Corbitt, 1985; Goode, 1988; Fisher, 1973; Forgasz, 2002; Fuchs, Fuchs, Hamlet, Powell, Capizzi, & Seethaler, 2006; Hannafin, & Foshay, 2008; Rendall, 2001). A meta-analysis exploring the effectiveness of computer-assisted instruction to teach secondary school mathematics (Küchler, 1998) suggested all CBI had an overall small positive effect on mathematics achievement, but a medium positive effect on the retention of mathematical concepts and skills of secondary school students.

Technology can be one option for offering alternative school students a self-paced, self-directed instructional method for learning with a non-threatening approach. Evidence from previous research shows technology, when developed with a carefully conceived instructional strategy, has a positive influence on students at risk of failure (Means, 1997; Merino, Legarreta, Coughran, & Hoskins, 1990). Online tutorials offering student feedback can improve performance and provide students with the visual and cognitive support needed to master abstract mathematical concepts (Chen, Toh, & Ismail, 2005, Schiel, Dassin, de Magalhaes, & Guerrini, 2002).

Traditionally, schools have not focused on technology as a means to support engaged learning. Computers present in schools serving at-risk students usually support drill-and-practice programs on basic skills rather than functioning as tools to support students in designing their own projects (DeVillar & Faltis, 1991). Students use CBI most often for drill and practice activities, but opponents believe such activity creates passive rather than active learners (Means et al, 1993). A discernable difference seems to be present between computer-*based* instruction (CBI) and computer-*assisted* instruction (CAI).

The Association for Educational Communications and Technology (AECT Task Force, 1977) has defined computer-assisted instruction (CAI) as a method of instruction in which purpose of the computer is to instruct the student and in which the computer contains instruction designed to teach, guide, and test the student until he or she attains a desired level of proficiency.

Shbeer (2004) examined the effects of two instructional strategies in alternative settings (self-paced text-based instruction and self-paced computer-based instruction), and results indicated students had a higher self-concept and a greater sense of control over performance using the computer-based strategy. Since computer-based instruction serves as a personal tutor for each student rather than as an instructor for a group of students, students are able to progress at their own rate of learning (Hicken, Sullivan, & Klein, 1992). The CBI can build students' sense of control in several ways, including choice over lesson objectives, selection of assessment tasks, suggested criteria for creating due dates, and help for scheduling assignments (McInerney, 2000).

Research has suggested at-risk students require opportunities to acquire advanced thinking skills as well as basic skills within the context of complex, meaningful problems (Beau, Valdez, Nowakowsi, & Rasmussen, 1994). Students cannot acquire skills through simply learning facts, but instead can acquire them by having an opportunity to interact with the content, define learning goals, and explore new understandings through authentic, challenging tasks. Technology can be a major catalyst for encouraging the learner to interact with the content (Isernhagen, 1999).

The At-Risk Student

Alternative Schools

Many view alternative schools by what they are not: (a) Not in the educational mainstream, (b) Geared for students not succeeding in traditional classroom settings, and (c) Not bound by the conventional rules and regulations regarding textbooks, class size, curriculum, grades or teaching styles (Boss, 1998).

Alternative schools and programs serve students who are at risk of dropping out of school for any number of reasons, including poor grades, truancy, suspension, and pregnancy (Paglin & Fager, 1997). For many of these students, the one-size-fits-all theory of education was unacceptable and students simply dropped out of the educational arena to pursue other interests. According to Roderick (1993), the most common reasons cited by both young men and young women for dropping out of school were not liking school and poor school performance. Males appeared to be more likely than females were to drop out of school because of conflicts with school personnel, expulsion/suspensions, and/or financial or home responsibilities. Females more frequently cited pregnancy and marriage than their male counterparts did.

Of the states with reported dropout rates, the median dropout rate was 4.2% in 2001, with a range of 4.0 to 7.0. Males who drop out of school comprise 5.6% of the total student population and are more likely to drop out of school than females, who comprise only 4.3 percent. This ratio has not tended to vary significantly over the last 30 years (Hoffman, 2001).

Dropout rates in the U.S. vary widely among racial and ethnic groups. The dropout rate among 15-24-year-olds was 4.1% for Whites, 6.3% for Blacks and 8.8% for students with Hispanic backgrounds (National Center for Education Statistics [NCES], 2001, Table 1). Although the total numbers for all groups has decreased in the past decade, Hispanic students have historically been the ethnic population with the highest percentage of dropouts over the last 30 years.

> Alternative education is a perspective, not a procedure or program. It is based upon the belief that there are many ways to become educated, as well as many types of environments and structures within which this may occur. Further, it recognizes that all people can be educated and that it is in society's interest to ensure that all are educated to at least a general high school level. To accomplish this requires that we provide a variety of structures and environments such that each person can find one that is sufficiently comfortable to facilitate progress. (Morley, 1991, p. 8)

Although Morley, in the paragraph above, somewhat contradicts himself in his perspective as not a procedure statement, he makes a point that alternative education is a way of thinking. Students do not give up on traditional educational pathways simply because they have failed to attain success in any one system or program within that pathway.

Across the nation, individuals view the purpose of alternative schools in a number of different ways. Although no typical model of an alternative school is considered the standard model, some common structures and processes contribute to the successes these schools have experienced. In addition to collaborative, site-based management, other common characteristics of alternative schools include small school size, small class size, extended roles for teachers that include student counseling and guidance, cooperative roles for students, voluntary membership, student involvement in governance, and absence or minimization of tracking, ability grouping, and other forms of labeling (Neumann, 1994).

Raywid (1999) categorized alternative schools into three distinct types, acknowledging that particular schools or programs may have features of more than one type. Type I alternatives are schools of choice and generally have high success rates. Type II alternatives are schools in which administrators place students, usually as a last chance prior to expulsion. They focus on behavior modification and address little attention to pedagogy or curriculum. Type III alternatives focus on remediation or rehabilitation. Students are usually referred to type III alternatives.

Most alternative schools have two primary goals. The first is to educate students in a setting that prepares them for adult life after their secondary education. The second goal is to modify behavior and prepare the student to return to his or her home school ("Alternative Education Programs," 1996). The exact beginning of alternative schools, as well as a more defined focus on the at-risk student, is difficult to pinpoint because various legislators and educators have perceived alternative schools in different concepts. The issues of Brown v. Board of Education, mandating compulsory education; lack of employment after the Great Depression; the *A Nation At Risk* report; the Individuals with Disabilities Education Act (IDEA) (Public Law 94-142); and other relevant factors all led to one common denominator: some type of non-traditional educational setting had to be established for this group of unconventional students.

The first schools known as *alternatives* emerged in the 1960s, initially in the private sector and eventually in the public domain (Raywid, 1999). These schools were primarily located in large urban communities and were designed to provide an optional method of educating students who were unsuccessful in the education mainstream. These early alternative schools sprang from an idealistic counterculture era when the progressive educational ideas of John Dewey enjoyed a resurgence of popularity (Neumann, 1994). With the enactment of the Elementary and Secondary Education Act of 1965, districts began to receive public backing and funds to create innovative alternate forms of educational opportunities for disadvantaged and minority students.

During the first decade of their existence, public alternative schools grew from a meager 100 schools to more than 10,000 (Raywid, 1981). Educators know little about the overall current state of public alternative education across the nation. Although estimates vary, data indicate the number of alternative schools increased during the 1990s. According to the National Center for Education Statistics (NCES) Common Core of Data, in the school year 1993–94, the nation had 2,606 public alternative schools (Hoffman, 2001). As of 2001, over 20,000 alternative schools and programs designed to reach students at risk for school failure were in operation (Barr & Parrett, 2001).

Even with the additional funding and federal and state mandates, alternative schools had become the exclusive preserve for public education's outcasts. Because of this segregation, the act of enrolling in the programs further labeled the school's clientele. Now, in addition to "at risk," they are often referred to as "alternative school kids" (Sagor, 1999).

About one third (33%) of districts with alternative schools and programs for at-risk students had at least one such school or program lacking the capacity to enroll new students during the 1999–2000 school year. Fifty-four percent of districts with alternative schools and programs for at-risk students reported cases where demand for enrollment exceeded capacity within the last three years (Kleiner, Porch, & Farris, 2002). Overall, 12% of all students in alternative schools and programs for at-risk students were special education students with Individualized Education Programs (Hoffman, 2001).

With demand outweighing the supply of quality teachers and individualized instruction, and the failure of traditional school methodologies with alternative school students, districts must consider other options. Whether students at risk of education failure are able to transfer back to regular schools or successfully graduate from alternative schools and programs may depend in part on the quality of the education and services they receive. Researchers have identified various factors as beneficial to at-risk students in alternative education environments, including dedicated and well-trained staff, effective curriculum, and a variety of support services provided in collaboration with an array of agencies (Quinn & Rutherford 1998).

Technology

The mere existence of technology and other at-risk tools in the classroom does not guarantee that learning will transpire; the tools must be part of a coherent education approach (National Research Council, 2000). Technology's potential is abundantly apparent in the research literature, but few studies have examined its effects on learning outcomes for at-risk students. Data from a national survey indicated the most frequently reported effects of computer use for low-ability students as in behavioral and attitudinal areas such as motivation, self-confidence, and self-discipline (Becker, 1986).

Avitabile (1996) concluded from his study with at-risk high school students, "The overall change in student attitudes reinforces my belief that students can learn content in a more confident way when they develop computer applications where they can implement their own ideas" (p. 25). Avitabile suggested applications containing blended sound, graphics, animation, and text appeared to benefit the at-risk student.

Generalizing from the relatively scarce research on the success of CBI for at-risk students is problematic because of methodological difficulties. The variance in types and processor speed of the computers, student-computer and student-teacher ratios, and percentage of time spent in computer-assisted learning or in teacher or peer tutoring in addition to computer-based instruction all contribute to accurate validity in reporting results (Ascher, 1984).

Student Attitudes

While many factors influence the success of using CBI with algebra, attitudes of students towards mathematics presented in this instructional format and their willingness to accept this type of instruction influence the success (Bassoppo-Moyo, 2010).

Numerous studies have reported attitude towards mathematics affects achievement, and a negative effect on achievement could contribute to mathematics anxiety (Hembree, 1990, McCoy, 2005, Wigfield & Meece, 1988). A study by Bialo and Sivin-Kachala (1996) found technology had positive effects on student attitudes toward learning and on student self-concepts. Students using computer-based instruction felt more successful in school, were more motivated to learn, and had increased self-confidence and self-esteem (Bialo & Sivin-Kachala, 1996). The authors noted this was particularly true when the technology allowed learners to control their own learning.

Sivin-Kachala (1997) reported similar findings in a meta-analysis of 219 studies examining the effects of the computer on student achievement between 1990 and 1997 and found increased student achievement and more favorable attitudes towards subjects when instruction involved the computer. Studies have found that CBI benefited students by increasing confidence and satisfaction and improving student attitudes, thus contributing to student learning (Lewis, 1997; Li & Edmonds, 2005; Vitabile, 1996).

Attendance

In the analysis of the "High School and Beyond" database, absenteeism was the strongest predictor of dropping out of school (Bryk & Thum, 1989). The research on the reasons why students skip school has primarily focused on family, personal, and school causes (Wilkins, 2008). One study results indicated several predictors for school absenteeism, including (a) avoidance of school-related stimuli that provoke negative affectivity, (b) escape from aversive social and/or evaluative situations, (c) pursuit of attention from significant others, and (d) pursuit of tangible rewards outside of school. Perceptions about the school environment also played a primary role in the reason for student non-attendance (Kearney, 2007). A study by Head and Jamieson (2006) indicated students who feel they don't belong find those feelings reinforced by the relationships within the school.

A major synthesis of research by Cotton (1995) concluded students using a computer-based program showed improved attendance. Another researcher found the average daily attendance observed for the students enrolled in CBI courses was higher than the average daily attendance recorded for the students enrolled in traditional classes (Trautman & Lawrence, 2004). In that study, the difference approached statistical significance, $z = 1.27$, $p = .102$. The evidence appeared to indicate that educationally disadvantaged students who use technology as their primary method of instruction stay in school (Trautman & Lawrence, 2004).

Barton (2005) found one of the cornerstones of dropout intervention programs and improving attendance must be self-paced, computer-assisted instruction, including Internet access and instruction, with heavy emphasis on the fundamentals of reading, writing, math, science, and social studies. Means et al. (1993) stated changes in student absenteeism, dropout rates, classroom interaction, and independent learning are just a few improvements educators could see after incorporating technology into the curriculum. More than ever before, schools and districts attempt to address the needs of students at risk of dropping out by providing academic and behavioral supports, personalization strategies, and alternatives to the traditional classroom.

Discipline

Students in alternative programs often have a history of (a) disruptive behavior in the general education environment, (b) poor attendance, and (c) lack of academic success.

Researchers have found a correlation between disruptive behavior and academic achievement. McIntosh, Flannery, Sugai, Braun, and Cochrane (2008) reported significant interactions between academic scores and office discipline referrals among eighth and ninth graders. Ahn (2010) discovered academic and behavioral school outcome variables were closely related with each other.

Students who display disruptive behavior and discipline problems in school are more likely to drop out, with the behavioral explanation placing the responsibility for dropping out of school squarely on the student as a result of personal actions or behaviors (Brown, 2010). Expulsion and suspension from school are additional indicators of student problems that lead to failure to complete high school (McDill, Natriello, & Pallas, 1986). In the" High School and Beyond" study, over 30% of sophomores who dropped out of school had been suspended, a suspension rate three times that of peers who remained in school (Ekstrom, Goertz, Pollack, & Rock, 1986).

Educators have traditionally viewed alternative schools as a safe way for school districts to handle disruptive students and inappropriate behaviors while maintaining an educational focus with students unable to tolerate traditional instructional settings. Research by Duke and Griesdorn (1999) studied 32 alternative schools and disciplinary incidents. They found every one of the 32 schools in the study reported relatively few serious discipline problems and expulsions. Duke and Griesdorn questioned the validity of the findings, given the large percentage of students with lengthy histories of disciplinary infractions, and attributed part of the success to the small size of the schools and the low teacher-student ratio. Hadderman (2000) reported findings of reduced disruptive incidents and suspensions in a Passaic, New Jersey, alternative school, compared with the students' prior behaviors in their traditional middle school before entering the alternative setting.

Not all the research on student discipline revealed positive results. Fulkerson, Harrison, and Hedger (1998) reported that students enrolled in Minnesota alternative schools were three times more likely to commit acts of vandalism, assault, or shoplifting than their general education counterparts, and two times more likely to be involved with gang activity. In a meta-analysis of research related to the effectiveness of alternative schools, Cox (1995) found that alternative education programs displayed a small overall effect on attitudes towards school, self-esteem, and school performance, but no effect on delinquency.

Little research indicating clear evidence of a relationship between student discipline and computer-based instruction in alternative school settings was found during the course of the current study. Greater student motivation and fewer discipline problems are common in technology-rich classrooms (Stratham & Torell, 1996). Two years into his "Apple Classrooms of Tomorrow" study, Dwyer (1994) found that student behavior and attendance improved with technology infused into the classroom.

Instructor Influence

Knowing how to teach math well to students with different abilities seems to be much more important than having math teachers who possess strong backgrounds in mathematics (Ball, Lubienski, & Mewborn, 2001). Current research of teachers' knowledge has indicated both knowledge of the content and knowledge about how to teach that content are critical for effective teaching (Ball, 1991; Fennema & Franke, 1992; Sherin, 2002; Shulman, 1987). Data from research studies on the correlation between teacher knowledge and mathematics indicated a positive association between a teacher's mathematical knowledge and his or her students' knowledge of advanced mathematical concepts (Mullens, Murnane, & Willett 1996).

In a study by Larson (2000) on teacher attributes and their effect on student achievement, the researcher examined and analyzed teaching credentials of 185 teachers of Algebra I from 23 high schools. The analysis did not succeed in identifying the school or teacher attributes that distinguished more effective from less effective schools and teachers. The effectiveness on Algebra I exam performance of ninth-grade instruction, when distinguished from the effects of students' eighth-grade preparation levels, proved unrelated in any systemic way to teachers' education levels, years of teaching experience, certification in math, or completion of in-service math training courses. One of the major tenets of the study was to investigate the effects of teacher attitudes toward CBI instruction on achievement, discipline, attendance, motivation, and course satisfaction.

Richardson and Ting (2000) found the interaction between teachers and students influences student learning. Richardson and Swan (2003) reported a significant correlation between student satisfaction, their instructors, and their perceived learning online. Findings from other research have shown the amount of professional development for online teachers has an effect on online and classroom-based teacher ability and on student perceptions (Hughes, McLeod, Brown, Maeda, & Choi, 2005; Zucker & Kozma, 2003). Research findings in studies of CBI seem to indicate a need for a paradigm shift of the teacher from the role of instructor to a classroom coach or facilitator. The role of the teacher might become one of preparing the instructional environment, anticipating needs of students, and providing contingencies (Wegner, Holloway, & Garton, 1999).

CHAPTER III

METHOD

Introduction

The main purpose of this quantitative study was to examine the effects of a commercial, computer-assisted instruction mathematics program (A+dvanced Learning Systems) and specific teacher attributes on algebraic achievement scores of secondary-school at-risk students enrolled in a district alternative high school. The examination included analyzing results of learners receiving CBI and those who do not, and combining these findings with qualitative data to explain effects on achievement. The study processes compared specific Algebra I concepts presented in the CBI program and the traditional Algebra I course taught in the school district to Missouri state standards to determine whether the A+ program produced greater gains in student achievement, as measured on the EOC state assessment test for Algebra I.

In addition, student attitudes toward the CBI Algebra I and textbook-based Algebra underwent analysis to determine whether a significant difference in positive attitudes towards algebra and school climate motivation appeared in either mode of instruction. The study examined the teacher's knowledge of the subject, background preparation for teaching Algebra I, and attitudes towards each algebra module within the CBI to determine whether a significant difference existed. The impact of an independent variable on five dependent variables was investigated. The independent variable was participation in a technology-based or classroom-based Algebra I mathematics course. The dependent variables were:

- Course grade

- Student attitude towards course components
- Student perceptions of school climate
- Academic achievement on state assessment (MAP/EOC)
- Teacher subject knowledge and influence on attendance, discipline, student motivation, and student course satisfaction.

Specifically, the following research questions guided the study:

RQ1: Is there a difference on mathematical scores on the state assessment examination (MAP) for two consecutive years for students enrolled in a computer-based instructional system and students enrolled in an Algebra I direct textbook-based instruction?

RQ2: Is there a relationship between state assessment scores and student mathematics grades of the studied groups over the course of the study?

RQ3: Is there a difference in attitude toward mathematics and school climate between students who receive CBI in Algebra I and students who receive direct instruction in Algebra I courses?

RQ4: Does a positive instructor attitude toward Algebra and school climate play a role in student motivation in CBI classes?

RQ5: Does enrollment in computer-based instruction influence student discipline incidents?

RQ6: Does enrollment in computer-based instruction influence student attendance?

Community Description

The study took place in Belton, Missouri, a suburb just south of Kansas City, Missouri. The 2000 United States Census reported Belton's population as 25,171, an increase of 20.3% over the 1990 census figures. In the city, 28.1% of the households have children under the age of 18 years. The median family income is $45,876 per year, with a city per capita income of $19,384. Of the city's residents, 8.6% live below the poverty level; 6.4% of all families live below the poverty level (U.S. Census Bureau, 2006-08).

The Belton School District had a total student population of 4,959, reflecting the ethnic make-up of the community in 2009-2010. Enrollment at the Belton High School, which includes the Belton Alternative Academy, was currently 1050 and had remained consistent in numbers since 2005. The student high school population was 82% White, 9.2% African American, 1.1% Asian/Pacific Islanders, 6.9% Hispanic, and 1% Native American (U.S. Census Bureau, 2006-08).

The district had 311 (29.2%) students eligible for free and reduced lunch at the high school level, as compared to the state of Missouri average of 43.7%. In 2007-08, the per-pupil expenditure was $7209. The Belton Alternative Academy, in which the curriculum design study took place, housed approximately 60 eighth- through twelfth-grade students. The percentage of students receiving free and reduced lunch was 34% (U.S. Census Bureau, 2006-08).

Participant Selection

The population of the study consisted of Missouri ninth-grade students attending the Belton, Missouri School District. A random sample of 30 at-risk high school students attending an alternative high school using technology enhanced Algebra I instruction and 40 students enrolled in textbook-based direct Algebra I classes was selected for the study. Approximately the same number of males as females were in the sample, and they ranged from low to high in socio-economic status. The majority of the student population in both the high school and alternative school was primarily White (61.5%), with African-American students comprising 22.9% and Hispanic students consisting of 14.3%. Achievement levels varied and were reflected in the data collection summary.

Table 1. *Student Percentages by Race*

	American Indian	Asian	Black	Hispanic	White
Total Students *n* = (70)	1.3%	0%	22.9%	14.3%	61.5%
Treatment Group *n* = (30)	0%	0%	23.4%	13.3%	63.3%
Control Group *n* = (40)	2.5%	0%	22.5%	15%	60%

The students in the treatment group and control group received instruction in the district's curriculum within the four core classes, which included Algebra I. The teachers used a variety of instructional techniques which included presenting lessons in a linear fashion, focusing on mathematical vocabulary prior to beginning each lesson and discussing essential questions. Several of the instructional strategies were similar between the two groups of students, although the treatment group instructional strategies took place solely using a computer-based Algebra I program. Both groups addressed the following Algebra I content strands, and the subgroups are assessed on the state assessment test given to all students enrolled in Algebra I.

- Numbers and Operations
- Algebraic Relationships
- Data and Probability

Two additional strands were also addressed (Geometric and Spatial Relationships and Measurement), but were not included in state assessment and were assessed locally.

Missouri End-of-Course (EOC) Exam for Algebra I

Both the control and treatment groups participated in the Missouri End-of-Course (EOC) exam for Algebra I. The Missouri EOC Assessments were developed and first administered in 2008. They were created to address the needs of Missouri districts, schools, teachers, and students, while also meeting federal requirements. The Missouri State Board of Education identified the following purposes for the Missouri EOC Assessments:

- Measuring and reflecting students' mastery toward post-secondary readiness
- Identifying students' strengths and weaknesses
- Communicating expectations for all students
- Serving as the basis for state and national accountability plans, and
- Evaluating programs. (Missouri Assessment Program Technical Report [MAP Technical Report], 2009)

Course-level expectations (CLEs) outline the ideas, concepts, and skills that form the foundation for an assessed EOC subject area, regardless of student grade level. CLEs are used rather than grade-level expectations (GLEs) because courses such as Algebra I could be delivered at any grade level, rather than in one specific grade. Course-level expectations are more specific, designed to each EOC subject area. The EOC state assessment includes test items that (a) are stand-alone and passage-based, (b) have selected response and performance events and writing prompts, (c) are aligned to the Missouri Course-Level Expectations, and (d) aligned to Norman Webb's Depth of Knowledge cognitive levels (MAP Technical Report, 2009). Appendix A indicates the concept assessed, the big idea, and the GLEs assessed for each of the Algebra I core areas.

The Missouri EOC Assessment scores are scaled in several ways: raw-score points, item response theory (IRT)-derived scale scores, and achievement level based on scale-score cuts. Missouri actively promotes the use of achievement-level results, reporting them annually on each assessment at the student, school, district, and state levels. Individual student and average scale scores are also used, but they play a secondary role and the general interpretation is with reference to their distance from achievement-level cut points. Test results are reported for students as a whole as well as by student group, including gender, ethnicity, migrant status, free and reduced lunch (FRL) status, English language proficiency, Title I, individualized education program (IEP) status, and accommodations used during testing (MAP Technical Report, 2009).

The Missouri EOC Assessment score indicates whether an individual student performs at the Below Basic, Basic, Proficient, or Advanced level in a given content area. Achievement-level descriptors provide details about the content expectations met or exceeded by students at each level. The level definitions follow (Missouri Assessment Program, 2009).

Advanced. Students performing at the Advanced level on the Missouri Algebra I End-of-Course Assessment demonstrate a thorough understanding of the course-level expectations for Algebra I. They demonstrate these skills in numbers and operations, algebraic relationships, and data and probability. In addition to understanding and applying the skills at the Proficient level, students scoring at the Advanced level use a wide range of strategies to solve problems and demonstrate a thorough understanding of important mathematical content and concepts. Scale score cut: 225-250 (Missouri Assessment Program, 2009).

Proficient. Students performing at the Proficient level on the Missouri Algebra I End-of-Course Assessment demonstrate an understanding of most course-level expectations for Algebra I. They demonstrate these skills in numbers and operations, algebraic relationships, and data and probability. In addition to understanding and applying the skills at the Basic level, students scoring at the Proficient level use a range of strategies to solve problems and demonstrate an understanding of important mathematical content and concepts. Scale score cut: 200-224 (Missouri Assessment Program, 2009).

Basic. Students performing at the Basic level on the Missouri Algebra I End-of-Course Assessment demonstrate some understanding of the course-level expectations for Algebra I. They demonstrate these skills in numbers and operations, algebraic relationships, and data and probability. In addition to understanding and applying the skills at the Below Basic level, students scoring at the Basic level use some strategies to solve problems and demonstrate some understanding of important mathematical content and concepts. Scale score cut: 177-199 (Missouri Assessment Program, 2009).

Below basic. Students performing at the Below Basic level on the Missouri Algebra I End-of-Course Assessment demonstrate a limited understanding of the course-level expectations for Algebra I. They demonstrate these skills in numbers and operations, algebraic relationships, and data and probability. In addition, students scoring at the Below Basic level use very few strategies to solve problems and demonstrate a limited understanding of important mathematical content and concepts. Scale score cut: 100-176 (Missouri Assessment Program, 2009).

Instruments

The Belton School District routinely evaluates pilot programs to determine their impact on student achievement. This study, as is consistent with district expectations, evaluated the effectiveness of this curricular design model. The following factors were evaluated:

- MAP/EOC data
- Student grades
- A+ Learning data not disaggregated and reported back to individual buildings
- Student surveys on satisfaction, attitudes, and motivation
- Teacher surveys/interviews on subject knowledge, attitudes, and educational history
- Attendance data
- Discipline referrals

As this study evolved, several research methodologies surfaced as possibilities and a quasi-experimental quantitative study was determined to be the methodology most appropriate to determine the answers to the research questions posed earlier. Many quasi-experimental studies use intact groups, with both groups naturally assembled through their class assignments. For test purposes, both the treatment and control groups of students should be as alike and interchangeable as possible. Because quasi-experimental studies do not necessarily call for equivalence of the groups measured, no attempts took place to intentionally match characteristics or to minimize differences that might exist between the two groups.

Analysis of both the CBI students and general education students took place using the same timeframe. Statistical computations were conducted using the Statistical Package for Social Sciences (SPSS). The function of the SPSS software program was to calculate statistics for all data. The independent variables were technology-enhanced instruction and teacher-based instruction. Using MAP/EOC test scores as the dependent variables, independent sample *t* tests were used to compare the mean scores of the two groups.

The *t* test is one of the most commonly used techniques for testing a hypothesis for a difference between sample means (Caprette, 2004). The *t* test determines the probability that the two populations of students are the same with respect to the variable tested. The default 0.05 level of significance (alpha, α) was used. Null hypothesis were rejected whenever the *p*-values obtained were equal to .05.

The purpose of the Missouri Assessment Program/EOC (MAP) is to measure students' progress in meeting the Show-Me Standards. These standards are a set of academic goals adopted by the State Board of Education in January 1996 as part of the board's goal to raise the bar for academic achievement and student performance in Missouri's public schools, to fulfill the educational reform initiative, and to comply with No Child Left Behind (NCLB). Since their inception, Missouri's Show-Me Standards have been further refined to better delineate Content Standards, Process Standards, and

Content Strands/Grade-Level Expectations as Missouri changed the testing program to comply with NCLB (MAP Technical Report, 2009).

Starting in 2006, grade-level tests were administered in Communication Arts and Mathematics. In 2008, administration of grade-span tests began in Science. In 2008, the Department of Elementary and Secondary Education (DESE) developed End-of-Course (EOC) Assessments for use at the high school level (MAP Technical Report, 2009).

With the development of the new test program, the state discontinued the MAP high school assessments in the spring of 2008. In 2009, educators no longer administered MAP at the high school level. Missouri End-of-Course Assessments replaced MAP. The MAP tests have therefore undergone multiple alignment analyses to ensure that MAP content reflects these refinements (MAP Technical Report, 2009).

According to DESE (MAP Technical Report, 2009), the reliability of raw scores on the MAP tests and End-of-Course was evaluated using Cronbach's (1951) coefficient alpha, which is a lower-bound estimate of test reliability (see Table 2). The reliability coefficient is a ratio of the variance of true test scores to those of the observed scores, with the values ranging from 0 to 1. The closer the value of the reliability coefficient is to 1, the more consistent the scores, where 1 refers to a perfectly consistent test.

As a rule of thumb, researchers consider reliability coefficients equal to or greater than 0.8 as acceptable for tests of moderate lengths. Total test reliability measures such as Cronbach's coefficient alpha and SEM consider the consistency (reliability) of performance over all test questions in a given form. These results imply how well the questions measure the content domain and could continue to do so over repeated administrations. The number of items in the test influences these statistics; a longer test is usually more reliable than a shorter test (MAP Technical Report, 2009).

Table 2. *MAP Reliability in Mathematics*

Grade	Number of Items	Number of Score Points	Cronbach's Alpha
5	62	69	0.91
6	61	68	0.92
7	62	69	0.92
8	64	76	0.93

Note. Adapted from *Missouri Assessment Program Technical Report*, (2009), CTB/McGraw-Hill, Monterey, CA.

The overall technical quality of the EOC Assessments is sound. The Spring 2008 stand-alone field tests produced pools of technically sound items, with a 91% retention rate after psychometric and content criteria were applied. From those pools, Riverside, the company contracted by DESE to produce the tests, was able to assemble psychometrically similar forms, which helped support the pre-equating model in place. Application of IRT pre-equating resulted in perfect or nearly congruent raw-to-scale score conversions between the Spring (base) and Fall forms at the proficiency level cuts (MAP Technical Report, 2009).

According to DESE, post-administration test analyses supported the technical quality of the Missouri EOC Assessments (MAP Technical Report, 2009). Evaluations of Item Response Theory (IRT) model assumptions supported the use of the Rasch model for all tests. Test reliabilities ranged from .83 to .88 across the content areas for the Fall and Spring forms. Conditional standard errors of measurement were between 6 and 7 scale score points at the cut scores.

The item analyses also showed that the Missouri EOC Assessments have sound psychometrics properties (MAP Technical Report, 2009). The *p*-value ranges were sufficiently broad to indicate that the items measure achievement across a broad range of difficulty. Nearly all items had discrimination values > .15, and only one item had a value < .10. Speed was not a factor in students' test performance. Item bias analyses conducted on the pools further indicated that items were functioning equivalently for gender and ethnic groups (MAP Technical Report, 2009).

Student grades were collected and analyzed for both the treatment group (A+ Learning CBI Algebra I course) and students enrolled in the textbook-based Algebra I course (control group) to determine any statistical differences in overall grades in each of the two groups and to determine created significant differences in grades over the course of the study.

The student school climate survey (Appendix B) was developed and administered to the students prior to the end of the school year. The survey consisted of 28 questions using a 5-point Likert-type scale along with several short-answer questions coded for validity and consistency. All questions in the survey were adapted from the Effective School Battery developed by Gottfredson (1984/1999).

The Effective School Battery (EBS) is a scientifically researched instrument designed to assess student population characteristics and student perceptions of school climate. The latter aspect was the primary focus of this research and questions from that section were chosen and modified for use in the study. The survey addresses attitudes towards the school, the program, and students enrolled in their respective educational programs. Result means from both the treatment and control surveys are in Appendix C.

Teachers completed the staff school climate survey (Appendix D), which had 28 questions similar to those on the student survey and was coded for validity and consistency to correspond to questions in similar areas on the Student School Climate Survey. This survey was also adapted from the EBS, with questions chosen and designed to answer specific information posed in the research study. Result means appear in Appendix E.

Assessing student attitudes to identify ways to improve them is a mainstream issue among researchers who study computer-related attitudes. Improving students' computer-related attitudes, including attitudes toward learning through the use of computers, is a key to maximizing the learning process through CAI (Ruffin, 2000). In utilizing technology with algebra, the key to improving the learning process is to determine the effects of specific variables on student attitudes toward both technology and algebra. Students in both control and treatment groups completed an Attitudes Towards Mathematics Inventory (ATMI) (Appendix F), coded for validity and consistency and consisting of 40 questions using a 5-point Likert-type scale. Result means from both groups appear in Appendix G.

Tapia (1996) developed the ATMI instrument for secondary students. See Figure 1 for a sample item. The ATMI was designed to measure four dimensions of attitude towards mathematics. The reliability coefficient alpha was .97 for the 40 items included on the final inventory. A principal components factor analysis revealed the following four factors:

- Students' sense of security
- Value of mathematics

- Motivation, and
- Enjoyment of mathematics

Directions: This inventory consists of the statements about your attitude towards mathematics. There are no correct or incorrect responses. The only correct responses are those that are true *for you*. Whenever possible, let the things that have happened to you this year help you make a choice. Read each item carefully. Please think about how you feel about each item. Enter the letter that most closely corresponds to how each statement best describes your feelings. Please answer every question. As you read the sentence, you will know whether you agree or disagree. If you strongly agree, circle A next to Number 1. If you agree, but not so strongly, or you only "sort of" disagree, circle B. If you feel neutral (don't agree or disagree) select C. If you disagree with the sentence, circle D. If you strongly disagree, circle E. PLEASE USE THESE RESPONSE CODES: A – Strongly Agree B – Agree C – Neutral D – Disagree E – Strongly Disagree
1. Mathematics is a very worthwhile and necessary subject 2. Mathematics is important in everyday life. 3. Mathematics is one of most important subject for people to study. 4. I can think of many ways that I use math outside of school.

Figure 1. Excerpt from the Attitudes Toward Mathematics Inventory

Algebra teachers (N = 5) completed an Algebra Teacher Survey (Appendix H), which included 20 questions using a 5-point Likert-type scale, along with several short answer questions coded for validity and consistency. The questions in the teacher survey concentrated on teacher preparedness, educational background, and knowledge of the subject content, along with questions relevant to motivation and attitudes of the students enrolled in their respective algebra classes. Surveys were coded for validity and consistency. Results from teacher responses are in Appendix I.

Student social development underwent evaluation through a series of measures available to school district personnel. The Belton School District monitors student attendance as a matter of practice. Student attendance is a good indicator of student engagement in the school environment. This measurement was aligned with the theory presented by Singh, Vaught, and Mitchell (1998) that students who are motivated in their school environment are more likely to attend school than their less enthused peers. Attendance for the 2009-10 academic year was compared with that of the 2008-2009 academic year.

The number and type of discipline interventions was evaluated to determine the impact of this curricular design on interpersonal and intrapersonal skills. Discipline referrals were collected and analyzed for each student in the survey, including number of referrals and the severity/penalty for each infraction, to determine any correlation between variables. Discipline interventions for the 2009-2010 academic year were compared with that of the 2008-2009 academic year.

Procedure for Surveys

Any individual student assessment requires parental consent; the appropriate informed consent is in the Parental Consent Form for Students (see Appendix J). Teachers received and signed the Adult Consent Form (see Appendix K). The University of Kansas Human Subjects Committee received, reviewed, and approved all survey materials prior to the commencement of the surveys.

The Student School Climate Survey and Student Attitudes Towards Mathematics Inventory were compiled on Survey Monkey for access to students in the computer labs at each of the respective buildings in the study. Students received consent forms in advance, which were collected and verified prior to student participation. No student names were disclosed to the primary field investigator in the conduct of the survey completion.

Student surveys and other data tied to a specific student were matched using a unique 4-digit code recorded by a third party. The third party input the 4-digit code into Survey Monkey and the student sat at a predetermined, assigned computer to view the webpage displaying directions for completing the survey and questions. The facilitator give brief directions for completing the survey and the amount of time (15 minutes) allowed for completion of the survey.

Teachers received a unique Survey Monkey link, which allowed them to access and complete the Mathematics Teacher Survey and the Teacher School Climate Survey online. Directions were clearly defined at the beginning of each survey. Confidentiality of results was explained to both students and teachers prior to and following survey participation.

Data Collection

The data underwent analysis to respond to the following questions the research sought to clarify.

RQ1: Is there a difference on mathematical scores on the state assessment examination (MAP) for two consecutive years for students enrolled in a computer-based instructional system and students enrolled in an Algebra I direct textbook-based instruction?

RQ2: Is there a relationship between state assessment scores and student mathematics grades of the studied groups over the course of the study?

RQ3: Is there a difference in attitude toward mathematics and school climate between students who receive CBI in Algebra I and students who receive direct textbook-based instruction in Algebra I courses?

RQ4: Does a positive instructor attitude toward Algebra and school climate play a role in student motivation in CBI classes?

RQ5: Does enrollment in computer-based instruction influence student discipline incidents?

RQ6: Does enrollment in computer-based instruction influence student attendance?

Length of Study

The study took place throughout the 2009-2010 academic year. Comparative data from the 2008-2009 academic year served as a baseline measurement for some qualities.

Limitations of the Study

As with all research studies, the current study had limitations. Two external threats affected the study validity. The first threat was the interaction between selection and treatment. This research study was quantitative in nature and focused on 30 at-risk Algebra I students in an alternative program and 40 general education Algebra I students at the district high school. Due to the variance in student populations between the two groups in the study, the sample sizes were not equal. This condition set up a quasi-experimental design for the study.

The second external threat to validity was the interaction between setting and treatment. The research occurred in a two unique settings and it may not be transferable to other educational environments. However, the study results will be a welcome addition to the existing body of research on the topic, extending the available research to a suburban, public school setting.

CHAPTER IV

RESULTS

Introduction to Results

The main purpose of this quantitative study was to examine the effects of a commercial, computer-based instruction mathematics program (A+dvanced Learning Systems) on algebraic achievement scores of secondary-school at-risk students enrolled in a district alternative high school. The study was designed to test the hypotheses between two groups of students enrolled in Algebra I classrooms using different instructional methodologies covering similar concepts. Although a direct comparison analysis was not possible on some hypotheses posed, several other key components allowed for comparison between groups. The statistical analysis addressed six overarching research questions.

RQ1: Is there a difference on mathematical scores on the state assessment examination (MAP) for two consecutive years for students enrolled in a computer-based instructional system and students enrolled in an Algebra I direct textbook-based instruction?

RQ2: Is there a relationship between state assessment scores and student mathematics grades of the studied groups over the course of the study?

RQ3: Is there a difference in attitude toward mathematics and school climate between students who receive CBI in Algebra I and students who receive textbook-based instruction in Algebra I courses?

RQ4: Does a positive instructor attitude toward Algebra and school climate play a role in student motivation in CBI classes?

RQ5: Does enrollment in computer-based instruction influence student discipline incidents?

RQ6: Does enrollment in computer-based instruction influence student attendance?

Analysis of Research Questions

The academic impact of the computer-based group underwent analysis as were students enrolled in the general education Algebra I course. Descriptive statistics provided within group analysis of the effectiveness of the treatment. These were assessed by measuring student gains in grade point average, teacher-generated common assessments, and mathematic state assessment scores over a two-year period.

Research Questions 1 and 2

The first research question asked "Is there a difference on mathematical scores on the state assessment examination (MAP) for two consecutive years for students enrolled in a computer-based instructional system and students enrolled in an Algebra I direct textbook-based instruction?" The second research question examined whether a relationship existed between state assessment scores and student mathematics grades over the two years included in the study.

Table 3 illustrates 2009 and 2010 MAP scores as well as 2009 and 2010 student grades for those students enrolled in computer-based Algebra I instruction. Pearson *r* scores appear for each variable. A Pearson *r* was calculated to determine the extent of the relationship among MAP 2009 scores with MAP 2010 scores for students enrolled in the A+ Learning Systems CBI program. Calculations obtained a correlation of .696 (n = 30), which was statistically significant at the .05 level. When squared, the strength of the relationship between scores on these two measures was determined to be 48.4%: a moderate amount of overlap exists between scores on these two measures.

The developers of the state assessment test designed the assessment tool to be highly correlated and to be equated across administration years. The correlation results therefore indicate the test design was functioning properly, and any increases in student scores are due to other variables, aside from any changes in test content between the 2009 and 2010 test administration. According to the data, the 2010 MAP scores correlated with 2009 test scores and 2010 student grades. The 2009 student grades did not show evidence of correlation but shifted in 2010, where a moderate correlation existed (.405) between grades and MAP scores.

Hypothesis 1 stated that there are no differences on mathematical raw-score points on mathematical scores on the Missouri state assessment examination for students enrolled in a computer-based instructional system across testing years. Based upon data collected, the null hypothesis stated was rejected.

Table 3. *CBI Student Grades and MAP Achievement Level Matrix*

	MAP 2010	MAP 2009	Grades 2010	Grades 2009
MAP 2010				
MAP 2009	.696*			
Grades 2010	.405*	.344		
Grades 2009	.094	-.132	.075	

MAP = Missouri Assessment Program
* statistically significant at the .05 level

A Pearson *r* was also calculated to determine the extent of the relationship among 2009 and 2010 student math grades for students enrolled in the CBI program. A correlation of .405 (*n* = 30) was obtained, which was significantly significant at the .05 level. When squared, the strength of the relationship between scores on the two measures was determined to be 16.4%: a moderate amount of overlap existed between scores on the two measures.

Table 4 shows 2009 and 2010 MAP scores, as well as student 2009 and 2010 student grades for those students enrolled in textbook-based Algebra I instruction. Pearson *r* scores appear for each measure.

Pearson *r* values were calculated to determine the extent of the relationship among MAP 2009 scores and MAP 2010 scores for students enrolled in the textbook-based Algebra I program. A correlation of .544 (*n* = 40) was obtained, which was statistically significant at the .05 level. When squared, the strength of the relationship between scores on the two measures was 29.5%: a small amount of overlap exists between scores on the two measures.

Again, data indicate the test design of the state assessment was functioning properly, indicating that any increases were due to other variables than the changes in test content. There is a positive relationship in the correlation of grades (.745) and MAP scores (.544) between 2009 and 2010 testing for students in the textbook-based classroom.

Pearson *r* values were calculated to determine the extent of the relationship between 2009 and 2010 student math grades for students enrolled in the textbook-based Algebra I program. A correlation of .745(*n* = 40) was obtained, which was significantly significant at the .05 level. The squared values indicated the strength of the relationship between scores on the two measures was 55.5%: a moderate amount of overlap existed between 2009 and 2010 math grades within the instruction group.

Table 4. *Textbook-based Student Grades and MAP Achievement Level Matrix*

	MAP 2010	MAP 2009	Grades 2010	Grades 2009
MAP 2010				
MAP 2009	.544*			
Grades 2010	.611	.385		
Grades 2009	.539	.549	.745*	

*statistically significant at the .05 level

Table 5 illustrates 2009 and 2010 MAP scores, as well as student 2009 and 2010 student grades for those students enrolled in CBI Algebra I instruction across the same years. The results indicated a significant increase in mean MAP scores for 2009 to 2010, $t\ (29) = -2.041$, $p < .05$. This increase illustrated a significant increase in MAP scores for those students enrolled in the CBI classroom with an increase of 14.7 percent between 2009 and 2010. Though the pattern of scores changed across years for the state population and is outside the scope of this study, the significant increase in assessment scores exhibited with this student group is important.

Students in CBI Algebra I instruction revealed a significant mean improvement between 2009 and 2010 grades, $t(29) = -3.21$, $p = .003$. The gain in mean grades from 4.07 on 2009 grades in math to 6.53 on 2010 math grades gain illustrates a noteworthy positive boost in student grades. This reflects an increase in grades from a D+ mean value (D+ = 4.0) to an approximate grade equivalent of C+ mean average (C+ = 7.0) in 2010. The Sig. (2-tailed) score of .050 indicated significance in a positive direction.

Hypothesis 2 stated that there are no relationships between state assessment (MAP) scores and student mathematics grades for students enrolled in a computer-based instructional system across testing years. Results failed to reject this hypothesis for 2009 data however data for 2010 revealed statistically significant differences.

Table 5. *CBI Student Grades and MAP Achievement Level Paired Samples*

	M	*SD*	*t*	*df*	Sig. (2 tailed)
MAP 2009 Achievement Level	1.63	.85			
MAP 2010 Achievement Level	1.87	.73			
			-2.04	29	.050
Grades 2009	4.07	3.15			
Grades 2010	6.53	3.05			
			-3.21	29	.003

Table 6 illustrates 2009 and 2010 MAP scores, as well as student 2009 and 2010 student grades for those students enrolled in textbook-based Algebra I instruction. Results indicated a significant difference in MAP scores from 2009 to 2010 for this instruction group. Students enrolled in textbook-based Algebra I instruction revealed a significant change in MAP scores, t (39) = -6.509, p < .001.

Examining the mean values, 2.20 and 2.88, revealed the students exhibited a meaningful increase in assessment scores with an increase of 23.6 percent between 2009 and 2010. These mean values are based on a 4-point scale ranging from 1 = Below Basic, 2 = Basic, 3 = Proficient, 4 = Advanced. Although these students averaged a Basic classification across the two years, the average high value highlights a shift closer to the Proficient level. The higher gains in MAP scores for the textbook-based students may have been partially attributed to those students receiving test assessment preparation instruction through a commercial software program while the CBI students received no state assessment preparation.

Focusing on grades, the results revealed no significant change in grades for the textbook-based instruction group, $t(39) = -.65$, $p = .52$. Therefore, unlike the CBI course, the mean grades for students in the textbook-based Algebra I instruction group remained constant across the two study years. There was an increase from 7.70 on 2009 grades in math to 7.95 on 2010 math grades, illustrating a positive, though not statistically significant change. This reflects an increase in grades from an approximate high C+ mean value (C+ = 7.0) to an approximate grade equivalent of B- mean average (B- = 8.0) in 2010.

Table 6. *Textbook-based Student Grades and MAP Achievement Level Paired Samples*

	M	*SD*	*t*	*df*	Sig. (2 tailed)
MAP 2009 Achievement Level	2.20	.687			
MAP 2010 Achievement Level	2.88	.686			
			-6.51	39	.000
Grades 2009	7.70	3.291			
Grades 2010	7.95	3.048			
			-.65	39	.522

Research Question 3

The third research question, "Is there a difference in attitude toward mathematics and school climate between students who receive CBI in Algebra I and students who receive direct instruction in Algebra I courses?" was addressed through a student survey (Appendix F). Mean values for each question in the survey appear in Appendix G.

Table 7 indicates student responses on the student survey on attitudes towards Algebra I and their responses on school climate. The results revealed that CBI students had a more favorable attitude towards Algebra I, $F(1,68) = 14.521$, $p < .001$.

Hypothesis 3 stated that there are no differences between students enrolled in a technology-enhanced instructional system as compared to students enrolled in textbook-based direct instruction based upon student attitude toward mathematics. Based on the data collected, this hypothesis was rejected.

Table 7. *Differences in Student Responses on Attitudes towards Algebra and School Climate Based on Instruction Type*

Variable	*M*	*SD*	*F*	*p*	*df*	*MS*
Attitude towards Algebra						
Textbook Algebra Instruction	3.21	.424				
CBI Algebra Instruction	3.62	.475				
Model Fixed Effects		.446				
Algebra Mean Attitude Between Groups			14.52	<.001	1	.290
Within Groups					68	.199
School Climate						
Textbook Algebra Instruction	3.49	.382				
CBI Algebra Instruction	3.64	.384				
Model Fixed Effects		.383				

School Mean Climate Between Groups	2.59	.112	1	.379
Within Groups			68	.147

Research Question 4.

Research question 4 addressed, “Does a positive instructor attitude toward Algebra and school climate play a role in student motivation in CBI classes?” One-way ANOVA, as indicated in Table 8, revealed a significant difference for algebra attitude, $F(3,66) = 6.10$, $p < .001$. To investigate this difference further, post hoc analysis revealed a significant difference in student attitudes for those in the CBI classroom (teacher 2) and those in the textbook-based class of teacher 4 (see Table 9).

Table 8. *Differences in Student Responses on Attitude towards Algebra Based on Classroom Teacher*

Teacher	Teacher	Students (*N*)	*M*	*SD*	*F*	Sig.
Textbook Instruction	1	16	3.28	.323		
CBI Instruction	2	30	3.62	.475		
Textbook Instruction	4	14	3.04	.559		
Textbook Instruction	5	10	3.36	.282		
Total		70	3.39	.488		
Algebra Attitude Mean Between Groups					6.10	.001

Table 9. *Differences in Student Responses on Attitude towards Algebra Based on Classroom Teacher*

Multiple Comparisons						95% Confidence Interval	
Dependent Variable	(I) Teacher	(J) Teacher	Mean Diff. (I-J)	*SE*	Sig.	Lower Bound	Upper Bound
Math Attitude	1	2	-.34647	.13672	.064	-.7068	.0139

Tukey HSD		4	.23668	.16163	.465	-.1893	.6627
		5	-07404	.17804	.976	-.5433	.3952
	2	1	.34647	13672	.064	-.0139	.7068
		4	.58314	.14295	.001	.2064	.9599
		5	.27243	.16127	.337	-.1526	.6975
	4	1	-.23668	.16163	.465	-.6627	.1893
		2	-.58314	.14295	.001	-.9599	-.2064
		5	-.31071	.18286	.332	-.7927	.1713
	5	1	.07404	.17804	.976	-.3952	.5433
		2	-.27243	.16127	.337	-.6975	.1526
		4	.31071	.18286	.332	-.1713	.7927

Looking at school climate, the results indicated the two groups did not differ in their perceptions of school climate, $F(1,68) = 2.59$, $p < .00$, even though the instructional groups are housed in separate facilities.

Hypothesis 4 stated that there are no differences between students enrolled in a technology-enhanced instructional system as compared to students enrolled in textbook-based direct instruction based upon student perceptions of school climate. Data collected failed to show evidence to reject this hypothesis.

One-way ANOVA revealed no significant difference for student perception of School Climate based on classroom teacher, $F(3,66) = 2.68$, ($p = .054$). All student responses on school climate have mean values between 3.3 and 3.7, indicating a neutral response for students, regardless of teacher (see Table 10). Hypothesis 5 stated that there are no differences between student attitude toward Algebra and school climate based on instructor attitude. Data collected failed to show evidence to reject this hypothesis.

Table 10. *Differences in Student Responses on School Climate Based on Classroom Teacher*

Teacher	Teacher Number	Students (*N*)	*M*	*SD*	*F*	*Sig.*
Textbook Instruction	1	16	3.65	.298		
CBI Instruction	2	30	3.64	.384		
Textbook Instruction	4	14	3.36	.476		
Textbook Instruction	5	10	3.40	.275)		
Total		70	3.56	38		
School Climate Mean Between Groups					2.68	.054

Table 11 illustrates the teacher responses on a survey of both groups on their perceptions of school climate, as well as responses on their experience and knowledge of subject content. Results revealed no difference in how teachers rated school climate and their knowledge of course content.

Table 11. *Differences in Teacher Responses on School Climate*

Variable	*M*	*SD*	*F*	*p*	*df*	*MS*
Attitude towards School Climate						
Textbook Algebra Instruction	3.80	.732				
CBI Algebra Instruction	4.27	.367				
Between Groups			1.94	.197	1	.607
Within Groups					9	.313
Teacher Knowledge Responses						
Textbook Algebra Instruction	3.48	.284				
CBI Algebra Instruction	3.89	.598				
School Mean Climate Between Groups			1.96	.195	1	.460
Within Groups					9	.235

Research Question 5

Research question 5 examined, “Does enrollment in computer-based instruction influence student discipline incidents?” Discipline records of both groups were examined over a two-year span to see if any statistical differences existed among or between groups. Table 12 indicates the mean on discipline reports of the two groups for 2009 and 2010 school years. Based on the paired sample *t* test, there was no significant difference in discipline incidents across years for either group. Based on the groupings of the two groups, direct comparison of the two groups would be inappropriate; however, discipline incidents increased in 2010 for the students in the textbook-based classroom and incidents decreased for students enrolled in the CBI program.

Hypothesis 6 stated that there are no relationships on the number of discipline referral for students enrolled in a computer-based instructional system across testing years. Data collected failed to show evidence to reject this hypothesis.

Table 12. *2009-2010 Discipline Incidents by Instruction Type*

Variable	*M*	*(SD)*	*df*	Sig. (2-tailed)
Textbook Instruction				
2009 Total Discipline Incidents	2.98	4.917		
2010 Total Discipline Incidents	5.30	11.219		
Paired Sample Test			39	.100
CBI Instruction				
2009 Total Discipline Incidents	13.13	12.306		
2010 Total Discipline Incidents	10.87	.367		
Paired Sample Test			29	.414

Though the results indicated no significant difference for either group, examination of the specific discipline incidents based on severity is appropriate. Table 13 indicates discipline incidents based on severity of the infraction. Minor incidents included tardiness, talking in class, and disruptions in the instructional process. The teacher usually handled minor infractions or sent the student to a “buddy seat,” which removed the student from the classroom for the remainder of the class.

Moderate incidents included continued tardiness, skipping class, and moderate disruption to the learning process. Consequences for moderate infractions were the removal of the student from class and in-school suspension, with length of suspension determined by the teacher and the infraction. Major incidents included fighting, stealing, multiple absenteeism, and major disruptions in the classroom. Consequences for major discipline infractions included out-of-school suspension or arrests.

Ranges of values for total discipline referrals for the students enrolled in the CBI classes exhibited from 0 to 45 total discipline referrals in 2009 to from 0 to 66 referrals in 2010. Decreases in total major and minor incidents decreased for this group between 2009 and 2010, while moderate incidents increased slightly. The decrease in the number of referrals may have been attributed to the CBI students becoming acclimated to the program.

Ranges for students enrolled in the textbook-based Algebra I classes were from 0 to 17 total incident referrals in 2009 to 0 to 51 total discipline referrals in 2010. The textbook-based Algebra I students showed an increase in both minor and major discipline referrals and a decrease in moderate incident referrals.

Table 13. *2009-2010 Discipline Incidents by Severity*

Variable	*Mean*	*SD*	*SE Mean*
Textbook Instruction			
2009 Major Discipline Incidents	.00	.00	.00
2010 Major Discipline Incidents	.10	.38	.06
2009 Moderate Discipline Incidents	.40	.96	.15
2010 Moderate Discipline Incidents	.25	.78	.12
2009 Minor Discipline Incidents	2.58	4.30	.68
2010 Minor Discipline Incidents	4.95	10.71	1.69
2009 Total Discipline Incidents	2.98	.91	.77
2010 Total Discipline Incidents	5.30	11.21	1.77
CBI Instruction			
2009 Major Discipline Incidents	.60	1.94	.354
2010 Major Discipline Incidents	.47	.87	.157
2009 Moderate Discipline Incidents	1.67	1.51	.277
2010 Moderate Discipline Incidents	2.27	3.47	.634
2009 Minor Discipline Incidents	10.87	11.67	2.12
2010 Minor Discipline Incidents	8.13	11.31	2.06
2009 Total Discipline Incidents	13.13	12.30	2.24
2010 Total Discipline Incidents	10.87	13.29	2.42

Research Question 6

Research question 6 posed the question: “Does enrollment in computer-based instruction influence student attendance?” Data from both groups were collected for the two study years. Table 14 indicates the mean on attendance reports of the two groups for 2009 and 2010 school years. Based on the paired sample *t* test, there was no significant difference in attendance across years for either group.

Ranges of values for attendance for the students enrolled in the CBI classes indicated absences from 1.2 days to 40.8 total days absent in 2009 and .04 days absent to 65 total days absent in 2010. Ranges for students enrolled in the textbook-based Algebra I classes increased from 0 to 16.4 total days absent in 2009 to 0 to 29.7 total days absent in 2010. Although the means indicated no significant differences in attendance between the two groups, the means listed may be skewed for the CBI students based on several outlying high numbers included in the analysis of the data.

Hypothesis 7 stated that there are no relationships on attendance for students enrolled in a computer-based instructional system across testing years. Data collected failed to show evidence to reject this hypothesis.

Table 14. *2009-2010 Attendance Incidents by Instruction Type*

Variable	*M*	*SD*	*Corr.*	*df*	Sig. (2-tailed)
Textbook Based Instruction					
2009 Total Absences	6.41	5.86			
2010 Total Absences	6.74	6.59			
Paired Sample Correlation			.681		.000
Paired Sample Test				39	.685
CBI Instruction					
2009 Total Absences	12.71	8.884			
2010 Total Absences	12.95	11.821			
Paired Sample Correlation			.658		.000
Paired Sample Test				29	.885

Summary

The results of the study have added quantitative data and evidence to the body of knowledge advocating the use of technology, including computer-assisted instruction, for at-risk secondary school students. Although the current study examined only mathematics, future studies should evaluate other curriculum areas quantitatively, possibly with a larger population of at-risk students. Another noteworthy extension would include the evaluation of computer-based instruction within the mainstream classroom to examine the effectiveness on a broader population.

Wenglinsky completed a similar and highly publicized study in 1998. Using data from 1996 National Assessment of Educational Progress (NEAP), Wenglinsky attempted to explore the relationship between mathematical literacy and technology use. As with the current study, he found the "Greatest inequities did not lie in how often computers were used, but in how they were used" (Wenglinsky, 1998, p. 3). One of Wenglinsky's primary findings was that a teacher's professional development in the use of technology to teach higher order thinking skills was positively correlated with students' academic achievement in mathematics. The current study is an important step in understanding the relationship between technology and mathematical literacy.

CHAPTER V

DISCUSSION AND SUMMARY

Considerations and Implications

The main purpose of this quantitative study was to examine the effects of a commercial, computer-based instruction mathematics program (A+dvanced Learning Systems) on algebraic achievement scores of secondary-school at-risk students enrolled in a district alternative high school. An analysis of the data shows two interesting themes:

1. Students enrolled in the computer-based Algebra I program showed a positive correlation between improved grades and state assessments;
2. Based on student responses, students enrolled in the computer-based Algebra I program had a more favorable attitude towards Algebra I and mathematics than did students enrolled in textbook-based Algebra I classes.

Relationship to Existing Research

Over the past 25 years, studies of the impact of computers and technology on student achievement have produced mixed results (Ash, 2001; Bangert-Drowns et al., 1985; Bassoppo-Moyo, 2010; Becker, 1986; Burton, 1995; Fletcher-Flinn, & Gravatt, 1995). Evidence from these studies indicated moderate, minimum, or no effectiveness at all from the use of technology. Technology and instructional design of software has evolved rapidly over the past quarter century, which leads to questioning several of the earlier findings and results, based on technology now considered antiquated.

CBI is no longer drill and practice, but instead provides the student with in-depth tutorials, interactivity, pacing, and immediate feedback. This interactivity, feedback, pacing, and individualization (Hawkins, 1993; Martindale, Pearson, & Curda, 2005) has the potential to improve student achievement in mathematics (Naime-Diefenbach, & Sullivan, 2001). Feedback and interactivity are among the factors influencing motivation in technology-enhanced environments and online learning systems (Bolliger, 2004; Smith & Dillon, 1999). The CBI program (A+ Learning Systems) utilized during the current study provided continual feedback and was self-paced, based on student individual needs. Students at risk for school failure benefit from explicit instruction designed to link prior knowledge with new content (Coyne, Kame'enui, & Carnine, et al. 2007). The CBI program in the study was designed to build on existing mathematics skills for students.

Motivating students who have failed in the traditional classroom setting is a key to success for at-risk students (Bangert, Kulik, & Kulik, 1983; Watson & Gemin, 2008). Based upon responses from the student motivational and attitudinal surveys administered in the current study, the students enrolled in the CBI course felt increased confidence and satisfaction in the course. Avitabile (1996) and Lewis (1997) found similar responses in their studies on the integration of technology into the learning environment, suggesting this type of improvement in student attitude contributed to enhanced student learning and achievement. Creating learning environments to encourage student integration into their social order and student interpersonal competency may also support student success (Quinn, Poirier, Faller, Gable, & Tonelson, 2006). Based upon student survey results in the current study, the participants in the CBI classroom felt the teachers treated them with dignity and respect, the school was welcoming, and expectations for success were higher, compared to students in the traditional classroom participating in the study.

Findings from the current study conflict with a 1995 study (Schumacker, Young, & Bembry, 1995) in which students participated in a CBI algebra program over the course of one semester. Data analyses from that study revealed that the traditional lecture group scored significantly higher than the treatment group on the algebra achievement test. The traditional group mean algebra score was 0.72 standard deviations higher than that of the CBI group. Moreover, no significant differences were found between the two groups in terms of their scores on attitude-scales. The variance between the two studies might be attributed to the length of the studies, with students in the current study becoming acclimated to the CBI program and the school environment during their participation for the two years of the study.

Attendance by choice can have "almost magic" results (Barr, as cited in "Alternative Schools Work," 1997, n.p.). Findings from the current study supported the findings of previous research on at-risk students and their attitudes toward course content. A major synthesis of research (Cotton, 1995) concluded that students using a computer-based program showed improved attendance. Student surveys (Appendix G) indicated the students enrolled in the CBI Algebra I course were less likely to skip school than were their traditional classroom counterparts, and were motivated to continue with their course.

Recommendations for Further Study

Based on the findings and discussions of this study, the following are suggested areas for further study. Further investigation of the use of computer-based Algebra I instruction be take place with a larger population. Students drawn from populations whose comparability is more closely matched may provide different results.

The second area for further investigation could include greater detail regarding the specific components of the CBI program and the various types of media used to present the mathematical concepts to students. Such a study could show whether one presentation method of mathematical concepts is more effective to student outcomes than another is. Additional investigation of other districts using computer-based Algebra I software with both general education and at-risk students might be beneficial in studying the effects of the computer-based program.

Summary

This study has provided a body of evidence providing educational leaders and policy makers with qualitative data to consider with existing research in making sound educational decisions. The goal of the study was to investigate the effects of using the A+ Learning System of mathematical academic achievement in a small suburban school district. Findings revealed that students enrolled in the computer-based instruction program had a significant increase in state assessment scores between 2009 and 2010 and a significant mean improvement in grades over the same period. . The CBI students had a significant increase on state assessment scores between year 1 (M=1.63) and year 2 (M=1.87); $t(29)=-2.04$, $p<.05$. Results found a significant increase in the grades for the at-risk students in the CBI group from a D+ to a C+ between year 1 (M=4.07) and year 2 (M=6.53); $t(29)=-.321$, $p<.05$.

Survey responses revealed that students enrolled in CBI Algebra I had a more favorable attitude toward mathematics (M=3.62) than did students enrolled in textbook-based Algebra I classes (M=3.21).

Several responses from student surveys indicated statistically significant differences from the textbook students. Students in CBI classes felt their school had clear academic standards that challenged them to improve,(M=4.06), $F(1,68) = 4.096$, $p < .05$.

They felt that the Algebra program challenged them(M=4.20), $F(1,68) = 15.626$, $p < .01$. CBI students felt that teachers treated their parents with respect and dignity(M=4.10), $F(1,68) = 6.913$, $p < .05$. They also scored higher than their textbook counterparts in their responses that school was preparing them for success at the next grade, college, or a job (M=4.26), $F(1,68) = 8.328$, $p < .05$.

Data analysis results from student surveys indicated the two groups in the study did not differ in their perceptions of school climate. One-way ANOVA of the two groups revealed no significant difference for student perception of school climate based on classroom teacher. Teacher perceptions of school climate indicated no difference in how teachers rated school climate and their data results indicated no difference in their knowledge of course content.

In the area of student discipline, based on paired *t* test results, no significant differences were noted in discipline incidents across years between the two groups studied. Based on the demographic groupings, direct comparison if the two groups would be inappropriate; however, discipline incidents increased in 2010 for the students in the textbook-based classroom and incidents decreased for students enrolled in the CBI program. Paired sample *t* tests indicated no significant difference in attendance rates across years in either instruction type.

Although the findings of this study did not indicate dramatic differences between the two groups, results showed the at-risk students who had experienced failure in traditional classroom experiences in the past were experiencing success with the CBI Algebra I course, showing improvement in grades, attitudes towards school, and attendance, and reduction in discipline incidents. Students attending alternative schools are usually in that setting because of their lack of success in the traditional classroom. Such lack of success might have been due to academic or behavioral problems that limited their learning and led to disciplinary action, as well as issues in attitude, motivation, or attendance.

To improve schools and student achievement, an evident need is clear to foster positive environments that support and engage students in learning and offer educational options suited to the unique characteristics of the students served. Schools must provide environments that are safe and welcoming, and must communicate high expectations for all students.

Conclusion

The findings of this study indicated CBI can be an effective method for at-risk learners and can have a positive impact on their mathematical learning. The analysis indicated positive gains in achievement and grades, as evidenced in state assessment scores and student grades. Evidence from the data collected showed the students enrolled in the technology-enhanced curriculum had a more positive attitude toward mathematics than their textbook-based counterparts and no statistically significant difference in their outlook of the school climate.

The purpose of this study was not specifically to defend or refute the superiority of either CBI or textbook-based classroom instruction, but to demonstrate that options are available to potentially benefit students who have not experienced success with the direct instruction classroom model.

Students identified as troubled or troubling tend to flourish in alternative learning environments where they believe that their teachers, staff, and administrators care about and respect them, value their opinion, establish fair rules that they support, are flexible in trying to solve problems, and take a non-authoritarian approach to teaching (Quinn et al., 2006). Schools that provide fewer services to meet the very kinds of student health and behavioral barriers to learning pose increasingly severe problems for their schools (Austin & Bailey, 2008). Offering CBI in schools affords the at-risk student an alternative that better suits the needs of diverse learners who may have different skill levels, learning styles, and varied language abilities and who have experienced failures in the traditional classroom. According to Estrada (n.d.), “If a child can’t learn the way we teach, maybe we should teach the way they learn.”

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APPENDIX A

EOC ALGEBRA I CONTENT STRANDS

Numbers and Operations

Concept	Big Idea	Course Level Expectation
Understand numbers, ways of representing numbers, relationships among numbers and number systems	A. Read, write and compare numbers	Compare and order rational and irrational numbers, including finding their approximate locations on a number line
	B. Represent and use real numbers	Use real numbers and various models, drawing, etc. to solve problems
	C. Compose and decompose numbers	*Use a variety of representations to demonstrate an understanding of very large and very small numbers
Understand meanings of operations and how they relate to one another	B. Describe effects of operations	*Describe the effects of operations, such as multiplication, division, and computing powers and roots on the magnitude of quantities
	D. Apply operations on real and complex numbers	*Apply operations to real numbers, using mental computation or paper-and-pencil calculations for simple cases and technology for more complicated cases
Compute fluently and make reasonable estimates	D. Estimate and justify solutions	*judge the reasonableness of numerical computations and their results
	E. Use proportional reasoning	*solve problems involving proportions

Algebraic Relationships

Concept	Big Idea	Course Level Expectation
Understand patterns, relations and functions	B. Create and analyze patterns	Generalize patterns using explicitly or recursively defined functions
	C. Classify objects and representations	Compare and contrast various forms of representations of patterns
	D. Identify and compare functions	Understand and compare the properties of linear and nonlinear functions
	E. Describe the effects of parameter changes effects of parameter changes	Describe the effects of parameter changes on linear , exponential growth/decay and quadratic functions including intercepts
Represent and analyze mathematical situations and structures using algebraic symbols	A. Represent mathematical situations	Use symbolic algebra to represent and solve problems that involve linear and quadratic relationships including equations and inequalities
	B. Describe and use mathematical manipulation	Describe and use algebraic manipulations, including factoring and rules of integer exponents and apply properties of exponents (including order of operations) to simplify expressions
	C. Utilize equivalent forms	Use and solve equivalent forms of equations (linear, absolute value and quadratic)
	D. Utilize systems	Use and solve systems of linear equations or inequalities with 2 variables
Use mathematical models to represent and understand quantitative relationships	A. Use mathematical models	Identify quantitative relationships and determine the type(s) of functions that might model the situation to solve the problem

Algebraic Relationships (continued)

Concept	Big Idea	Course Level Expectation
Analyze change in various contexts	A. Analyze change	Analyze linear and quadratic functions by investigating rates of change, intercepts and zeros

Data and Probability Strand

Concept	Big Idea	Course Level Expectation
Formulate questions that can be addressed with data and collect, organize and display relevant data to answer them	A. Formulate questions	Formulate questions and collect data about a characteristic which include sample spaces and distributions
	C. Represent and interpret data	Select and use appropriate graphical representation of data and given one-variable quantitative data, display the distribution and describe its shape
Select and use appropriate statistical methods to analyze data	A. Describe and analyze data	Apply statistical measures of center to solve problems
	C. Represent data algebraically	Given a scatterplot, determine an equation for a line of best fit
Develop and evaluate inferences and predictions that are based on data	A. Develop and evaluate inferences	Make conjectures about possible relationships between 2 characteristics of a sample on the basis of scatterplots of the data

Note. Adapted from *Missouri Assessment Program Technical Report*, (2009), CTB/McGraw-Hill: Monterey, CA.
*These CLEs are locally assessed.

APPENDIX B

2009-10 BELTON SCHOOL CLIMATE SURVEY: STUDENT

Student Response Form

I appreciate that you are considering participating in this survey to help us understand design learning environments. We anticipate that you will complete the survey in less than fifteen minutes.

To support anonymity, your participant ID will be immediately separated from the information contained in the survey. Your name will not be associated with the information that you provide. Your participation in this survey is strictly voluntary. You may quit the survey at any time before clicking the submit button.

I appreciate you taking the time to share your ideas and comments. If you have any questions or comments regarding this study please contact:

Fred Pellerito at the University of Kansas (phredp@ku.edu)or (fpellerito@bsd124.org).

Instructions: Please choose your response for each question from the list below. There are no right or wrong answers and all responses will be confidential.

1. Please select the best answer

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I feel safe at my school.	◯	◯	◯	◯	◯
My school is clean and has an inviting appearance.	◯	◯	◯	◯	◯
The school provides a welcoming environment.	◯	◯	◯	◯	◯
My school has clear academic standards that challenge me to improve.	◯	◯	◯	◯	◯
Teachers in this school provide quality instruction in mathematics.	◯	◯	◯	◯	◯
The principal of the school is a good leader.	◯	◯	◯	◯	◯
This school's office staff is courteous and helpful.	◯	◯	◯	◯	◯
The school has a good relationship with the community.	◯	◯	◯	◯	◯
Students at this school are treated with respect and dignity.	◯	◯	◯	◯	◯
The school provides positive experiences for all students.	◯	◯	◯	◯	◯
Faculty and staff at the school treat parents with respect and dignity.	◯	◯	◯	◯	◯
Volunteers are welcome at my school.	◯	◯	◯	◯	◯
Students use computers at the school.	◯	◯	◯	◯	◯
The Algebra program challenges me.	◯	◯	◯	◯	◯
The Algebra program is motivating to me.	◯	◯	◯	◯	◯
I find the Algebra program too difficult.	◯	◯	◯	◯	◯
My school keeps me informed about school events and activities.	◯	◯	◯	◯	◯
My teachers make sure I know how I am doing in class.	◯	◯	◯	◯	◯
Student behavior at my school is satisfactory the school year.	◯	◯	◯	◯	◯
I am likely to skip classes at this school.	◯	◯	◯	◯	◯
I am likely to get in trouble at this school.	◯	◯	◯	◯	◯
I have access to services provided by the high school.	◯	◯	◯	◯	◯
I am satisfied with a guidance services at my school.	◯	◯	◯	◯	◯
This school is preparing me for success at the next grade level, at college, or a job.	◯	◯	◯	◯	◯
My teacher is knowledgeable about the subject area.	◯	◯	◯	◯	◯
I can talk to my teacher if I have a problem in any area.	◯	◯	◯	◯	◯
I am doing better at this school than in other schools.	◯	◯	◯	◯	◯

2. Choose one

	F	D	C	B	A
What overall grade would you give to the school?	◯	◯	◯	◯	◯

APPENDIX C

2009-10 SCHOOL CLIMATE STUDENT SURVEY MEANS

2009-10 School Climate Student Survey Questions	$\bar{x}$ CBI	$\bar{x}$ Textbook
I feel safe at my school.	3.87	3.95
My school is clean and has an inviting appearance.	3.43	3.72
The school provides a welcoming environment.	3.54	3.70
My school has clear academic standards that challenge me to improve.	4.06	3.70
Teachers in this school provide quality instruction in Algebra.	3.70	3.85
The principal of the school is a good leader.	4.03	3.35
This school's office staff is courteous and helpful.	3.73	3.95
The school has a good relationship with the community.	3.73	3.80
Students at this school are treated with respect and dignity.	3.43	3.28
The school provides positive experiences for all students.	3.46	3.25
Faculty and staff at the school treat parents with respect and dignity.	4.10	3.58
Volunteers are welcome at my school.	3.83	4.05
Students use computers at the school.	4.36	4.30
The Algebra program challenges me.	4.20	3.35
The Algebra program is motivating to me.	3.53	3.32
I find the Algebra program too difficult.	2.93	2.35
My school keeps me informed about school events and activities.	3.66	3.55
My teachers make sure I know how I am doing in class.	3.80	3.73
Student behavior at my school is satisfactory this school year.	2.86	3.13
I am likely to skip classes at this school.	2.16	1.93
I am likely to get in trouble at this school.	2.56	2.33
I have access to services provided by the high school.	3.20	3.50
I am satisfied with a guidance services at my school.	3.66	3.43
This school is preparing me for success at the next grade, college, or a job.	4.26	3.75
My teacher is knowledgeable about the subject area.	4.16	4.00
I can talk to my teacher if I have a problem in any area.	4.20	3.88
I am doing better at this school than other schools.	3.63	3.45
What overall grade would you give to the school?	3.83	3.68

APPENDIX D

2009-10 BELTON SCHOOL CLIMATE SURVEY: STAFF

Staff Response Form

I appreciate that you are considering participating in this Algebra teacher survey to help us understand design learning environments. I anticipate that you will complete the survey in less than fifteen minutes.

To support anonymity, your participant ID will be immediately separated from the information contained in the survey. Your name will not be associated with the information that you provide. Your participation in this survey is strictly voluntary. You may quit the survey at any time before clicking the submit button.

I appreciate you taking the time to share your ideas and comments. If you have any questions or comments regarding this study please contact:

Fred Pellerito at the University of Kansas (phredp@ku.edu) or (fpellerito@bsd124.org).
Instructions: Please click the button under your responses below.

1. Answer each question with your choice from the list.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The school provides a safe environment for teaching and learning.	○	○	○	○	○
This school maintains a clean and inviting appearance.	○	○	○	○	○
The school provides a welcoming environment.	○	○	○	○	○
This school is making steady progress implementing rigorous academic standards.	○	○	○	○	○
Teachers in this school provide quality instruction in mathematics.	○	○	○	○	○
The principal of the school is a good leader.	○	○	○	○	○
This school's office staff is courteous and helpful.	○	○	○	○	○
The school has a good relationship with the community.	○	○	○	○	○
Students at this school are treated with respect and dignity.	○	○	○	○	○
The school provides positive experiences for all students.	○	○	○	○	○
Faculty and staff at the school treat parents with respect and dignity.	○	○	○	○	○
Volunteers are welcome at this school.	○	○	○	○	○
Students have adequate access to computers at the school.	○	○	○	○	○
The Algebra program challenges students.	○	○	○	○	○
The Algebra program is motivating students.	○	○	○	○	○
The Algebra program is too difficult for some students.	○	○	○	○	○
Students and parents are informed about school events and activities.	○	○	○	○	○
Students and parents receive effective communication about academic progress.	○	○	○	○	○
Student behavior at this school is satisfactory the school year.	○	○	○	○	○
Students are likely to skip classes at this school.	○	○	○	○	○
Students are likely to get in trouble at this school.	○	○	○	○	○
Students have access to services provided by the high school.	○	○	○	○	○
The services of the guidance office staff are satisfactory.	○	○	○	○	○
Teachers at the school prepare all students for success at the next grade level, at college, or the job.	○	○	○	○	○
Teachers are knowledgeable about the subject area they teach.	○	○	○	○	○
Teachers are accessible/available if a student has a problem in any area.	○	○	○	○	○
Students are likely to perform better academically at this school than at other schools	○	○	○	○	○

2. Please choose a response from the list below.

	D	F	C	B	A
What overall grade would you give to the school?	○	○	○	○	○

Comments

APPENDIX E

2009-10 SCHOOL CLIMATE TEACHER SURVEY MEANS

2009-10 School Climate Teacher Survey Questions	$\bar{x}$ CBI	$\bar{x}$ Textbook
The school provides a safe environment for teaching and learning.	4.33	4.25
This school maintains a clean and inviting appearance.	3.83	4.25
The school provides a welcoming environment.	4.33	4.00
This school is making progress implementing rigorous academic standards.	4.50	3.75
Teachers in this school provide quality instruction in mathematics.	4.16	4.00
The principal of the school is a good leader.	4.16	4.00
This school's office staff is courteous and helpful.	4.33	3.75
The school has a good relationship with the community.	4.83	4.25
The school has a good relationship with the community.	4.66	4.25
The school provides positive experiences for all students.	4.66	4.25
Faculty and staff at the school treat parents with respect and dignity.	4.66	4.25
Volunteers are welcome at this school.	4.66	4.25
Students have adequate access to computers at the school.	4.16	3.00
The Algebra program challenges students.	4.66	4.50
The Algebra program is motivating students.	4.33	4.00
The Algebra program is too difficult for some students.	3.50	4.50
Students and parents are informed about school events and activities.	4.50	3.75
Students and parents receive effective communication about academic progress.	4.50	3.75
Student behavior at this school is satisfactory the school year.	4.50	3.75
Students are likely to skip classes at this school.	4.16	3.25
Students are likely to get in trouble at this school.	2.83	3.25
Students have access to services provided by the high school.	2.33	3.75
The services of the guidance office staff are satisfactory.	4.33	3.50
Teachers at the school prepare all students for success at the next grade level, at college, or the job.	4.33	4.25
Teachers are knowledgeable about the subject area they teach.	4.50	4.50

2009-10 School Climate Teacher Survey Questions	$\bar{x}$ CBI	$\bar{x}$ Textbook
Teachers are accessible/available if a student has a problem in any area.	4.83	4.50
Students are likely to perform better academically at this school than at other schools.	4.50	3.75
What overall grade would you give to the school?	4.33	4.25

APPENDIX F

STUDENT ATTITUDE TOWARD MATHEMATICS INVENTORY

Directions: This inventory consists of the statements about your attitude towards mathematics. There are no correct or incorrect responses. The only correct responses are those that are true for you. Whenever possible, let the things that have happened to you this year help you make a choice. Read each item carefully. Please think about how you feel about each item. Enter the letter that most closely corresponds to how each statement best describes your feelings. Please answer every question.

1. Please answer each question

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Mathematics is a very worthwhile and necessary subject.	○	○	○	○	○
I want to develop my mathematical skills.	○	○	○	○	○
I get a great deal of satisfaction out of solving mathematics problems.	○	○	○	○	○
Mathematics helps develop the mind and teaches a person to think.	○	○	○	○	○
Mathematics is important in everyday life.	○	○	○	○	○
Mathematics is one of most important subject for people to study.	○	○	○	○	○
High school math courses would be very helpful no matter what I decide to study.	○	○	○	○	○
I can think of many ways that I use math outside of school.	○	○	○	○	○
Mathematics is one of my most dreaded subjects.	○	○	○	○	○
My mind goes blank and I am unable to think clearly when working with mathematics.	○	○	○	○	○
Studying algebra makes me feel nervous.	○	○	○	○	○
Mathematics makes me feel uncomfortable.	○	○	○	○	○
I'm always under a terrible strain in a math class.	○	○	○	○	○
When I hear the word mathematics, I have a feeling of dislike.	○	○	○	○	○
It makes me nervous to even think about having to do a mathematics problem.	○	○	○	○	○
Mathematics does not scare me at all.	○	○	○	○	○
I have a lot of self-confidence when it comes to management ask.	○	○	○	○	○
I'm able to solve mathematics problems without too much difficulty.	○	○	○	○	○
I expect to do fairly well in any math class I take.	○	○	○	○	○
I'm always confused in my mathematics class.	○	○	○	○	○
I feel a sense of insecurity when attempting mathematics.	○	○	○	○	○
I learn mathematics easily.	○	○	○	○	○
I am confident that I could learn advanced mathematics.	○	○	○	○	○
I have usually enjoyed studying mathematics and school.	○	○	○	○	○
Mathematics is dull and boring.	○	○	○	○	○
I like to solve new problems in mathematics.	○	○	○	○	○
I would prefer to do an assignment in math than write an essay.	○	○	○	○	○

I would like to avoid using mathematics in college.	◯	◯	◯	◯	◯
I really like mathematics.	◯	◯	◯	◯	◯
I am happier in a math class than in any other class.	◯	◯	◯	◯	◯
Mathematics is a very interesting subject.	◯	◯	◯	◯	◯
I'm willing to take more than the required amount of mathematics.	◯	◯	◯	◯	◯
I plan to take as much mathematics as I can during my education.	◯	◯	◯	◯	◯
The challenge of math appeals to me.	◯	◯	◯	◯	◯
I think studying advanced mathematics is useful.	◯	◯	◯	◯	◯
I believe studying math helps me with problem solving and other areas.	◯	◯	◯	◯	◯
I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.	◯	◯	◯	◯	◯
I am comfortable answering questions in math class.	◯	◯	◯	◯	◯
A strong math background could help me in my professional life.	◯	◯	◯	◯	◯
I believe I am good at solving math problems.	◯	◯	◯	◯	◯

APPENDIX G

2009-10 STUDENT ATTITUDE TOWARD MATHEMATICS SURVEY MEANS

2009-10 Math Attitude Student Survey Questions	$\bar{x}$ CBI	$\bar{x}$ Textbook
Mathematics is a very worthwhile and necessary subject.	3.43	3.75
I want to develop my mathematical skills.	3.83	3.82
I get a great deal of satisfaction out of solving mathematics problems.	3.30	3.33
Mathematics helps develop the mind and teaches a person to think.	3.66	3.82
Mathematics is important in everyday life.	3.80	3.75
Mathematics is one of most important subject for people to study.	3.93	3.67
High school math courses would be very helpful no matter what I decide to study.	3.50	3.62
I can think of many ways that I use math outside of school.	3.66	3.60
Mathematics is one of my most dreaded subjects.	3.73	2.95
My mind goes blank and I am unable to think clearly when working with math.	3.06	2.60
Studying algebra makes me feel nervous.	2.83	2.60
Mathematics makes me feel uncomfortable.	2.96	2.40
I'm always under a terrible strain in a math class.	2.90	2.30
When I hear the word mathematics, I have a feeling of dislike.	2.83	2.60
It makes me nervous to even think about having to do a mathematics problem.	2.46	2.45
Mathematics does not scare me at all.	3.26	3.60
I have a lot of self-confidence when it comes to management ask.	3.43	3.50
I'm able to solve mathematics problems without too much difficulty.	3.36	3.41
I expect to do fairly well in any math class I take.	3.53	3.60
I'm always confused in my mathematics class.	2.93	2.52
I feel a sense of insecurity when attempting mathematics.	2.76	2.72
I learn mathematics easily.	2.70	3.30
I am confident that I could learn advanced mathematics.	3.16	3.40
I have usually enjoyed studying mathematics and school.	2.73	3.20
Mathematics is dull and boring.	3.30	2.87
I like to solve new problems in mathematics.	2.76	3.15
I would prefer to do an assignment math than to write an essay.	3.06	3.62
I would like to avoid using mathematics in college.	3.00	2.90

2009-10 Math Attitude Student Survey Questions	$\bar{x}$ CBI	$\bar{x}$ Textbook
I really like mathematics.	2.80	3.12
I am happier in a math class than in any other class.	2.53	3.00
Mathematics is a very interesting subject.	3.06	3.27
I'm willing to take more than the required amount of mathematics.	2.40	3.12
I plan to take as much mathematics as I can during my education.	2.60	2.85
The challenge of math appeals to me.	2.80	3.00
I think studying advanced mathematics is useful.	3.30	3.30
I believe studying math helps me with problem solving and other areas.	3.46	3.47
I am comfortable expressing my own ideas on how to look for solutions to a difficult problem in math.	3.40	3.35
I am comfortable answering questions in math class.	3.10	3.65
A strong math background could help me in my professional life.	3.56	3.75
I believe I am good at solving math problems.	3.47	3.47

APPENDIX H

2009-10 BELTON MATHEMATICS TEACHER SURVEY

Instructions: As part of my dissertation study, I'm looking at a variety of variables that might affect student educational achievement in mathematics. This teacher survey is one of the instruments being used. No personal information is being disclosed and all responses are confidential and will not be shared with any other parties or individuals.
Please respond to each question honestly. Thanks in advance for your input.

1. Please answer each question below.

What is your certification area(s) and how long certified?	
How many undergraduate math courses did you complete?	
How many graduate math classes did you complete?	
What is your background in mathematics?	
What is the greatest strength of this Algebra program?	
What do you feel is you greatest area of strength in Algebra?	
What do you feel is you greatest area for improvement in Algebra?	
Last technology/computer course taken (month/year).	
The last math course I took was(month/year).	
Any other comment about the Algebra program?	

2. What is the highest degree you hold?

	BS	BS+	MS	MS+	Ed. Sp.	Ed.D. or PhD.
Choose one	○	○	○	○	○	○

3. Are you working towards another degree at this time?

○ Yes

○ No

Indicate degree seeking

4. I rate my technology skills as:

	Don't use much	Beginner	Intermediate	Advanced	Expert
Choose one	○	○	○	○	○

5. Please answer each question.

	0	1-2	3-4	5-6	7-8	9-10	10+
How many years have you taught Algebra?	○	○	○	○	○	○	○
How many years have you taught a Computer-Based Instruction (CBI) Course?	○	○	○	○	○	○	○
How many years have you taught a CBI math course?	○	○	○	○	○	○	○
How many years have you taught mathematics?	○	○	○	○	○	○	○
How many years have you been in education?	○	○	○	○	○	○	○

6. Please answer each question.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I use a variety of teaching strategies which incorporate technology	○	○	○	○	○
I use a variety of instructional strategies based on the individual.	○	○	○	○	○
I use a variety of instructional strategies based on the lesson/concepts.	○	○	○	○	○
Teachers are involved with the decision making at this school.	○	○	○	○	○
I am satisfied with the current school's curriculum and instruction.	○	○	○	○	○
Students are satisfied with the current school's curriculum and instruction.	○	○	○	○	○
Parents are satisfied with the current school's curriculum and instruction.	○	○	○	○	○
This school has high standards and expectations for students.	○	○	○	○	○
I am the key to motivating students to succeed in math.	○	○	○	○	○
I am confident of all subject content in algebra.	○	○	○	○	○
I have a positive attitude towards math.	○	○	○	○	○
I have a positive attitude towards my program.	○	○	○	○	○
I have the latitude to adjust my course to fit student needs.	○	○	○	○	○
I have the technological skills required for teaching this course.	○	○	○	○	○
I use a variety of technology in my course.	○	○	○	○	○
Presenting math concepts using different media is essential.	○	○	○	○	○
My students have a positive attitude towards algebra.	○	○	○	○	○
Students completing my algebra course understand the concepts.	○	○	○	○	○
My program is motivating to students to succeed.	○	○	○	○	○
This math program is meeting students' needs that other programs could not address.	○	○	○	○	○
There are sufficient technology resources available for my students.	○	○	○	○	○

APPENDIX I

2009-10 BELTON MATHEMATICS TEACHER SURVEY MEANS

2009-10 Teacher Attitude/Knowledge Survey	$\bar{x}$ CBI	$\bar{x}$ Textbook
Time certified? (yrs)	9.50	5.50
How many undergraduate math courses did you complete?	5.66	10.50
What do you feel is your greatest area for improvement in algebra?	0.83	1.50
Last technology/computer course taken (month/year).	2.66	3.25
The last math course I took was (month/year).	1.66	3.25
Highest degree you hold	3.66	3.25
Are you working towards another degree at this time?	1.33	1.75
Indicate degree seeking.	1	2
I rate my technology skills as…	2.33	2.75
How many years have you taught algebra?	3.16 yrs	4.00 yrs
How many years have you taught a CBI course?	3.33 yrs	0.50 yrs
How many years have you taught a CBI math course?	1.00 yr	2.00 yrs
How many years have you taught mathematics?	2.16 yrs	4.00 yrs
How many years have you been in education?	6.16 yrs	6.25 yrs
I use a variety of instructional strategies based on the lesson/concepts.	3.66	4.50
Teachers are involved with the decision making at this school.	3.50	4.50
I am satisfied with the current schools' curriculum and instruction.	4.00	4.25
Students are satisfied with the current schools' curriculum and instruction.	3.66	2.75
Parents are satisfied with the current schools' curriculum and instruction.	3.83	3.25
This school has high standards and expectations for students.	3.83	3.25
I am the key to motivating students to succeed in math.	4.00	4.00
I am confident of all subject content in algebra.	4.33	3.25
I have a positive attitude towards math.	4.33	4.50
I have a positive attitude towards my program.	4.33	4.50
I have the latitude to adjust my course to fit student needs.	3.66	3.25
I have the technological skills required for teaching this course.	4.33	3.25
I use a variety of technology in my course.	4.50	2.75
Presenting math concepts using different media is essential.	3.83	3.75

My students have a positive attitude towards algebra.	3.33	2.75
Students completing my algebra course understand the concepts.	3.83	3.25
My program is motivating to students to succeed.	3.83	3.00
This math program is meeting student needs that other programs could not address.	4.33	3.50
There are sufficient technology resources available for my students.	2.83	1.75

APPENDIX J

PARENTAL CONSENT FORM FOR STUDENTS

Parental Consent Form For Student Participation in Academic Survey: The Effects of Technology-Enriched Mathematics Instruction on At-risk Secondary School Students

INTRODUCTION

The Department of Educational Leadership and Policy Studies at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to have your student participate in the present study. You should be aware that even if you agree to participate, you are free to withdraw your student at any time. If you do withdraw your student from this study, it will not affect your student's relationship with this unit, the services it may provide to you, or the University of Kansas.

PURPOSES OF THE STUDY

The purpose of this comparative study is to determine whether there are differences in rate of change in mathematics achievement scores between groups of high school at-risk students using a computer-based instructional program versus students receiving traditional instruction in learning algebraic concepts. This study will examine specific components of both programs, teacher influence on motivation in mathematics and provide a basis to investigate the effects on student's learning, attendance, discipline and socialization in the public school setting.

RISKS

This study contains no risk to your student. Your child will be involved in classes for the electives and high school classes at both Belton High School (Freshman Center) and the Belton Alternative Academy. Regardless, you are welcome to remove your student from the study at any time throughout the school year.

BENEFITS

Research suggests that there are substantial potential benefits to students who are enrolled in mathematics programs utilizing technology. Some studies indicate better grades and overall academic performance. Others address the positive social development: greater self-esteem, increased likelihood of positive risk-taking, fewer absences, and decreased disciplinary problems. This study will look at the two Algebra I programs offered in the Belton School District and the relationships between various factors in each program

PAYMENT TO PARTICIPANTS

Neither participants nor their parents/guardians will receive monetary reimbursements for their involvement in this study.

PARTICIPANT CONFIDENTIALITY

Your child's name will not be associated in any publication or presentation with the information collected about your child or with the research findings from this study. Instead, the researcher(s) will use a study number or a pseudonym rather than your child's name. Your child’s identifiable information will not be shared unless required by law or unless you give written permission. Permission granted on this date to use and disclose your information remains in effect indefinitely. By signing this form you give permission for the use and disclosure of your child's information, excluding your child's name, for purposes of this study at any time in the future.

REFUSAL TO SIGN CONSENT AND AUTHORIZATION

You are not required to sign this Consent and Authorization form and you may refuse to do so without affecting your student’s right to any services you are receiving or may receive from the University of Kansas or to participate in any programs or events of the University of Kansas. However, if you refuse to sign, your student cannot participate in this study.

CANCELLING THIS CONSENT AND AUTHORIZATION

You may withdraw your consent to allow your student to participate in this study at any time. You also have the right to cancel your permission to use and disclose information collected about your student, in writing, at any time, by sending your written request to Fred Pellerito MS [address omitted]

If you cancel permission to use your student’s information, the researchers will stop collecting additional information about your student. However, the research team may use and disclose information that was gathered before they received your cancellation, as described above.

QUESTIONS ABOUT PARTICIPATION

Questions about procedures should be directed to the researcher(s) listed at the end of this consent form.

INFORMATION TO BE COLLECTED AND PROCEDURES

Students will participate in a short survey lasting no more than 15 minutes and done online. No identifying information will be asked or collected and questions will be asked

pertaining to their attitudes towards mathematics and their perceptions of the current school climate in their respective educational setting
The information collected about your student will be used by Fred Pellerito, Dr. Ron Aust, members of the research team, the KU Educational Leadership and Policy Studies Department, and officials at KU that oversee research, including committees and offices that review and monitor research studies.

In addition, Dr. Aust and his team may share the information gathered in this study, including your information, with the Belton School District and professional educational organizations and journals. The research which will be gathered and the information which will be analyzed are new to the public education arena. Sound research is that which can be verified by other sources as the most reliable. All students can gain through the information which we gather this year. Again, your student's name would not be associated with the information disclosed to these individuals.

Please return the completed consent form on the following page to your child's respective Algebra teacher. Thanks for your assistance with this study which will improve the of the mathematics program in the Belton School District.

PARTICIPANT CERTIFICATION

I have read this Consent and Authorization form. I have had the opportunity to ask, and I have received answers to, any questions I had regarding the study and the use and disclosure of information about me for the study. I understand that if I have any additional questions about my rights as a research participant, I may call [deleted] or write the Human Subjects Committee Lawrence Campus (HSCL), University of Kansas, [deleted]

I agree to allow my child to take part in this study as a research participant. I further agree to the uses and disclosures of my information as described above. By my signature, I affirm that I am at least 18 years old and that I have received a copy of this Consent and Authorization form.

_________________________________ _____________________
Student's Printed Name Date

_________________________________ _________________________________
Parent/Guardian Printed Name Parent/Guardian Signature

Researcher Contact Information

Fred Pellerito MS [address deleted]
Dr. Ron Aust [address deleted]

HSCL #18743 Approval date 5/11/2010. Pellerito/Aust (ELPS) The Effects of Technology Enriched Mathematics Instruction on At-Risk Secondary School Students. HSCL reviewed and approved this project under the expedited procedure provided in 45 CFR 46.110 (f) (7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. As described, the project complies with all the requirements and policies established by the University for protection of human subjects in research. Unless renewed, approval lapses one year after approval date.

APPENDIX K

ADULT CONSENT FORM

ADULT CONSENT FORM FOR PARTICIPATION IN ACADEMIC SURVEY

THE EFFECTS OF TECHNOLOGY ENRICHED MATHEMATICS INSTRUCTION ON AT-RISK SECONDARY SCHOOL STUDENTS

INTRODUCTION

The Department of Educational Leadership and Policy Studies at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to participate in the present study. You may refuse to sign this form and not participate in this study. You should be aware that even if you agree to participate, you are free to withdraw at any time. If you do withdraw from this study, it will not affect your relationship with this unit, the services it may provide to you, or the University of Kansas.

PURPOSES OF THE STUDY

The purpose of this comparative study is to determine whether there are differences in rate of change in mathematics achievement scores between groups of high school at-risk students using a computer-based instructional program versus students receiving traditional instruction in learning algebraic concepts. This study will examine specific components of both programs, teacher influence on motivation in mathematics and provide a basis to investigate the effects on student's learning, attendance, discipline and socialization in the public school setting.

INFORMATION TO BE COLLECTED/PROCEDURES

Teachers will participate in a short survey lasting no more than 15 minutes and done online. No identifying information will be asked or collected and questions will be asked pertaining to their attitudes towards mathematics, educational background in mathematics and technology and their perceptions of the current school climate in their respective educational setting.

The information collected about your student will be used by Fred Pellerito, Dr. Ron Aust, members of the research team, the KU Educational Leadership and Policy Studies Department, and officials at KU that oversee research, including committees and offices that review and monitor research studies.

RISKS

This study contains no risk to you. The study will be involved in classes for Algebra I at both Belton High School (Freshman Center) and the Belton Alternative Academy.

Regardless, you are welcome to remove yourself from the study at any time throughout the school year.

BENEFITS

Research suggests that there are substantial potential benefits to students who are enrolled in mathematics programs utilizing technology. Some studies indicate better grades and overall academic performance. Others address the positive social development: greater self-esteem, increased likelihood of positive risk-taking, fewer absences, and decreased disciplinary problems. This study will look at the two Algebra I programs offered in the Belton School District and the relationships between various factors in each program

PAYMENT TO PARTICIPANTS

Participants will receive no monetary reimbursements for their involvement in this study.

PARTICIPANT CONFIDENTIALITY

Your name will not be associated in any publication or presentation with the information collected about you or with the research findings from this study. Instead, the researcher(s) will use a study number or a pseudonym rather than your name. Your identifiable information will not be shared unless required by law or you give written permission. Permission granted on this date to use and disclose your information remains in effect indefinitely. By signing this form you give permission for the use and disclosure of your information for purposes of this study at any time in the future.

REFUSAL TO SIGN CONSENT AND AUTHORIZATION

You are not required to sign this Consent and Authorization form and you may refuse to do so without affecting your right to any services you are receiving or may receive from the University of Kansas or to participate in any programs or events of the University of Kansas. However, if you refuse to sign, you cannot participate in this study.

CANCELLING THIS CONSENT AND AUTHORIZATION

You may withdraw your consent to participate in this study at any time. You also have the right to cancel your permission to use and disclose information collected, in writing, at any time, by sending your written request to Fred Pellerito MS, [address omitted]

If you cancel permission to use your information, the researchers will stop collecting additional information about you. However, the research team may use and disclose information that was gathered before they received your cancellation, as described above

QUESTIONS ABOUT PARTICIPATION

Questions about procedures should be directed to the researcher(s) listed at the end of this consent form.

INFORMATION TO BE COLLECTED AND PROCEDURES

Teachers and students will participate in a short survey lasting no more than 15 minutes and done online. No identifying information will be asked or collected. Teacher questions will be asked pertaining to attitudes towards mathematics and their perceptions of the current school climate in their respective educational setting and questions pertaining to educational background in the areas of mathematics and technology.
The information collected will be used by Fred Pellerito, Dr. Ron Aust, members of the research team, the KU Educational Leadership and Policy Studies Department, and officials at KU that oversee research, including committees and offices that review and monitor research studies.

In addition, Dr. Aust and his team may share the information gathered in this study, including your information, with the Belton School District and professional educational organizations and journals. The research which will be gathered and the information which will be analyzed are new to the public education arena. Sound research is that which can be verified by other sources as the most reliable. All students can gain through the information which we gather this year.

QUESTIONS ABOUT PARTICIPATION should be directed to
Fred Pellerito, MS [address omitted]
Dr. Ron Aust, Faculty Supervisor [address omitted]

If you have any questions about your rights as a research participant you may contact the Human Subjects Committee Lawrence Campus [address omitted], write the Human Subjects Committee Lawrence Campus (HSCL), [address omitted]

KEEP THIS SECTION FOR YOUR RECORDS. IF YOU WISH TO PARTICIPATE, COMPLETE THE INFORMATION ON THE FOLLOWING PAGE AND RETURN IT TO THE RESEARCHER.

PARTICIPANT CERTIFICATION

THE EFFECTS OF TECHNOLOGY ENRICHED MATHEMATICS INSTRUCTION ON AT-RISK SECONDARY SCHOOL STUDENTS

HSCL # 18743

If you agree to participate in this study please sign where indicated, then tear off this section and return it to the investigator(s). Keep the consent information for your records.

I have read this Consent and Authorization form. I have had the opportunity to ask, and I have received answers to, any questions I had regarding the study and the use and disclosure of information about me for the study.

________________________________ ______________________

Type/Print Participant's Name Date

____

Participant's Signature