The Implementation of Technology in Education

An Interactive Qualifying Project Report

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by

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Abstract

This Interactive Qualifying Project describes and evaluates the impacts of implementing technology into a 7th and 8th grade algebra classroom at Central Tree Middle School located in Rutland, MA. After researching literature and conducting surveys, we examined the effects of technology in education by teaching with technological advancements in the classroom. We assessed: 1) how different learning styles impact this implementation of technology into the classroom, and 2) whether the presence, or absence, of technology aids in student learning.

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Introduction

Introduction

This IQP implemented technology into a seventh and eighth grade algebra class at Central Tree Middle School (CTMS) in Rutland, MA. We experimented with the use of graphing calculators and computer software to support the course curriculum in order to determine whether the presence, or absence, of technology had a positive, negative, or null effect in this classroom. We taught with technological tools to one class as an experimental group. We taught this class twice a week, for an hour. We used another class as a control group; we had no contact with this class. We also considered how individual learning styles effected the usefulness of technology in this classroom. Our methodologies for evaluation were observing the students' grades on worksheets and quizzes, conducting student surveys, and hosting a game of jeopardy between the two classes.

Tests to evaluate the student's learning style were given to the students in both classes to complete at home. Each test was reviewed and we determined each student's preferred learning style. There are six themes of learning styles that are defined on pages 18 and 19. We analyzed this information to see if a relationship between the student's learning style and computer-based learning existed.

We experimented with technology in the classroom by introducing graphing calculators and computer programs to the 8:15 Algebra class for one hour a week. Worksheets and quizzes were distributed weekly and graded on individual

achievement. Identical quizzes were distributed to the 10:00 Algebra students, but we did not interact with this class throughout the term. A weekly meeting with the Algebra teacher, Mrs. Linda Limoli, was also scheduled to discuss the lesson plans for the week.

The principal of CTMS, Mrs. Ellie Fernands, granted us permission to purchase two copies of each program at the school's expense. Many of the labs required the students to work in groups of three due to the limited supply of computer software. The programs used introduced Algebra concepts and spreadsheets in a fun and interactive manner. Every week, the school's computer technician, Mr. Ed McTigue, would install the appropriate software onto four computers in the computer lab. Worksheets pertaining to the computer programs were created and issued to the students. These worksheets were to be completed within the period. Quizzes were also given as an evaluation of the students' understanding of the material.

Technology plays an increasing role in society. This project is worthwhile because of the common use of technology, namely computers, in everyday life. This IQP concludes that technology can be effective in education when used to support a well-planned course curriculum. The faculty of CTMS is able to use the results of this IQP to support their curriculum with the appropriate levels of technology. We have prepared an oral presentation on the results of this IQP for the faculty of CTMS.

This IQP project was a good topic for fulfilling the objectives of the degree requirement. By implementing technology into an algebra class and evaluating the outcomes, we analyzed this particular interaction between technology and society.

Focus Question

Does technology in the classroom improve learning in the classroom, and how do individual learning styles effect this outcome?

Problem Statement

There is much controversy over technology in the classroom. There are two incongruous conclusions. Some sources conclude that students greatly benefit from technology in the classroom. Other sources conclude that course goals can be achieved without the use of any technology. We performed several experiments in a mixed algebra one classroom of seventh and eighth grade students to determine the effectiveness of technology in the classroom.

Every student has a different learning style that effects the usefulness of computers and calculators in the classroom. We determined which learning styles are most effected, and whether in a positive or negative manner. In order to determine the effectiveness of technology in the classroom, we first determined students' learning styles and then found an efficient method to evaluate their achievements.

Definition of Technology

Technology is: "the application of scientific knowledge to practical purposes in a particular field" (Gove, 1967, p. 1950). Technology includes the creation and use of technical means, special skills or knowledge applied to technology. The interactions of these technical means with life, society, and the environment "draw upon such subjects as industrial arts, engineering, and applied and pure science" (Flexner, 1987, p. 2348). Technology education is a "comprehensive, action-based educational program" (Alkin, 1992, p.1389). Students study the evolution, utilization, and significance of technical means. Technology education also addresses the organization, personnel, systems, techniques, resources, and products of industry. The study of social and cultural impacts of technology demonstrates the effectiveness of technology.

Background and Description of Central Tree Middle School

Central Tree Middle School (CTMS) in Rutland, MA was built from the spring of 1997 through the summer of 1998. This school was built to create more room for the increasing number of students in the Wachusett Regional School District. Before CTMS was built, Kindergarten was held in the Rutland Community Center, grades one and two were held in the Primary Building, and grades three through eight were held in Naquag Middle School. Currently, Naquag School holds Kindergarten through fourth grade and is located in front of CTMS, which holds grades five through eight. Although the schools have different principals, the principals attempt to work together to keep the two schools in close contact.

Central Tree Middle School (CTMS) has many advantages over other schools in the area. When building CTMS, technology became an important issue among the school building committee members. They felt that implementing technology into the classroom was a significant approach in reforming the school's curricula. The faculty can take advantage of a computer lab holding approximately fifteen computers and many other technological teaching aides. This lab is open to all classes, but teachers must schedule to use the lab in advance. CTMS also has an average of three to five computers in each classroom, all of which have Internet access. There is also an abundance of new teaching equipment. Math classes now have the advantage of using TI-83 Graphing Calculators.

7th and 8th Grade Algebra

Mrs. Linda Limoli teaches the algebra classes at Central Tree Middle School. She has been teaching for twenty-eight years. Her current algebra class is a pilot program of a combined seventh and eighth grade class. One of the course goals is to have the students work as a class, not as separate seventh grade and eighth grade students. Extra help is available for the students two days a week for half an hour after class.

The use of technology in this algebra classroom has been very limited. However, there is the use of calculators in this classroom. Mrs. Limoli believes: "calculators are a wonderful tool and allow investigations that [one] might shy away from," but they should be used as a tool, not a crutch (Limoli, 1998). The students are currently using scientific calculators to perform fractional operations, but TI-83 Graphing Calculators are available to the class. Before this school year, Mrs. Limoli had used neither computer nor computer software in the classroom.

There is specific material that the students are expected to understand at both the beginning and the end of the course. At the beginning of the year, students should know and understand how to apply the mechanics of the four operations to whole numbers, integers, positive real numbers, percents, area, perimeter and volume. They should have some basic knowledge of formulas, measurements, and geometry. Students should understand some probability and statistical problems. By the end of the year, students should know and understand how to apply the mechanics of the four operations to polynomials, graphing on both the number line and the coordinate axis, and solving algebraic and quadratic equations.

Literature Review

Wachusett Regional School District Curriculum

The Wachusett Regional School District Curriculum categorizes middle school mathematics into four classes: seventh grade mathematics, eighth grade mathematics, algebra, and advanced algebra. Each class contains a general overview of the concepts the students must understand in order to progress to the next level of mathematics.

The seventh grade curriculum stresses the importance of decimals, percents, and fractions, introducing scientific calculators, solving problems using estimation, and strategies to use signed numbers. In eighth grade math, students need to develop an understanding of the coordinate plane, palindromes, integers and their properties, percentages and proportions. There is also some review on fractions and decimals. Algebra stresses that students learn how to translate, evaluate, solve and apply algebraic expressions, equations, inequalities and linear equations, and factor polynomials. Advanced algebra consists of understanding the operations and properties of functions, limits, rate of change, area under a curve, vectors, and polar and parametric equations. However, Central Tree Middle School does not offer an advanced algebra course to its students (Wachusett Regional District Curriculum, 1998).

The Massachusetts Mathematics Curriculum Framework

The Massachusetts Mathematics Curriculum gives a nonspecific overview for mathematics in grades five through eight. The curriculum simply states the concepts the students should be able to understand and apply through problem solving, communicating, reasoning, and connecting. There is also a general outlook on algebra that stresses the importance of introducing algebraic concepts in grades five through twelve. It is important for students to understand that algebra is the foundation more advanced mathematics and will be needed throughout their education.

In the beginning of the Massachusetts Frameworks, there is a section that states to teachers the importance of mathematics and the significance of using technology in the classroom. There also are instructions for connecting and integrating mathematics to real world problems (Massachusetts Mathematics Curriculum Frameworks, 1998). These categories are merely guiding principles established by the state to aid teachers in helping students understand the impact of mathematics in their future.

Summary of District and State Curricula

The Wachusett Regional District Curriculum not only satisfies the Massachusetts Mathematics Curriculum Framework but also gives much more detail. The district curriculum specifies what to teach the students and what tools should be used in order to teach the students. While the state curriculum states that students should learn through problem-solving, communicating, reasoning, and connecting, the district frameworks break down each of those learning styles into steps.

The state and district curricula work together. The state frameworks offer ideas and examples on how the material should be presented while the district curriculum specifies what material needs to be taught. Algebra in both cases is offered as a separate class from typical seventh and eighth grade mathematics because not all students are required to reach the algebra level.

The traditional teaching of mathematics has been reformed over the years. Currently, many teachers do not know how to implement calculators and computers into their teaching methods due to their lack of knowledge of computers (http://www.edweek.org/sreports/tc98). The National Council of Teachers of Mathematics now requires reform for the teaching methods and technological tools used in the math curriculum. The objective of this reform is to help students envision and perceive knowledge (National Council of Teachers of Mathematics, 1998).

Impacts of Learning

"Learning is the act of gaining knowledge or understanding of or skill in by study, instruction, or experience" (Gove, 1967, p. 1286). For years, the educational system has based methods of teaching on one uniform, universal method. This method insinuates that all students are capable of learning the same material from a single textbook in the same invariable fashion adequate to evaluate their learning. Today, teachers and educators are questioning this method of teaching. It may not be an ample approach in helping students learn because of the individual differences in students. According to Howard Gardner, "We are able to know the world through language, logical-mathematical analysis, spatial representation, musical thinking, the use of the body to solve problems or to make things, an understanding of other individuals, and an understanding of ourselves" (Gardner, 1991, p. 145). Identifying which learning style is most effective and for whom is the inevitable question that needs to be answered. There are five basic learning styles that this section will focus on: perception, input, organization, processing, and understanding (Brent, Felder, 1997).

Perception is the learning style that describes how students understand the material being taught. There are two types of perception learners: sensing and intuitive. Sensing learners tend to learn information more efficiently by seeing or hearing what is happening. They prefer to be taught facts and data rather than learn about models or theories. Intuitive learners, on the other hand, would rather learn about models. They like variety but dislike redundancy. Everyone is both sensory and intuitive, but some people are more one than the other (Brent, Felder, 1997). The next type of learning style focuses on how students receive external information. A

visual student understands this information better through pictures, diagrams, sketches, flow charts, maps, and demonstrations. Most people favor this style of learning. Verbal input is information processed through written and spoken words. Every student learns both visually and verbally, but there is usually a preference toward one or the other. Verbal listeners must also be visual learners because teachers are more likely to teach both visually and verbally (Brent, Felder, 1997). Organization deals with how students coordinate data. Induction is the process of organization where students begin by observation, then conjecture the rules and principles associated with the observation. Deduction is the opposite; students start with principles and theories and then gather the consequences and phenomena. Everyone starts as an inductive learner. Children must first learn through observing and imitating what is happening around them before they can actually understand it. (Brent, Felder, 1997) Active and reflective learning deals with how students process information. Active learners process information through talking, moving, and working with other people. Reflective learners process information contemplatively and prefer working alone. Again, everyone is both active and reflective although preference depends on the individual (Brent, Felder, 1997). The means in which students understand information can be divided into two learning styles, sequential and global. The difference between these two styles is that sequential learners process information one step at a time while learning from each step. They tend to perform with partial understanding of the data being introduced. On the other hand, global learners understand information by recognizing the bigger picture. Global learners have an ability to solve complex problems quickly but are unable to explain their results (Brent, Felder, 1997). The process in which students learn is impacted greatly

by a number of factors. The teaching style used is only one of these many factors. If there are mismatches between teaching styles and methods of understanding, students tend to become bored, inattentive, or disruptive in class. Other effects of these mismatches may cause students to perform poorly on tests, homework, and other assignments. The extreme consequence would be students becoming discouraged of the curriculum and themselves. This discouragement could result in students dropping out of school. The reformation of the curriculum is trying to stress the importance of introducing a variety of teaching methods within the school in order to satisfy the individual differences of students.

Holland's Model

Holland's Model is an indicative test of students' individual learning styles. The six themes of Holland's Model are realistic, investigative, artistic, social, enterprising, and conventional. Personal styles and occupational environments are given for each theme. The test is divided into four sections: activities, competencies, occupations, and self-estimates. Students indicate whether they like or dislike several given activities. They indicate activities that they do well and activities that they have never performed or perform poorly. Students also show their feelings and attitudes about many kinds of work. They rate themselves on given traits compared with other students their age. All of these sections are divided into the six themes. Within each theme, the students tally their scores for the four different sections. Students add up the amount of activities that they like or that they do well, the occupations that they like, and the number that they circled for self-estimates. They do this summation for all six themes. The students rank the themes from the theme with the highest number to the theme with the lowest number. The theme with the highest number is that student's particular learning style.

Realistic learners are described as being aggressive, preferring concrete work, and having poor interpersonal interactions. Occupations for realistic learners involve skilled trades and technician skills. Skilled trades include being a plumber, electrician, and machine operator. Technician skills include being an airplane mechanic, photographer, and draftsperson.

Investigative learners are intellectual, abstract, analytical, independent, sometimes radical and task-oriented. Their occupational environments are scientific,

such as chemistry, physics, and mathematics. Other occupations for investigative learners are technical, such as a laboratory technician, computer programmer, and electronics worker.

Artistic learners are imaginative, value aesthetics, prefer self-expression through the arts, and are rather independent and extroverted. Occupational environments for the artistic learner are artistic, such as a sculptor, artist, and designer, musical, such as a music teacher, orchestra leader, and musician, and literary, such as an editor, writer, and critic.

Social learners prefer social interaction, social presence, and are concerned with social problems. They are religious, community-service oriented and interested in educational activities. Their occupational environments include educational environments, such as a being a teacher, educational administrator, and college professor. Social learners' occupations also include social welfare, such as being a social worker, sociologist, rehabilitation counselor, and professional nurse.

Enterprising learners are extroverted, aggressive, adventurous, and prefer leadership roles. They are dominant, persuasive, and make use of good verbal skills. Their occupational environments include managerial positions, such as personnel, production, and sales manager, and various sales positions, such as sales in life insurance and real estate, and a car sales person.

Conventional learners are practical, well controlled, sociable, and rather conservative. They prefer structured tasks and conformity sanctioned by society. Their occupational environments include office and clerical work, such as being a timekeeper, file clerk, teller, accountant, keypunch operator, secretary, bookkeeper, receptionist, and credit manager.

This is the indicator that we chose to use, as explained in our procedure.

Evolution of Technology

The use of technology in the classroom has greatly evolved in the past century. Film and radio were among the first technologies introduced to the classroom. Television was introduced later.

Film was the first technology to be used in the classroom. In 1910, public schools in Rochester, New York first used motion pictures in a classroom setting. In 1917, a Chicago school organized the first visual education department. After World War I, many city school districts established similar bureaus. Film-oriented college courses for teachers appeared in the 1920s. In 1931, twenty-five states had units in their departments of education devoted to films a related media (Cuban, 1986).

Radio was introduced later. In 1920, the Radio Division of the U.S. Department of Commercial and Educational Stations began classroom broadcasting to enhance classroom instruction. Haaren High School in New York City was the first public school to use radio to teach a class. Faculty broadcast lessons to accounting classes in 1923. Dr. Virgil Dickson of Oakland, California had a series of lessons broadcast from 1924 to 1925. These lessons included penmanship, arithmetic, and history. In total, there were fifty-six lessons lasting twenty-five minutes each. In 1924, the "Little Red Schoolhouse" was a weekly program for students. A survey taken in 1942 reported that twenty-nine systems in seventeen states provided broadcasts to classrooms (Cuban, 1986).

Classroom use of instructional television started in a Los Angeles high school in 1939. Philadelphia public schools also experimented with instructional television in 1947. In May of 1953, a Houston, Texas radio station, KUHT, broadcast an

educational program called "Continental Classroom." This broadcast helped introduce instructional television to the country. By 1953, the Federal Communications Commission (FCC) allocated two hundred and forty-two channels for educational purposes (Cuban, 1986). This started an issue on the reformation of education and the use of instructional television in classrooms across the country. Within the next ten years, a push for advancement in education became an important issue. By 1971, over one hundred million dollars had been spent by both public and private sources to bring instructional television into education (Cuban, 1986). In the1950s, a number of schools had received grants and local funds in order to bring instructional television into the classroom (Cuban, 1986).

Positive Effects of Technology in the Classroom

Effective use of technology in education begins with: "a well-conceived course" (Albright, Graf, 1992, p. 10). The course should have learning objectives and content designed to meet student needs. Technology should be implemented into instruction in order to meet course goals. Effective technologies should be regarded as: "resources that provide unique learning opportunities for students, within the broader context of a carefully structured learning environment" (Albright, Graf, 1992, p. 10-11).

There are many uses of technology in the instructional context. Lewis and Wall (1988, p.3) identify six of the most frequent uses of technologies in teaching. 1) Technology enables students to experience times, places, people, and events. These experiences could not be accomplished in the classroom without the use of technology. 2) Technology allows students to visualize phenomena that are either too small or too dynamic for the teacher to convey effectively. 3) Teachers use technology to perform routine tasks, such as drill and practice. 4) Technology in the classroom prepares students for work. They learn how to use and apply spreadsheet, word processing, or computer-aided design technologies. 5) Using technology for routine record-keeping or communication enhances teacher and student productivity. 6) Technology enables students to be reached through distance learning. (Albright, Graf, 1992).

Distance education technology has greatly evolved. There are four primary roots of distance education: print, voice, video, and computer. In the mid-1800s, correspondence study was the form of distance education. This form was maintained

throughout the first half of the twentieth century. In the 1920s, radio brought classes to rural and remote areas. Telephones were used in distance education in the 1950s and 1960s. Amplified telephones and bridges to link calls allowed telephones to be used for this purpose. In the 1960s, television was primarily one-way broadcasting. However, in the 1970s and 1980s, television changed to more interactive modes. Thus, they were used in distance education. Computers "enlarged the range of tools available." They brought classrooms to individual homes and offices. Computer conferences were also a new form of distance education. The evolution of technology has vastly improved distance education (Albright, Graf, 1992).

Technology provides an alternative to print. Online finding tools help access lists and locations of desired materials. Computerized indexes and catalogs allow students to search using combination of terms and to access any word in the record. Technology allows students to research effectively and speedily. Alternatives to print include computer-based online public access catalogs (OPACs), periodical indexes in digital form, microforms, and CD-ROMs. Many media centers have collected audiovisual materials available (Albright, Graf, 1992).

Negative Effects of Technology in the Classroom

The introduction of modern technology, namely computers, has not always helped public school students. "Communication and data technology have provided students with ways to access information in an efficient and timely manor. The overall use of computers, however, has stifled the students' mastery of reading and math concepts that are lost when instant responses and calculations are made" (Lederman, 1993, p. 54).

The use of computers in high-school science and math courses is problematic. Computers in the classroom now are comparative to hand-held calculators in the classroom twenty years ago. Both computers and calculators speed up calculations and allow more material to be covered. However, they also "obscure the fact that the students are not learning the necessary concepts" (Lederman, 1993, p. 54). Frank Barnes, professor of electrical and computer engineering at Colorado University, Boulder, states: "If I put an algebra problem on the blackboard I don't want to have to explain how to solve it. I want to use it to go ahead and explain the course I am teaching" (Lederman, 1993, p. 55). While computers aid in covering course material at a quicker pace, they often hinder students from learning the material being covered.

The manner in which a computer is used to instruct is indicative of its effectiveness. Computers should not be used if their sole purpose is simply to use a computer. Many traditional courses have no need for computer usage. The importance of the material being covered should take precedence over the "electronic sizzle" (Lederman, 1993, p. 55) of a computer. It becomes increasingly apparent that:

"technology should be adapted to the course, not the other way around" (Lederman, 1993, p. 55).

The effectiveness of computers in the classroom is often debated. Much success in the classroom is attributed to the use of computers. However, Charles Pillar, in a recent article in Macworld, asks: "how much of the success can be attributed to the interaction of machine, teacher, and child, and how much to the increased attention given to the child because of the machine" (Lederman, 1993, p. 55). Thus, whether computers or increased attention is more effective is yet to be answered.

Debate of Technology in the Classroom

There has been much controversy about the effectiveness of technology in the classroom. Research proves that technology in education can raise students' achievement in school when used for the right reasons. There are many factors underlying the effectiveness of technology in the classroom. The teacher's technical ability is one of the most important factors. How well the teacher is able to use the computer proves to have a great effect on the students' grades. Research has found that computers used for wrong reasons may do more harm than good. According to Harold Wenglinsky, a research scientist from the Educational Testing Service, "Technology, indeed, can have positive benefits, but those benefits depend on how the technology is used" (http://www.edweek org/sreports/tc98).

Research has also proven that students are less productive after spending long periods of time using computers. A study done by Wenglinsky on the effects of technology in mathematics among elementary and middle school students shows that technology is more effective for the middle school students (http://www.edweek org/sreports/tc98).

Although many studies have confirmed the effectiveness of technology in the classroom, researchers are concerned if these results can be replicated in classrooms across the country. According to Wenglinsky: "Students whose teachers had professional development in computers outperformed students whose teachers didn't" (http://www.edweek org/sreports/tc98).

Teachers who have access to technology in the classroom should be provided with appropriate classes to teach them how to use the technology.

Technology in the Classroom

The earliest computers were thought to be powerful calculators used for mathematical computation (http://klington.cs.iupui.edu/~aharris/mmcc/mod2/abwww0.html). Currently, the main objective of computers has shifted from calculation to communication. Computers are still used for calculation, but communication is the ultimate goal. The Internet is an active source for communication. It can retrieve information from virtually anywhere and bring it to one's desktop. Students can use an up-to-date web site when they need help with homework. Computers can be used as a very effective form of instruction.

Computers in the classroom can be used productively in several ways. In order for computers to be an effectual tool, teachers must be knowledgeable of computers and their programs before trying to instruct their students. (http://klington.cs.iupui.edu/~aharris/mmcc/mod2/abwww0.html). Classroom computers and multimedia labs allow students to readily access technology (Davis Jeanne, 1997). Teachers may also use computers for menial tasks such as recording grades, making exams, and storing lesson plans. Therefore, teachers have more time to help students.

Computer software has many practical applications in the classroom. The majority of mathematical software tests computational skills. These programs are designed as a complement to traditional math curricula. Students are able to work on separate lessons within the curricula allowing them to progress at their own pace. This separation is practical for students in the same class with diverse mathematical

capabilities. Using mathematical software, students tend to finish lessons faster and retain more information (http://www.nprdc.navy.mil/wworks/find30.htm). This software allows students to test their knowledge, and, if necessary, review appropriate lessons (http://www.nprdc.navy.mil/wworks/find30.htm). Computer-based instruction is beneficial when applied to the traditional style of teaching.

Recently, the use of technology in the classroom has been reformed. Mathematics consisted of memorizing formulas and performing computations, therefore, using calculators was considered cheating (Bruder, 1992). When the National Council of Teachers of Mathematics changed the curriculum standards in 1989, they stressed the analytic, problem-solving, and creative aspects of mathematics. These standards require technology in the classroom, and it is now accepted that the use of calculators and computers enables students to enhance their mathematical skills (Hollister, 1997).

Calculator-based labs allow students to create plots and graphs, and analyze data that is collected on a device attached to the graphing calculator. The graphing calculator converts given equations to graphic representations. This conversion helps students to visualize the connection between mathematical concepts and solutions.

Helen Hook, a math teacher at Granby High School in Norfolk, VA, brought graphing calculators into her classroom. As a result, she reports: "students are showing a greater interest in math." With this new technology available, she concludes: "I am now able to lead my students to discovery. I help them ask why and assist them as they draw their own conclusions" (Bruder, 1992, p. 23)

Mary Lindquist, president of The National Council of Teachers of Mathematics, believes that the graphing calculator "has really made more of an

impact on mathematics [than the computer] because every child can have one" (Hill, 1993, p.26). Lynn Arthur Steen, executive director of the Mathematical Sciences Education Board, disagrees with Lindquist. He believes: "You can have a complete, solid curriculum meeting the NCTM Standards and not use the computers" (Hill, 1993, p.26). Judah Schwartz, professor of mathematics and physics at Harvard and M.I.T, believes that: "Computers are a necessary tool for all math curriculum-starting at age zero. A computer is so flexible, so supportive of different scenarios. With graphing calculators, there's a lot of overhead to learning because you are driving it from an idiotic keyboard. As an interface, it's crummy. I would much rather have three kids on a computer than one each to a calculator." (Hill, 1993, p.26)

Literature Review Summary

There are several conclusions that can be drawn from the literature review. Individual learning styles, how technology is implemented into the classroom, and the technical knowledge of the teacher are all major factors in the effectiveness of this implementation.

Individual differences have a great impact on how students learn, regardless of teaching methods. For technology to be effective in the classroom, teachers must be knowledgeable of the tools that they will be using in the classroom.

We were aware of individual learning styles when we taught. Although it is impossible to teach in a way that satisfies each learning style, we took into consideration that some students find technology to be more effective in learning than other students.

Technology should be adapted to the course in which it is being used. Teachers should utilize technology to support a well-planned course. Technology should demonstrate the importance of the course material, rather than applying the course material to technology. This information aided us in our teaching. We used computer software that stressed the main points of the material that the students were learning.

In order to teach technology effectively, teachers must know how to use technology in a competent manner. This understanding is crucial to the benefit of the students. Therefore, we made sure that we had a full understanding of both the material and the technology that were teaching.

Grade Builder: Algebra 1

Grade Builder: Algebra 1 is a program created by five peer tutors who present Algebra concepts in a friendly and fun environment. It is both video and audio animated. The main menu resembles a Cyber Learning Café with simulated Internet access. It consists of two discrete sections that are presented in a wide variety of interactive lessons that help prepare students to use Algebra in a real-world basis. This program is created for students in grades six through eight and is set up to allow them to learn Algebra at a pace that is comfortable for them. The lesson section of this program provides a wide variety of illustrative questions and examples pertaining to the topic selected. The lessons are divided into a number of screens that are highlighted by lights in the upper right corner of the screen. These lights were used as stopping points in which the students were asked to record their answers on the provided worksheets. At the end of each lesson there is a drill of ten multiple-choice questions reviewing the preferred Algebra lesson. *Death by Algebra* is a game show that tests the students with a series of questions that reinforce the lessons. Their scores are recorded next to the corresponding lesson. These scores may be improved as the student progresses through the lessons by simply playing the game once more. The program will record the best score. *Soak your Sibling* is a more advanced game that the students are able to play that applies more pressure for them to think fast. It is more arcade-style and challenges the student to quickly reply with the accurate responses in order to "soak" your opponent.

SAT: Math

SAT: Math is a program that helps teach the students many mathematical concepts, including many Algebra theories. It contains no audio interaction and is presented in a more formal manner. This program is intended to review typical problems that are found on the math section of the SATs and is designed in two sections. The first section consists of a brief tutorial that is set up in textbook style. The tutorial allows the user to plug in various numbers into an equation that is being taught. This allows the student to follow steps in order to solve the algebraic problem. The second section of this program allows the student to solve several problems pertaining to the preferred lesson. If the problem is entered incorrectly, the program provides a step by step review on how to solve the problem.

Multimedia Labs

The Multimedia Algebra Labs program is a beneficial mathematical device used to help teach Algebra students using a variety of interactive labs. This program teaches students how to implement mathematical strategies to every day life. This program contains many different features. The labs are divided into three parts. The first part includes a short video and introduction to the material being reviewed. Next are a number of exercises that are to be completed by the students. There is also a journal that is available for the students to record problems or comments as they progress through each lab. A word processor and spreadsheet program is used to gather this data. Each lab takes approximately half an hour to complete. This time constraint made it difficult to use this software at CTMS, but we were able to use it once. The students enjoyed this program because it required more work on their part where as the Grade Builder: Algebra 1 program was found to be "childish."

Technology Counts '98: Putting Technology to the Test

(http://www.ets.org)

On September 29, 1998, *Education Week* released the results of a study conducted by the Educational Testing Service (ETS) that unites the use of computers in schools to higher student test scores. This study concluded that the higher test scores were the result of how the students used the computers rather than how often the computers were used. Each year, billions of dollars are spent in order to bring technology into public schools. The public is now questioning whether or not the technology is effective.

This study analyzed 4th and 8th grade mathematical test scores from a 1996 federally sponsored test know as the National Assessment of Educational Progress (NAEP). This test includes teacher's responses to the use of technology in the classroom and the training with the equipment. ETS Associate Research Scientist Harold Wenglinsky, the principal scientist of this study states, "Technology can have positive benefits, but those benefits depend on how the technology is used". Wenglinsky controlled all the factors that affect students' achievements, factors such as socioeconomic status, class size, and teacher qualifications, and found that there is a correlation between particular types of technology use and higher students' academic achievements.

Wenglinsky found that 8th grade teachers who used computers simply for "drill and practice" resulted with students who performed poorly on the NAEP. In contrast, 8th grade students who utilized computers for "simulations and applications" performed better on the NAEP as opposed to students who did not use computers in

the classroom. Among 4th graders, students whose teachers utilized computers for learning games performed up to 15 percent better than students whose teachers did not use computers.

Among the 4th and 8th graders, higher test scores resulted amongst students whose teachers had professional training in computers. Although "drill and practice" is associated with lower test scores, 8th graders are more than likely to have teachers using this type of teaching. This is because of the educator's lack of preparation and training on computers. 8th graders whose teachers are educated with computers performed more than a third of a grade level higher than students whose teachers lacked knowledge or were not trained properly.

Research indicates that training teachers on how to integrate technology into the curriculum is a critical factor for the success and effectiveness of technology applications in schools.

Previous Interactive Qualifying Projects

Students at Worcester Polytechnic Institute (WPI) have attempted to implement new technological advances into course curriculum at different learning institutions. The Interactive Qualifying Project (IQP) includes the research and accomplishments of the students' methodologies. A great deal of research focuses on devising the most beneficial methodologies for both the students and the teachers. Similarly, for our IQP, we are trying to incorporate advanced technology into a school that is brand new to both the students and the community. In order for us to incorporate technology into the school effectively, we have done extensive research on previous IQPs. In total, we looked at six IQPs that were done by students at Worcester Polytechnic Institute (WPI). These IQPs helped us understand what methodologies are effective and ineffective.

The first IQP reviewed was The Future of Education (1996) by Dawn Campanelli, Adam Clark, and Heather Dunham. This IQP addressed many of the major areas included in our IQP. The proposal consisted of the WPI students' research on examining the effects of computers and technology in the educational system and an exploration on the evolution of computer use in the classroom. The evolution discussed the importance of implementation and case studies involved in the project. Some of the important aspects of implementing computers into the classroom were found through research of past material done by other college students. This IQP was prepared well through extensive research and close observation of the effects of technology in education.

The second IQP examined was Internet Technology (1996) by Luke Demoracski and Nathan Hendrix. In this IQP, researching, developing, and instructing a curriculum to teach the use of the Information Superhighway was proposed. They focused on teaching high school students and teachers the advantages of using the Internet at Doherty Memorial High School. The evolution of the Internet was researched in order to understand the impact it has had on society. Although these WPI students accomplished the main goal of the project by instructing high school students how to utilize the Internet, this IQP lacks in depth and scope of the full implementation of Internet use at Doherty High School in using their methodologies for their project.

The third IQP researched was Sixth Grade Algebra Methods (1995) by Donald Joseph, David Lassy, and Ian Pawloski. This IQP focused on determining whether or not an interactive teaching method, through the extensive use of in class exercises and hands-on problem solving, was successful among sixth grade students. This project was inadequately constructed; the final report consisted primarily of appendices with work performed by the sixth grade students. While some students in the sixth grade comprehended advanced mathematics, most students were unable to understand the material. The students' lack of success in this program is attributed to a weak foundation in basic arithmetic skills. Observing the students' work, it was apparent that an interactive program in Algebra appeared to be overly advanced for sixth grade students.

The fourth IQP examined was the Introduction to Computers at Doherty High School (1995) by Steven Mack and Andrew Schnellinger. They proposed to introduce the use of computers to the mathematics faculty at Doherty High School and

hoped to initiate a consecutive progression of learning that would aid in teaching students. They intended to create a varied learning environment through proper training, along with software that corresponded with what the students were learning. This project focused on stimulating the students' interest in the math and science fields. We found this project to contain many grammatical and paragraph spacing errors that could have been avoided but were left unnoticed by the students prior to handing in this project.

The fifth IQP researched was Interactive Learning: A Look at Computers in Education (1996) by Kevin Osborn, Andrew Pluta, William Spratt, and Michael Todd. They proposed to work with issues surrounding computers in the classroom. Their project's main focus was the Interactive Physics program and how similar programs should be used in conjunction with education. What they hoped to accomplish was to reveal the advantages and disadvantages of computers used in education. Although the idea of this project seemed important and relevant to our IQP, their final report was extremely short and redundant and contained little information concerning the impact of technology in education.

The last IQP analyzed was Computers in Education (1997) by Joe Kalinowski and David Howes. They proposed to familiarize the faculty at the Blackstone Valley Regional Technical High School the computer basics so that they would be able to utilize technology in their school. They sought to find out whether teachers would take advantage of computers as educational tools if they were made readily available. Training classes were offered for interested teachers on various computer applications. These classes were taught with the assumption that the teachers possessed no basic computer knowledge. Surveys were distributed to the teachers before and after the

training classes in order to find pertinent information for their project. These evaluations included questions to ascertain if the teachers would use computers more regularly after the training.

Learning about other IQPs gave us a more realistic insight of our own project by acquainting us with past accomplishments as well as failures. Being able to see what happened in other projects gives us an impression on what to expect with our students at Central Tree Middle School. By researching these projects prior to beginning the actual working phase of our IQP, we know the shortcomings and can hopefully avoid them to produce a project that organized well and is what we originally expected. The main problem in the majority of these IQPs was the lack of preparation from the students. As a result of this lack of preparation, the students stumbled upon problems that may have been avoidable with proper research. This lack of research caused the IQP students to have less insight on how to solve these problems. We now have more knowledge of difficult situations that may occur during our project, and hopefully we will be able to elude them.

Procedures & Methodologies

This IQP focused on taking the new technology offered to the math classes, finding effective methods of teaching and using the new equipment, and helping students learn mathematics in a more casual and fun environment. We introduced new methods of teaching using technology and determined if it significantly impacted the students' understanding, analytic skills, and futures.

We implemented technology into the classroom by teaching the students using the computer lab. There were also other technological tools that were also available for use, including TI-83 Graphing Calculators, and computer software. The TI-83 Graphing Calculators were used to help students understand the mechanics of graphing on the coordinate axis. Based on our research of computer software, we bought software that we believed would most benefit the students.

We attended classes twice a week, teaching one half of the class the first day and the other half of the class the second day. While we were working with part of the class, Mrs. Limoli lectured the remainder of the students. We understand that basic lecture, worksheets, bookwork, and group work are an important part of the learning process. However, we hope that technology helped the students gain a better understanding of algebra. Every week we designed a lesson plan corresponding to the material that Mrs. Limoli was teaching. The lesson plan that Mrs. Limoli intended to accomplish from October 26, 1998 to January 29, 1999 is included in Appendix B.

Central Tree Middle School (CTMS) currently has two algebra classes. The first class is held from 8:15 to 9:15. This class consists of a mixture of seventh and eighth graders. This year is the first year that CTMS has made algebra available for

selected seventh grade students. This mixed class was the focus of our IQP. The second class is held from 10:00 to 11:00. This class contains only eighth graders. We evaluated the students by using the class that we taught as the experimental group and the algebra class that we did not teach as the control group.

Holland's Model

We chose to give the students this learning style indicator for a few reasons. Angela Blais, the guidance counselor at CTMS, recommended Holland's Model. The test is free to give to the students and it is easy to follow.

We distributed this test to the students in both classes. They took the test at home and returned them to us. These tests gave us the individual learning style of each student.

We used these results to compare: each student's learning style to his or her overall grades on our worksheets and quizzes in the 8:15 class, and each student's learning style to his or her overall grades on our quizzes in the 10:00 class. These comparisons are detailed in our analyses.

Worksheets

We gave the students a several worksheets to complete during the periods that we taught. An exact account of the lesson plans and description of each period are included in Appendix C and Appendix D respectively. Some of the worksheets were to be completed in a group, while others were to be completed individually.

Learning Styles vs. Overall Worksheet Grades of the 8:15 Class

By giving the students the learning style tests, we wished to determine a correlation between the amount scored on the learning style test and worksheet grades of the 8:15 class.

Math Anxiety vs. Overall Worksheet Grades

We gave students in both classes a math anxiety test. This test is included in Appendix J. This test indicated each student's apprehension towards mathematics. We gave the students this test to determine if students with lower or higher anxiety received lower or higher grades.

Quizzes

Carefully observing the students' grades on quizzes was a methodology that we used to evaluate their performance. We made three quizzes that we gave to both classes. The exact same quizzes were given to both classes. We gave the 8:15 class one quiz at the end of three different days that we taught. These quizzes corresponded to the material that we had taught them using technological tools. We gave the students the quizzes on material that we had taught either on that day or the previous day that we had taught. Mrs. Limoli gave the 10:00 class the quizzes one at a time whenever she could fit it in her lesson plans.

We evaluated the students' worksheets by recording their answers based upon a given scale. We compared the students' individual scores for each problem. We compared their scores to their learning style tests. We understand that using technology in the classroom allowed for more one-on-one interaction with the students. Therefore, the students had the opportunity to learn more individually.

By giving the two classes the same quizzes, we hoped to see whether or not one class performed better on the quizzes than the other class. If the 8:15 class outperformed the 10:00 class, it would help to conclude that the presence of technology in the classroom was beneficial as a teaching aid. However, if the 10:00 class outperformed the 8:15 class, it would help to conclude that the presence of technology in the classroom was not necessarily beneficial as a teaching aid. This information would not, however, determine whether the absence of technology in the classroom was more beneficial for the students.

Learning Styles vs. Overall Quiz Grades

By giving the students the learning style tests, we wished to determine a correlation between the amount scored on the learning style test and quiz grades of both classes.

Math Anxiety vs. Quiz Grades of the 8:15 Class

We wished to determine a correlation between a student's level of math anxiety and the student's quiz grade.

Quiz Grades of the 8:15 Class vs. the 10:00 Class

We hoped to conclude whether the presence or absence of technology had a positive, negative, or null effect on students' grades. By giving the same quizzes to both our experimental and control groups, we wished to discover a relationship between their quiz grades.

Surveys (Pre vs. Post)

Surveys were another methodology used to evaluate the students' performance. We gave pre-surveys and post-surveys to both classes. The pre-surveys were identical for both classes. We gave the students these surveys before we had any contact with the students. These surveys included general backgrounds and attitudes towards technology and math. These survey results are included in Appendix K. After we were done teaching the 8:15 class using technological tools, we gave the students in both classes post-surveys. These surveys were almost identical to the pre-surveys. We wanted to see if the students' attitudes towards technology in general and technology in the classroom had changed in either class. These survey results are also included in Appendix K.

Jeopardy

We used a game of Jeopardy as a methodology to evaluate the students in both classes. There were three teams of approximately twelve students each. The 8:15-9:15 class had twenty-four students and the 10:00- 11:00 class had thirteen students. The 8:15- 9:15 class was divided into two teams of twelve. Students were randomly divided into teams by drawing names from a hat. The 10:00- 11:00 class was one team. Teams were divided into pairs, by randomly drawing names from a hat. Pairs were lined up within their team. A category and a question were chosen. The first pair from each team had approximately two to three minutes to answer this question. Points were awarded to teams with the correct answer, and no points were penalized for wrong answers. The first set of pairs went to the end of their respective teams' lines. The second set of pairs repeated the same process. This rotation continued until all questions had been answered.

On Monday, March 1, 1999, we set up a time to meet with both the 8:15-9:15 class and the 10:00 class. The Jeopardy game was presented on a laptop and light projector using Microsoft PowerPoint and lasted about an hour. There were two rounds, each round consisting of the same five categories with three questions each: graphing, spreadsheets, slope, solving equalities, and solving inequalities. The first round's questions for each category were worth 100 points, 200 point, or 300 points, and the second round's questions were doubled. We allowed any student from both classes to answer questions that the pair representing each team was unable to answer. The student who was able to answer the question correctly acquired partial points for his or her team.

Analyses

We evaluated the students in both the 8:15- 9:15 class and the 10:00– 11:00 class. We implemented technology into the 8:15- 9:15 class and used the 10:00-11:00 class as a control, as detailed on page 6. We evaluated the students using three methodologies: quiz grades, surveys, and a game of Jeopardy.

Explanation of Statistical Analyses

To determine if the results we found were statistically correlated, we had to run an analysis. First we had to determine if the statement being tested was a null or alternative hypothesis. The null hypothesis would be that there is no difference between the two means of the pools of data. (Moore, 400) And the alternative hypothesis is just the opposite, that they have different means. We will assume through out this paper that we are working with an alternative hypothesis since our findings show that the averages in many of our cases are different.

Next, we ran a t-test: Two-sample Assuming Unequal Variances on Excel. Since this was a two-sample assessment we ran one set of data against another set of data to find if there was a correlation. The t-test that we used is designed to assess the strength and credibility of the data that we found against the alternative hypothesis. After applying the mentioned test we obtained results of the mean (average), one-tailed p-tests, and two-tailed p-tests. For our usage we are most concerned with the one-tailed and two-tailed p-tests. If the one-tailed p value is low, less then about five percent, then we can conclude that the two data sources are truly different and therefore correlated. If the two-tailed p value is low, less then about five percent, we can conclude that the first data source is truly less then or more then the first data source. If the one-tailed or two-tailed p values are high then we can conclude that there is no correlation between the two data sources.

Learning Styles vs. Overall Worksheet Grades of the 8:15 Class

To find a correlation between the students' grades and learning styles we split each learning style into two different groups, one with the higher scores and another with the lower scores. And from these two groups of students, six different measurements were taken for each learning style on each quiz. We took the average of the two different groups of the same learning style and compared it to the students' average grade. After doing the analyses, we ran t-tests to determine if there was a true correlation.

As the students' realistic, investigative, and artistic learning style score increased from the first data set to the second data set there test scores dropped three, five, and six out of one hundred points respectively. And as the social, enterprising, and conventional learning style score increased from the first data set to the second data set there test scores rose five, seven, and seven out of one hundred points respectively. After running the t-test, we could not conclude that there was any statistically significant correlation between any learning style score and worksheet score.

Learning Styles vs. Overall Quiz Grades

Six different regressions were done on each of the quizzes to find a correlation between grades and learning styles. We ran a linear regression on the number scored for each learning style and the quiz grade. Here, we found that there was no conclusion and had to search for a different correlation.

We split each learning style into two different groups, one with the higher scores and another with the lower scores. And from these two groups of students, six different measurements were taken for each learning style on each quiz. We took the average of the two different groups of the same learning style and compared it to the average grade. After doing the analyses, we once again had to run t-tests to determine if there was a true correlation.

For all of the quiz grades combined we found that students with a higher realistic learning score scored on average three point out of one hundred lower. For higher investigative learning scores, students scored one point out of one hundred points lower. For artistic learning styles, we found that students scored on average one point out of one hundred points higher for higher learning style scores. For the enterprising learning style, we found that on average students with lower learning scores scored five points out of one hundred points higher. And finally, with the social and conventional learning style, we found that students with higher learning scores scored nine and eight points out of one hundred points higher on average, respectively.

Next, we found ran the t-test to discovery if there is a true relationship or not. Therefore, if there is a true correlation between the students scores and their learning style scores the p values would be low. The social one-tailed and two-tailed p values

were 3.7 percent and 7.4 percent respectively. The conventional one-tailed and two-tailed p values were 5.2 percent and 10.5 percent respectively. From these p values we can conclude that for the social and conventional learning styles there is a statistically significant correlation between the students learning style scores and quiz grades. All of the other p values are too high to determine if a correlation exists between the remaining learning styles and test scores.

	Average of Lower	Average of Higher	Difference	one-tailed P value	two-tailed P value
Realistic	85	82	3	0.25	0.51
Investigative	84	83	1	0.39	0.78
Artistic	83	84	-1	0.42	0.83
Social	79	88	-8	0.04	0.07
Enterprising	81	86	-5	0.14	0.29
Convenmtional	80	87	-8	0.05	0.10

Math Anxiety vs. Quiz Grades of 8:15 Class

We used the same technique as above to find the correlation between math anxiety and quiz grades. It was found that there was a four out of one hundred point difference between the students who had low math anxiety and high math anxiety. After running the t-test for this data, we found that the one-tailed p test was 23 percent. Since the p value is so high, the correlation between math anxiety and quiz grades is not statically significant. And therefore, we can not conclude that students with lower math anxiety have a tendency to have higher grades then students who have a higher anxiety towards mathematics.

Quiz Grades of the 8:15 Class vs. the 10:00 Class

Once again, we sought to find a relationship between the two classes and their quiz grades. We found that the average of the 8:15 class quiz grades was 81 percent, and the average of the 10:00 quiz grades was 87 percent. To see if these values were statistically significant, we again ran the t-test to find the one-tailed and two-tailed p values. The one-tailed and two-tailed p values were 0.0908 and 0.181 respectively. This means that there is a 9.08 percent chance that the averages of the two quiz grades are truly different, and an 18.1 percent chance that the quiz grades of the 10:00 class are truly higher. These percentages of p values seem to be overly high. From this statement, we can conclude that the correlation of quiz grades between the two classes is not statistically significant.

Surveys (Pre vs. Post)

The 8:15-9:15 class had generally the same results on the post evaluations surveys as in the pre evaluation surveys. The number of students who claimed that they enjoyed math increased as the year progressed. The number of students who prefered group work as opposed to individual work was consistent. A variety of questions pertaining to technology in the classroom were surveyed. The number of students who would rather use the TI-83 Graphing Calculators constituted the majority of the class. Only three students expressed that they would rather use the scientific calculators. Almost the entire class stated that they enjoyed using computers in the classroom, but only about half of the students commented that they would prefer using the computers on a daily basis.

The 10:00 class was fairly consistent with the pre and post evaluation surveys. The number of students who said they enjoyed math increased, and the number of students who prefer group work as opposed to individual work also increased. In the post evaluation surveys, the students were asked if they would rather use the graphing calculator or a scientific calculator. This can presumably be attributed to the little exposure the 10:00 class has had with the graphing calculators.

Generally the results of the surveys for both classes were undeviating. The only deviating factor was the utilization of the graphing calculators in the 8:15-9:15 class. This is most likely the reason why so many students in that class would much rather use the graphing calculator as opposed to the scientific calculator.

Jeopardy

We compared how well the three teams competed at Jeopardy. The final scores of the teams indicated how well each team grasped the material. All three teams performed very well and the scores were very close. Team 1, which consisted of twelve students from the 8:15-9:15 class, came in first place with a total of 5300 points. The 10:00 class came in second place with a total of 5250 points, trailing behind team 1 by only 50 points. Team 2, achieving a total of 4700 points, was not far behind the winning teams and played very competitively. Each team put forth their best efforts and it was apparent that the majority of the students were exceedingly familiar with the algebra material. Although the three teams seemed to have difficulty with the graphing category, they encountered no problems with the remaining four categories. The 10:00 class did very well on the spreadsheet questions, and most of these students have never used spreadsheets.

We believe that this game helped us conclude that our teaching the 8:15-9:15 did not affect how well the students performed. Each student seemed to understand the material quite well regardless of which class they attended.

General Conclusions

This project required an ample amount of research and planning from each of us, in order to effectively integrate technology into the algebra class at CTMS. Although we attempted to evaluate the grades and given surveys from the students, many biases occurred that we did not anticipate. Problems including absent students, restricted time, finding time to meet with Mrs. Limoli, and insufficient data are only a few. Many students were absence for the days that we taught, and making up the work was difficult to enforce because we were only present for two days a week. We only had an hour to work with the students which resulted in incomplete worksheets that made it difficult for us to properly grade the student's work. Due to the commute to Rutland and our overwhelming schedule, it was strenuous to meet with Mrs. Limoli and difficult to get a hold of the worksheets and surveys we had distributed to both algebra classes.

Overall, we found that although research generally confirms that technology in the classroom is effective in raising student's academic achievements, it all adheres to the teacher and how well they are familiar with the technology. There are many stages that one must consider when attempting to integrate technology in the classroom. First, educators must realize that technology is merely a tool. It should be viewed as a teaching aid that is rapidly becoming a major part of our everyday lives. It is never to late for "computer-phobic" teachers to learn and understand that new technologies are reliable teaching tools. Most importantly, teachers must have many hours of training time with the technology, especially teachers who have no experience using computers and other technological devices. Helping teachers learn how to integrate technology into the curriculum is a critical factor for the prosperous implementation

of technology utilization in schools. The selected software also needs to reflect the research on how students learn and unite with the teaching and learning activities of the classroom.

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Appendix A

Interviews

Interviews

We interviewed two algebra teachers, Mr. Natoli and Mrs. Pezzella. These interviews gave us another perspective of teaching methodologies. These interviews are included in Appendix A.

Neither Mr. Natoli's class nor Mrs. Pezzella's class has students of different grade levels in the same class. Both classes have only eighth grade students. Mr. Natoli states: "There is no mix because this is a group of advanced 8^{th} graders taking 9^{th} grade math" (Natoli, 1998). Mrs. Pezzella believes that seventh grade students would not be ready for algebra; it would be too stressful for them. Extra help is offered to students in both classes during teacher-student free time.

The teaching methodologies for both Mr. Natoli's class and Mrs. Pezzella's class consist of lecture with some group work. Mrs. Pezzella believes that it is difficult to have students work in groups until the basic concepts of algebra have been understood. This comprehension helps students to contribute to group discussion. In both classes, homework is assigned to students from the textbook and worksheets.

The use of technology differs from Mr. Natoli's class to Mrs. Pezzella's class. Mr. Natoli feels that teaching without the use of calculators is more effective. However, a variety of calculators are made available to the students, depending on need. Mrs. Pezzella believes that calculators allow students to concentrate more on algebra without worrying about the four basic operations of mathematics. Mrs.

Pezzella's students supply their own four function calculators, while the school supplies graphing calculators for in school use. Mr. Natoli's class has access to computers, and the students use the algebra program Geometer Sheteh Pad. Mrs. Pezzella's class does not have access to computers.

Both teachers use district and state curricula to create their respective curriculum. Both teaching methods effectively meet district and state curricula guidelines.

Name: John Natoli

School: Onondaga Hill Middle School, Syracuse NY

How long have you been teaching?

12 years

How long have you been teaching algebra?

6 years

To what grade levels are your algebra class offered?

8th grade

Is there more than one grade level in the same algebra class?

No.

If so, how do you feel about the mixing of grade levels in this class?

N/A

Is this mixture good or bad?

Please explain.

There is no mix because this is a group of advanced 8th graders taking 9th grade math.

When in the same class with higher-grade levels, do the students in lower levels tend to fall behind?

N/A

Do they need extra help?

What is offered to students for extra help in algebra?

When teachers have free time or after school.

To whom is this help offered (students in lower grade levels, any student who needs extra help, all students)?

All students.

What are your teaching methodologies?

Do you use groups in the classroom?

The teacher leads the discussion and occasionally some group work.

How are students grouped?

Randomly.

What activities and resources do you have?

Lecture and some group work from the textbook.

Do you assign homework?

Yes.

How is homework assigned?

What types of homework are assigned?

Problems from the textbook and teacher made worksheets.

How often is homework assigned?

Daily.

Calculators:

Which teaching method do you find most effective?

Without calculators.

If there is the use of calculators in your classroom, what type of calculators do you use?

Varies with need.

Do you use computers to aid in the teaching of algebra?

Yes.

If so, what software do you use?

Geometer Sheteh Pad

Do frameworks given by the state help in the design of your course curriculum?

Yes.

Do frameworks address algebra?

Yes.

What are the contents of the frameworks?

New standards are currently being worked on, but some began this year.

What do state frameworks and district curriculum really do?

District curriculum is established to meet state standards.

Name: Mrs. Pezzella

School: Auburn Middle School, Auburn MA

How long have you been teaching?

20 years

How long have you been teaching algebra?

This year will be my second year teaching 8th grade algebra.

To what grade levels are your algebra class offered?

8th graders are offered algebra and 7th graders are only offered pre-algebra. The school has discussed having 7th graders take a test to see if they could be moved up to the algebra level, but the school feels that too few 7th graders are capable of doing this.

Is there more than one grade level in the same algebra class?

No.

If so, how do you feel about the mixing of grade levels in this class?

N/A

Is this mixture good or bad?

Please explain.

I do not feel that this will ever happen at Auburn Middle School, and I feel that it is better that it didn't because only a few 7th graders would be capable of moving up and this could be stressful for them.

When in the same class with higher-grade levels, do the students in lower levels tend to fall behind?

N/A

Do they need extra help?

N/A

What is offered to students for extra help in algebra?

To whom is this help offered (students in lower grade levels, any student who needs extra help, all students)?

I encourage students to see me during homeroom, which is 20 minutes long, 5 times a week. I am also available after class for 40 minutes, three times a week. This time is offered to any and all students who need help. There is also a math help period offered to students if they are available.

What are your teaching methodologies?

Do you use groups in the classroom?

How are students grouped?

The students have so much information to learn that is makes this class very fast paced. Students learn a lesson per class, so many of the

classes consist of lecture and students trying problems on their own. For the most part the students must work alone until Chapter 2. Chapter 1 and 2 help the students learn the basic concepts and foundation of algebra that they need in order to be able to contribute to group work. After Chapter 2 I allow students to work in pairs or groups of four, but I do not discourage them from working alone.

What activities and resources do you have?

Group work is about it. I have looked for activities and games that would be appropriate for this class, but most of them seem to develop skills that these kids already have. I sometimes play team Jeopardy to help the students use verbal expressions and familiarize them with all the algebra terminology. Computers are out of the question because there is not nearly enough computers here at AMS. Right now our goal is to have at least one computer per classroom for the teachers to use. The town just doesn't have the funds to do this, never mind supplying access to computers for all students.

Do you assign homework?

Yes.

How is homework assigned?

Homework is assigned verbally and gone over at the beginning of class.

What types of homework are assigned?

I assign homework from the book, but I never give more than 20 problems per night. The odd numbered questions are always assigned because the answers are in the back of the book. This way the kids can look up the answer to make sure that they are doing the problems correctly.

How often is homework assigned?

Homework is assigned four times a week. I do not assign homework on the weekends because I feel that they need their time to just be kids and to spend sometime with their families.

Calculators:

Which teaching method do you find most effective?

The kids are allowed to use calculators for test and homework. I find that this is more effective because this gives the students more time to concentrate on the concepts of algebra rather than the basic steps of multiplying and adding. By now these students should know how to do that, so I find that calculators are very helpful to my algebra students.

If there is the use of calculators in your classroom, what type of calculators do you use?

Regular calculators are supplied by the students and graphing calculators are supplied by the school. Graphing calculators are not used until closer to the end of the year.

Do you use computers to aid in the teaching of algebra?

No because we do not have enough computers to use them as teaching aides.

Do frameworks given by the state help in the design of your course curriculum?

Yes, my curriculum is based on the NCTM (National Council of Teachers in Mathematics) and these standards are set for the nation and they follow the state and district frameworks.

Do frameworks address algebra?

Yes, the frameworks do address algebra but in a general manner.

Appendix B

Course Schedule

October 28, 1998 - January 29, 1999

The University of Chicago School Mathematics Project Algebra

Chapter 3: Addition in Algebra

3.1 Models and Properties of Addition

3.2 More Properties of Addition

3.3 The Coordinate Plane

3.4 Two Dimensional Slides

3.5 Solving $\mathbf{ax + b = c}$

3.6 The Distributive Property and Adding like Terms

3.7 The Distributive Property and Removing Parenthesis

3.8 Writing Linear Expressions

3.9 Adding Algebraic Fractions

3.10 Solving $\mathbf{ax + b < c}$

Chapter 4: Subtraction in Algebra

4.1 Subtraction of Real Numbers

4.2 Models for Subtraction

6.7 Size Changes

6.8 Proportions

6.9 Similar Figures

Chapter 7: Slopes and Lines

7.1 Rates of Change

7.2 The Slope of a Line

7.3 Properties of Slope

The above schedule includes the chapters that Mrs. Limoli taught from October 26, 1998 to January 29, 1999.

Appendix C

Lesson Plans

Week 1

We taught the students on Wednesday, November 4th, and Friday, November 6th. We taught twelve students on Wednesday and eleven students on Friday. We taught the same lesson on both days. We used four computers, approximately three students per computer in the computer lab. The class engaged in two activities. The students on two computers worked on the first activity while the students on the other two computers worked on the second activity. They worked on one activity for the first half of the period, and then they worked on the other activity for the second half of the period.

One activity was from the software Grade Builder: Algebra 1. We used lesson 4: Equations: Solving Equations Using more than One Operation. This activity corresponds to lesson 3-5: Solving ax + b = c in the students' textbook. We made a worksheet for the students to fill out while working with the software. This worksheet is included in Appendix A. This program divides lessons into different sections indicated by lights at the top of the screen. Likewise, the worksheet is divided into different sections corresponding to the lights. The worksheet served as an indication of the students' understanding of the lesson.

The second activity was the program SAT: Math. We used activity 6: Linear Equations and Inequalities, lesson 1: General Linear Equations. We used section 1: ax + b = 0 and section 2: Exercises. This activity also corresponded to lesson 3-5 in the students' textbook. We also made a worksheet for this activity (Appendix A).

We gave the students an evaluation sheet at the end of the period. The evaluation scaled all questions on a one to five scale. The students rated the programs and their usefulness. They also rated their probability of using the programs outside the classroom if available. The students also indicated their preference for class or lab. We gave the students a version of this evaluation sheet after most lab sessions.

Week 2

We taught the entire class of twenty-three students on Friday, November 13th. The class engaged in two activities. One activity was taught in the computer lab while the other activity was taught in the library. The students were divided into their typical Wednesday and Friday groups. One group worked on activity one while the other group worked on activity two. The groups switched activities a little more than halfway through the period.

One activity, taught in the computer lab, was from the software Grade Builder: Algebra 1. This activity corresponds to lessons 3-5: Solving $ax + b = c$, 3-10: Solving $ax + b < c$, 5-3: Solving $ax + b = cx + d$, and 5-6: Solving $ax + b < cx + d$. We made a worksheet for this activity (Appendix B).

The other activity, taught in the library, used TI-83 Graphing Calculators. This activity corresponds to lesson 3-7: Distribution Property in the students' textbook. We taught the students the Distribution Property and we acquainted the students with the use of the TI-83. We made a worksheet for this activity (Appendix B).

We gave the students an evaluation sheet at the end of the period.

Week 3

We taught the students on Wednesday, November 18th, and Friday, November 20th. We taught ten students on Wednesday and eleven students on Friday. We taught the same lesson on both days. We used four computers, approximately three students per computer in the computer lab. The class engaged in two activities. All students worked on Solving Equations with Variables on Both Sides first, and then Solving Inequalities by Multiplying and Dividing.

The first activity was from Grade Builder: Algebra 1. We used lesson 4: Equations: Solving Equations with Variables on Both Sides. This activity corresponded to lesson 5-3: Solving $ax + b = cx + d$ in the students' textbook. We made a worksheet for the students to fill out while working with the software. This worksheet in included in Appendix C.

The second activity was from the same program. We used lesson 5: Inequalities: Solving Inequalities by Multiplying and Dividing. This activity corresponded to lessons 3-10: Solving $ax + c < c$, and 5-6: Solving $ax + b < cx + d$ in the students' textbook. We made a worksheet for the students to fill out while working with the software. This worksheet in included in Appendix C.

We gave the students a quiz on solving equations and inequalities with variables on both sides. This is included in Appendix C. The quiz consisted of six questions. The students had approximately ten minutes to complete the quiz. They were also allowed to ask questions to help them understand the lesson and solve the problems.

We did not give the students an evaluation sheet this week because they had already evaluated the program Grade Builder: Algebra 1 a previous week.

Week 4

We taught the students on Wednesday, December 2nd, and Friday, December 4th. We taught twelve students on Wednesday and twelve students on Friday. We taught the same lesson on both days. Each student used a separate computer. We introduced the students to ClarisWorks spreadsheet program. This activity corresponded to lesson 4:4: Spreadsheets in the students' textbook. We did not make a worksheet for this activity. We had the students print out their document. An example of this document is included in Appendix D.

We gave the students a short quiz on solving equations and inequalities with variables on both sides. . The students had approximately five minutes to complete the quiz. They were also allowed to ask questions to help them understand the lesson and solve the problems.

We gave the students an evaluation sheet at the end of the period.

Week 5

We taught all seventeen of the students on Wednesday, December 9th. The class engaged in two activities. Four groups worked on the computers while the others worked with the TI-83 Graphing Calculators. They worked on one activity for the first half of the period, and then they worked on the other activity for the 2nd half on the period.

One activity was from the Multimedia Algebra Lab program. We used Lab 1: Tools of Algebra, Activity 2: Modeling Relationships with Variables. This activity corresponded to lesson 4-4: Spreadsheets in the students' textbook. We made worksheets for the students to fill out while working on this program (Appendix E).

The second activity corresponded to lesson 4-9: Graphing Linear Patterns in the students textbook. The goal of this lesson was to teach the students how to translate word problems into mathematical expressions. For this activity we used the TI-83 Graphing Calculators. We made a worksheet (Appendix E) for the students to fill out while completing this activity.

We gave the students a quiz on spreadsheets, included in Appendix E. The quiz consisted of four questions. The students had approximately ten minutes to complete the quiz. They were also allowed to ask questions to help them understand the lesson and solve the problems.

We gave the students an evaluation sheet at the end of the period.

Week 6

We taught the entire class on Tuesday, January 26 and Friday, January 29. On January 26, the entire class was in the library. The students worked individually on several activities. One activity was on graphing on the TI-83 Graphing Calculators. This activity corresponded to lesson 5-5: Using an Automatic Grapher. We also gave the students a review sheet on solving equalities and inequalities and a Math Anxiety test. We also gave them a worksheet corresponding to lesson 6-1: The Algebraic Definition of Division.

On Friday, January 29 we taught the entire class in the computer lab. The activity was from Grade Builders: Algebra I. We used lesson 11: Graphing Linear Equations: Slope of a Line. This activity corresponded to lesson 6-2: Rates in the student's textbook.

Appendix D

Description of Period

On Wednesday, November 4th, we arrived at Central Tree Middle School (CTMS) early to ensure that the two programs were installed into the library computer. The computer lab was unavailable for this day. When the students entered the library, the four groups of three students were assigned to a computer. The students had extremely limited space to interact with the computers. Group members had to sit behind each other in order to see the computer screen. The students in the back became easily distracted. They copied the worksheets of the students next to them and chatted about non-related material. The importance of individual work was stressed to the students several times, but the copying did not stop.

A number of students disliked the Grade Builder: Algebra 1 program. They complained that the characters were annoying and the students skipped many of the screens. They then asked simple questions that they had obviously missed in the program. When the program evaluation sheets were analyzed, the Wednesday students' attitudes toward the program were very negative.

The SAT: Math program had a more positive evaluation. The students had been taught the material prior to working with the software and they seemed to enjoy solving problems from this material. The only problem observed was that the academically weaker students did not contribute to their group's worksheet. The stronger students corrected the weaker students' equations. Our objective was to test the students individually as an indication of the students' understanding of the material.

We taught the same lesson plan on Friday, November 6th. However, we were located in the computer lab on Friday. There were approximately three students per computer on four computers. Each of the computers used was in different sections of the computer lab, leaving enough room for each group to interact with their computer. The students enjoyed and understood the lessons more than the Wednesday class. The Friday class progressed faster and asked fewer questions than the Wednesday class. They gave the software higher evaluations.

We taught the entire class on Friday, November 13th. The class was divided into Wednesday's class and Friday's class. One class worked on an activity in the computer lab while the other class worked with TI-83 graphing calculators in the library. They switched activities halfway through the period. The students in the computer lab did not finish the intended lesson due to lack of understanding of the material and time. The students in the library had diverse responses to the TI-83. Many students were completely baffled and needed extra guidance, yet other students breezed through the lesson and started exploring on their own.

On Wednesday, November 18th, the software that was required for the lesson was installed on four computers in the computer lab. There was sufficient space for all group members to interact with the computers.

On both Wednesday, November 18th and Friday, November 20th, two separate lessons were taught from the same program, Grade Builder: Algebra 1. The students were more attentive this week from the previous week. A short quiz was given at the end of the period. The students were separated from each other with at least one chair between each student. This individual work helped us to distinguish the students who

were experiencing problems from the students who understood the material. The students were very cooperative and group work seemed to improve.

On Wednesday, December 2nd, the software for the intended lesson could not be correctly installed on the computers. Therefore, we were forced to create a lesson plan in fifteen minutes. We decided to teach the ClarisWorks spreadsheet program. Each student was able to work on a separate computer. The students were cooperative and attentive, and they seemed to like working with spreadsheets.

On Friday, December 4th, we again taught the ClarisWorks spreadsheet program. The students had a firm grasp of the lesson and progressed rapidly. They often worked ahead. They seemed excited to create their own spreadsheets and they generally gave the program a positive evaluation.

On Wednesday, December 9th, we taught the entire class. This was not our intended plan, but during our Tuesday meeting with Mrs. Linda Limoli, she expressed concern that her students were falling behind schedule. We offered to teach the entire class on Wednesday so that Limoli could give an exam on Friday. The class was divided into Wednesday's class and Friday's class. One class worked on an activity in the computer lab while the other class worked with TI-83 Graphing Calculators in the library. The classes switched activities halfway through the period. The students in the computer lab seemed to understand the material. However, we experienced difficulty running the programs. Many of the computers froze, causing seven students on a computer for a brief period of time. The students in the library had difficulty with the graphing lesson. They only completed a third of the intended lesson.

On Tuesday, January 26th, we taught the entire class. All of the students worked in the library. They were given one activity at a time. When they completed

the first activity they were given the next one and so forth. Activities included a worksheet on graphing with the TI-83 Graphing Calculators, a math anxiety test, and worksheets on solving equalities and inequalities and the algebraic definition of division. Individual work was stressed, and the each student progressed at his or her own pace. As always, we encouraged the students to ask questions. Some students asked many questions. However, other students would not ask for help when they needed it. When, we noticed that these students were falling behind, we would give these students more help. Some students finished all the work that we gave them before the end of the period. Others took the last worksheet home to finish. Overall, we were extremely pleased with the students' work for this period. Everything went smoothly. Therefore, the students seemed to greatly benefit from these activities.

On Friday, January 29th, we again taught the entire class. We had all of the students in the computer lab, and they worked in their original groups. A lesson was taught from the program Grade Builder: Algebra 1. We had this program installed on four more computers, therefore a total of eight computers had this program. We stressed the importance of group work. When a group finished the assigned lesson, the group played either *Death by Algebra* or *Soak your Sibling*. One exceptional group redid the lesson to make sure that they fully understood it. When all groups had finished the lesson, the students took a quiz in the library. The quizzes were given to see how the students individually had benefited from the group work in the computer lab.

Appendix E

Week 1:

November 4, 1998
November 6, 1998

Name_____ Date_____

SAT: Math

Week 1

Directions:

- Click on **6. Linear Equations and Inequalities.**
- Click on **1. General Linear equations.**
- Click on **1. a * x + b = 0.**

Read this screen, and try plugging in several different values for a and b. Consider the equation 6 x + 6 = 20.

What is a equal to? a = _____. What is b equal to b? b = _____.

What are a and b? variables constants equations expressions

What is x? variable constant equation expression

Show your work below:

What is your answer? x = _____.

- When finished, click on the door.
- Click on **2. Exercises.**
- Solve 10 equations.

1.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

2.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

3.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

4.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

5.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

6.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

7.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

8.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

9.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

10.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

- When finished, click on the door.
- Click on **3. Exercises.**
- Solve 10 equations.

1.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

2.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

3.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

4.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

5.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

6.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

7.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

8.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

9.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

10.a.) Initial equation: _____

b.) Solve the equation (show work below and circle your final answer):

When your group is done, call over one of the tutors.

Name_____ Date_____

Grade Builders: Algebra I

Week 1

Directions: Click on **Run Grade Builder**. Log in with your assigned Group Number.
Click on:

Start Session
Lessons
4. Equations
Solve Equations Using More Than One Operation.

Light 1: Listen.

Light 2: Listen. Stop.

$4x + 5 = 9$

$x =$ _____

Light 3: Listen.

Light 4: Listen. Stop. Write the equation to the question:

_____

Solve the equation (show your work):

How much money did you have in the beginning? _____

Light 5: Listen.

Light 6: Listen. Stop. Is your equation right (be honest)? Yes No

Light 7: Listen.

Light 8: Listen.

Light 9: Listen. Stop. Solve the equation on the screen. Show your work below:

What is your answer? d = _____.

Light 10: Listen. Stop. Is your answer correct (be honest)? Yes No

Light 11: Listen. Stop. Solve the following equation and show work below:

What is your answer? _____.

Light 12: Listen. Stop. Solve the following equation and show work below:

What is your answer? _____

Light 13: Solve the given equations (12). What is your score (ex. 9/12)? _____

When your group is done, call over one of the tutors.

Appendix F

Week 2:

November 13, 1998

Name _____ Date _____

Grade Builders: Algebra 1

Week 2

Directions:

Click on: 5. Inequalities
Solving Inequalities by Adding and Subtracting

Light 1: Listen and stop.

Write the four inequality properties for addition and subtraction:

_____

_____

_____

_____

Light 2: Listen and stop.

How much did he spend on other purchases? Write the inequality:

_____

Solve in the space provided:

How much did he spend on other purchases?

_____

Light 3: Listen and stop.

Was your equation right (be honest)? Yes No

Light 4: Listen and stop.

How would you solve for x?

$2x \geq x + 4$

A. Add x to both sides
B. Subtract 4 from both sides
C. Subtract x from both sides
D. Add 4 to both sides

Light 5: Listen and stop.

Was your answer right on the first try? Yes No

Light 6: Listen and stop.

Solve this inequality:

Show work in the space provided:

Solve this inequality:

Show work in space provided:

Light 7: Listen.

Light 8: Drill.

Decide what to do to both sides of the inequality.

A. Add an integer B. Subtract an integer C. Subtract a variable

1. Write the inequality: _____

   What was your answer? A. B. C.

   Was your answer right? Yes No

2. Write the inequality: _____

   What was your answer? A. B. C.

   Was your answer right? Yes No

3. Write the inequality: _____

   What was your answer? A. B. C.

   Was your answer right? Yes No

4. Write the inequality: _____

   What was your answer? A. B. C.

Was your answer right? Yes No

5. Write the inequality: _____

What was your answer? A. B. C.

Was your answer right? Yes No

6. Write the inequality: _____

What was your answer? A. B. C.

Was your answer right? Yes No

7. Write the inequality: _____

What was your answer? A. B. C.

Was your answer right? Yes No

8. Write the inequality: _____

What was your answer? A. B. C.

Was your answer right? Yes No

9. Write the inequality: _____

What was your answer? A. B. C.

Was your answer right? Yes No

10. Write the inequality: _____

What was your answer? A. B. C.

Was your answer right? Yes No

How many did your group get right? _____ out of 10

Do not play Death by Algebra. Do something else.

Click on: 5. Inequalities
Solving Inequalities by Multiplying and Dividing

Light 1: Listen and stop.
Write the four inequality properties for multiplying and dividing:

Light 2: Listen and stop.

How many quarts of oil can you buy for $5 if oil costs $1.50 per quart?

A. 3
B. 4
C. 5
D. 6

Was your answer right on the first try (be honest)? Yes No

Light 3: Listen.

Light 4: Listen and stop.

Solve this inequality.

Show your work below.

Light 5: Listen and stop.

Write the inequality properties for multiplying and dividing by a negative number.

So what should you do with the inequality when multiplying or dividing by a negative number? _____ _____ _____

Light 6: Listen and stop.

Solve for x: $2x < 4x - 6$

A. $3 < x$
B. $x < 3$
C. $x < -3$
D. $x > 3$

Light 7: Drill.

Which sign goes in the blank?

A. > B. <

1. Write the inequality: _____

   What was your answer? A. B.

   Was your answer right? Yes. No.

2. Write the inequality: _____

   What was your answer? A. B.

   Was your answer right? Yes. No.

3. Write the inequality: _____

   What was your answer? A. B.

   Was your answer right? Yes. No.

4. Write the inequality: _____

   What was your answer? A. B.

   Was your answer right? Yes. No.

5. Write the inequality: _____

   What was your answer? A. B.

   Was your answer right? Yes. No.

6. Write the inequality: _____

   What was your answer? A. B.

   Was your answer right? Yes. No.

7. Write the inequality: _____

   What was your answer? A. B.

Was your answer right? Yes. No.

8. Write the inequality: _____

What was your answer? A. B.

Was your answer right? Yes. No.

9. Write the inequality: _____

What was your answer? A. B.

Was your answer right? Yes. No.

10. Write the inequality: _____

What was your answer? A. B.

Was your answer right? Yes. No.

How many did your group get right? ____ out of 10

When you are done, call over one of your tutors.

Name_____ Date_____

TI-83 Worksheet

Week 2

Listen to explanation.

The Distributive Property and Removing Parentheses

For all real numbers a, b, and c:

$c(a + b) = ca + cb$

$c(a - b) = ca - cb$

Ex) Show on the TI-83:

$45(30 + 7) = (45)(30) + (45)(7) = (45)(37)$

Ex) Textbook: p.32: Example 1.

Solution: b

Press:

2^{nd}

$\sqrt{}$

196

ENTER

Check:

Press:

14

x^2

ENTER

Ex)

Press:

MODE

Arrow down to FLOAT; Arrow over to 5

ENTER

2^{nd}

QUIT

2^{nd}

$\sqrt{}$

2

ENTER

MODE

Arrow down to FLOAT; Arrow over to 9

ENTER

2^{nd}

QUIT

2^{nd}

$\sqrt{}$

2

ENTER

MODE

Arrow down to FLOAT

ENTER
2^{nd}
QUIT
2^{nd}
√
2
ENTER

Ex)

Press:

4 * 3 * 2
ENTER

Answer: _____

Press:

4 * 3
ENTER
2^{nd}
ANSWER
*
2
ENTER

Answer: _____

Ex)

Press:

4 / 2 + 1
ENTER

Answer: _____

Press:

4 / 2
ENTER
2^{nd}
ANSWER
+
1
ENTER

Answer: _____

Graphing:

Press:

Y =

Enter:

2 * x + 3

Press:

WINDOW

Listen to instructions.

Enter values: -10, 10, 0, -10, 10 and 0.

Listen to instructions:

TRACE

ZOOM (IN and OUT)

TABLE

Appendix G

Week 3:

November 18, 1998
November 20, 1998

Name _____ Date _____

Grade Builders: Algebra 1

Week 3

Solving Equations with the Variables on Both Sides

Click on 4. Equations.
Click on Solving Equations with the Variables on Both Sides.

Light 1: Listen.
Light 2: Listen.
Light 3: Listen.
Light 4: Listen and stop.
Collect the variables:
If $3d + 4 = 15 - 8d$, then: _____.

Light 5: Listen.
Light 6: Listen.
Light 7: Listen and stop.

Equation 1: _____.
A) -x B) 7x C) 2x

Equation 1: _____.
A) -x B) 7x C) 2x

Equation 2: _____.
A) -x B) 7x C) 2x

Equation 3: _____.
A) -x B) 7x C) 2x

Equation 4: _____.
A) -x B) 7x C) 2x

Equation 5: _____.
A) -x B) 7x C) 2x

Equation 6: _____.
A) -x B) 7x C) 2x

Equation 7: _____.
A) -x B) 7x C) 2x

Equation 8: _____.
A) -x B) 7x C) 2x

Equation 9: _____.

A) -x B) 7x C) 2x

Equation 10: _____.

A) -x B) 7x C) 2x

How many did your group get right? _____ out of 10.

Name _____ Date _____

Grade Builders: Algebra 1

Week 3

Click on: 5. Inequalities
Solving Inequalities by Multiplying and Dividing

Light 1: Listen and stop.
Write the four inequality properties for multiplying and dividing:

_____

_____

_____

_____

Light 2: Listen and stop.
How many quarts of oil can you buy for $5 if oil costs $1.50 per quart?

A. 3
B. 4
C. 5
D. 6

Was your answer right on the first try (be honest)? Yes No

Light 3: Listen.

Light 4: Listen and stop.
Solve this inequality:
Show your work below.

Light 5: Listen and stop.
Write the inequality properties for multiplying and dividing by a negative number.

_____

_____

_____

_____

So what should you do with the inequality when multiplying or dividing by a negative

number? _____ _____ _____

Light 6: Listen and stop.

Solve for x: $2x < 4x - 6$

A. $3 < x$

B. $x < 3$

C. $x < -3$

D. $x > 3$

Light 7: Drill.

Which sign goes in the blank?

A. > B. <

1. Write the inequality: _____

   What was your answer? A. B.

   Was your answer right? Yes. No.

2. Write the inequality: _____

   What was your answer? A. B.

   Was your answer right? Yes. No.

3. Write the inequality: _____

   What was your answer? A. B.

   Was your answer right? Yes. No.

4. Write the inequality: _____

   What was your answer? A. B.

   Was your answer right? Yes. No.

5. Write the inequality: _____

   What was your answer? A. B.

Was your answer right? Yes. No.

6. Write the inequality: _____

What was your answer? A. B.

Was your answer right? Yes. No.

7. Write the inequality: _____

What was your answer? A. B.

Was your answer right? Yes. No.

8. Write the inequality: _____

What was your answer? A. B.

Was your answer right? Yes. No.

9. Write the inequality: _____

What was your answer? A. B.

Was your answer right? Yes. No.

10. Write the inequality: _____

What was your answer? A. B.

Was your answer right? Yes. No.

How many did your group get right? ____ out of 10

When you are done, call over one of your tutors.

Name _____Date _____

Quiz 1

1.) $3x=2x+22$

2.) $5x-6=-3x+2$

3.) $4x<2x+1$

4.) $7x<2x+10$

5.) $5x\geq-8x+12$

Bonus: What do you do when you multiply an inequality by a negative?

Appendix H

Week 4:

December 2, 1998
December 4, 1998

Name _____ Date _____

Quiz 2

Solving Equalities and Inequalities
Show all work.

1) $-3x + 6 > 18$

2) $5x + 12 = -x$

3) $7x + -3 < 18$

Appendix I

Week 5:

December 9, 1998

Name _____ Date _____

Multimedia Algebra

Week 5

Lab 1: Activity 2

1.a. Write a variable expression for the number of people riding the buses:

_____.

1.b. What value did you use to represent the number of buses?

_____.

1.c.

1.d. Circle: YES NO. Why or why not?

_____.

2.a. Write a variable expression for the number of people riding in cars:

_____.

2.b. What value did you use to represent the number of cars?

_____.

2.c. What expression did you input?

_____.

3.a. What expressions did you input into cells E2 and F2 to represent the number of trucks and people in trucks?

E2: _____.

F2: _____.

3.b. Write a variable expression for the total number of buses (b), cars (c), and trucks (t):

_____.

3.c. What expression did you input into cell G2?

_____.

4.a. What expression did you input?

_____.

4.b.

4.c. What is the total number of vehicles on the road now?

_____.

4.d. How many people are traveling on the highway?

_____.

5.a. Write a summary of your results:

_____

_____

_____.

5.b. If all of the 35, 000 people road buses, what would be the total number of buses on the road? _____.

5.c. If everyone rode in cars, what would be the total number of vehicles on the road?

_____.

6.a. How did you change the expression in cell D2 to show more people per car?

_____.

6.b. Write a summary of your results:

_____

_____

_____.

Name_____ Date_____

Graphing Linear Patterns

Week 5

After graphing the linear equations on this worksheet, graph the linear equations on your TI-83 graphing calculator. Call over one of the tutors to check your work.

Suppose Julie begins with $40 in the bank and adds $15 to her account each week. Let t be the total amount in her account at the end of w weeks. Write the equation the describes the amount of dollars she will have in her account at the end of w weeks.

_____

Fill in the table and graph the above equation.

w	t

Kenda begins with 14 empty cans of Pepsi. She drinks 3 cans of Pepsi a day. Write a linear equations showing the amount of e empty Pepsi cans she will accumulate after d days.

Fill in the table and graph the above equation.

d	e

a.) Draw the graph of $y = 5x$. Chose your own values of x.

b.) On the same grid you used in part a, draw the graph of $y = -5x$.

c.) At what point(s) do the graphs of parts a and b intersect?

Name _____ Date _____

Quiz 3

Spreadsheets

	A	B	C	D	E	F
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

1.) Circle a column.
2.) Box a row.
3.) Put your name in a cell.

	A	B	C	D	E
1	**Student**			**Age**	
2	Joe		13		
3	Carl		20		
4	Chris		25		
5	Matt		12		
6	Ashley		4		
7	Scott		17		
8	Kevin		40		
9	Jose'		35		
10	Mary		65		
11	Beth		2		
12					
13					

4.) What is the formula to find the average age of the students? (Note: we are looking for a formula, not an answer.)

_____

Appendix J

Week 6:

January 26, 1999
January 29, 1999

Name: _____ Date: Jan. 26, 1999

Week 6: Lesson 5-5 Using an Automatic Grapher -- pg. 310

Read pages 310 and 311 in your book. When you get to **Example 1**, follow the instructions to graph the equation $y = 4x - 5$. When you get the graph, call over one of the instructor's and get one of their initials here --> _____ Do not continue until you have your graph checked with one of your instructors!

Try **Activity 1** on the bottom of page 311. Copy the graph on the grid below.

Describe one thing your graph has in common with the graph in **Example 1**.

_____

_____

_____

Try **Example 2**. Read through the ENTIRE solution. Make sure you understand what is going on!! If you have problems, please don't be afraid to ask for help!

Now do **Activity 2**. Draw your graph in the space provided below.

Write the coordinates of three points that are on your graph.

_____ _____ _____

Now try **Example 3**. Once you have graphed both equations and found the point of intersection, call over one of the instructors and get their initials --> _____

Do not continue until you have had your graphs checked!!

Answer the following problems and be sure to show all of your work!

1. On an automatic grapher:

A. What is a window? _____

B. What is a default window? _____

2. What are the dimensions of the default window on your graphing calculator?

_____

In questions **3 - 5**, tell whether the equation is in a form with which it can be entered into your grapher.

3. $y = 4 + 3x^2$ Yes No

4. $y = 2.7x$ Yes No

5. $y = x - y = 7$ Yes No

6.

A. Graph the solutions to $x + y = 90$ on three different windows.

B. **True** or **False**. The point (5,85) in on each of graph you drew in part **A**.____

C. Trace along the graph from the left to right with a cursor. Describe what happens to the x- and y- coordinates.

_____

_____

_____

Name: _____ 1/26/99

Review Sheet: **Solving equalities and inequalities**

1) $5x + 2 = 11x + (-7)$

2) $3a + (-6) = 9 + 4a$

3) $7x + (-14) \leq 2x + (-1)$

4) $5x + (-14) > 7x + 2$

5) $(4/7)c + (2/7) = 1$

6) $-3y \leq 2y + 25$

Extra Credit: $-3x + (1/4) < (7/12)$

Do You Have Math Anxiety?

A Self Test

Rate your answers from 1 to 5; add them up and check the key below.

(1) = Disagree, (5) = Agree

1. I hate math class. **1 2 3 4 5**
2. Math isn't so tough now; but, it's going to get really hard soon. **1 2 3 4 5**
3. I tune out in math class. I don't mean to do it -- it just happens. **1 2 3 4 5**
4. I don't really like asking my math teacher questions. **1 2 3 4 5**
5. I panic when called on in math class. **1 2 3 4 5**
6. I worry much more about math tests than any other kind. **1 2 3 4 5**
7. I can't wait until I don't have to take any more math. **1 2 3 4 5**

Scoring Key:

28 - 35 Yep! You've got it. Check our 10 hints on how to reduce math anxiety.

21 - 27 Not exactly comfortable with math, huh?

14 - 20 Hanging loose.

7-13 Whew! Cool as a cucumber!

Name: _____ Date: Jan. 26, 1999

The Algebraic Definition of Division

Simplify:

1) $(x/7) \div (5/6)$

2) $(2\pi) \div -(\pi/10)$

3) Solve:

$-16m = 128$

Name _____ Date _____

Grade Builder: Algebra 1

11. Graphing Linear Equations
Slope of a Line

Light 1: Listen and stop.

Slope = rise / run = vertical / horizontal = - 1/4.

Why is the slope negative? _____.

Light 2: Listen.

Light 3: Listen and stop.

What is the slope of the staircase? _____.

Light 4: Listen.

Light 5: Listen and stop.

Circle the correct answer:

Rise =	x-axis	y-axis
Run =	x-axis	y-axis

Given point one: (-5, -3) and point two: (4, 5).

Light 6: Listen and stop.

What do you think that happens when the slope becomes zero

_____.

Light 7: Listen and stop.

Were you right? _____.

What does happen when the slope is zero (horizontal)?

_____.

What happens when the slope is vertical? __-

_____.

Light 8: Drill

1. Write the problem: _____

   What was your answer? A. B C

   Was your answer right? Yes. No.

2. Write the problem: _____

   What was your answer? A. B C

   Was your answer right? Yes. No.

3. Write the problem: _____

   What was your answer? A. B C

Was your answer right? Yes. No.

4. Write the problem: _____

What was your answer? A. B C

Was your answer right? Yes. No.

5. Write the problem: _____

What was your answer? A. B C

Was your answer right? Yes. No.

6. Write the problem: _____

What was your answer? A. B C

Was your answer right? Yes. No.

7. Write the problem: _____

What was your answer? A. B C

Was your answer right? Yes. No.

8. Write the problem: _____

What was your answer? A. B C

Was your answer right? Yes. No.

9. Write the problem: _____

What was your answer? A. B C

Was your answer right? Yes. No.

10. Write the problem: _____

What was your answer? A. B C

Was your answer right? Yes. No.

How many did your group get right? ____ out of 10

When you are done, call over one of your tutors.

Appendix K

Pre-Evaluation Survey Results

Algebra I (8:15 – 9:15)

Total number of students: 24

Male: 11/24

Female: 13/24

8th Grade: 18/24

M: 6/18

F: 12/18

7th Grade: 6/24

M: 4/6

F: 2/6

Total number of students with older siblings: 7/24

Male: 3/7 **Female:** 4/7

Total number of students with employed parents: 17/24

Male: 6/17 **Female:** 11/17

Total number of students who participate in after school activities: 18/24

Male: 10/18 **Female:** 8/18

Total number of students who enjoy math: 7/24

Male: 7/7 **Female:** 0/7

Total number of students who took Pre-Algebra: 19/24

Male: 7/19 **Female:** 12/19

Total number of students who prefer group work to individual work: 18/24

Male: 9/18 **Female:** 9/18

Total number of students who plan to attend college: 24/24

Male: 11/24 **Female:** 13/24

Total number of students who have used a computer: 24/24

Male: 11/24 **Female:** 13/24

Total number of students who have a computer at home: 24/24

Male: 11/24 **Female:** 13/24

Total number of students with Internet access: 18/24

Male: 6/18 **Female:** 12/18

Algebra I (10:00 – 11:00)

Total number of students: 13

Male: 9/13

Female: 4/13

Total number of students with older siblings: 8/13

Male: 7/8 **Female:** 1/8

Total number of students with employed parents: 12/13

Male: 9/12 **Female:** 3/12

Total number of students who participate in after school activities: 11/13

Male: 8/11 **Female:** 3/11

Total number of students who enjoy math: 7/13

Male: 7/7 **Female:** 0/7

Total number of students who took Pre-Algebra: 13/13

Male: 9/13 **Female:** 4/13

Total number of students who prefer group work to individual work: 10/13

Male: 7/10 **Female:** 3/10

Total number of students who plan to attend college: 13/13

Male: 9/13 **Female:** 4/13

Total number of students who have used a computer: 13/13

Male: 9/13 **Female:** 4/13

Total number of students who have a computer at home: 13/13

Male: 9/13 **Female:** 4/13

Total number of students with Internet access: 9/13

Male: 7/9 **Female:** 2/9

Post-Evaluation Survey Results

Algebra 1 (8:15- 9:15)

Total number of students: 20

Male: 8/20 **Female:** 12/20

8th Grade: 15/20

M: 5/20 **F:** 10/20

7th Grade: 5/20

M: 3/5 **F:** 2/5

Total number of students with older siblings: 6/20

Male: 2/6 **Female:** 4/6

Total number of students with employed parents: 18/20

Male: 6/18 **Female:** 12/18

Total number of students who participate in after school activities: 16/20

Male: 6/16 **Female:** 10/16

Total number of students who enjoy math: 9/12

Male: 5/9 **Female:** 4/9

Total number of students who prefer group work to individual work: 16/20

Male: 7/16 **Female:** 9/16

Total number of students who plan to attend college: 20/20

Male: 8/20 **Female:** 12/20

Total number of students who prefer to use a scientific calculator: 3/19

Male: 2/3 **Female:** 1/3

Total number of students who prefer to use a graphing calculator: 16/19

Male: 6/16 **Female:** 10/16

Total number of students who prefer using TI-83 Graphing Calculators in the classroom everyday: 16/20

Male: 8/16 **Female:** 8/16

Total number of students who like using computers: 19/20

Male: 7/19 **Female:** 12/19

Total number of students who enjoy using computers in the classroom: 16/20

Male: 6/16 **Female:** 10/16

Total number of students who prefer using computers in the classroom every day: 13/20

Male: 6/13 **Female:** 7/13

Algebra 1 (10:00- 11:00)

Total number of students: 13

Male: 9/13 **Female:** 4/13

8th Grade: 13/13

Total number of students with older siblings: 8/13

Male: 7/8 **Female:** 1/8

Total number of students with employed parents: 12/13

Male: 9/12 **Female:** 3/12

Total number of students who participate in after school activities: 11/13

Male: 8/11 **Female:** 3/11

Total number of students who enjoy math: 9/13

Male: 6/9 **Female:** 3/9

Total number of students who prefer group work to individual work: 11/13

Male: 7/11 **Female:** 4/11

Total number of students who plan to attend college: 13/13

Male: 9/13 **Female:** 4/13

Total number of students who prefer to use a scientific calculator: 12/13

Male: 9/12 **Female:** 3/12

Total number of students who prefer to use a graphing calculator: 1/13

Male: 0/1 **Female:** 1/1

Total number of students who prefer using TI-83 Graphing Calculators in the classroom everyday: 6/13

Male: 5/6 **Female:** 1/6

Total number of students who like using computers: 13/13

Male: 9/13 **Female:** 4/13

Total number of students who prefer using computers in the classroom every day: 10/13

Male: 8/10 **Female:** 2/10

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