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Technology : The Positive And Negative Effects On Student Achievement

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**Technology: The Positive and Negative Effects on Student Achievement and the
Various Types of Technology that Increase a Student's Ability to do Work**

by

Jennifer Lyn Flanagan

A thesis submitted to the Department of Education and Human Development of the
State University of New York College at Brockport in partial fulfillment of the
requirements for the degree of Master of Science in Education

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Various Types of Technology that Increase a Student's Ability to do Work**

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Abstract

Technology is the technical means people use to improve their surroundings. People use technology to improve their ability to do work. Classrooms around the world have implemented many forms of technology to enhance student interest and achievement. One form of technology that is common to math classrooms is the graphing calculator. One eighth grade math class of nineteen students from an urban middle school was taught a unit on Solving Systems of Equations by Graphing. The unit was implemented with and without the use of the graphing calculator. Students were first introduced to the unit through the use of pencils and graph paper. All the graphing was done by hand and students had to determine the solutions of the systems of equations by proper graphing techniques. The students were then tested at the end of the unit. Students were then given the same unit but were now able to use the graphing calculator as a means to enhance their learning of Solving Systems of Equations through graphing. Students were then tested again but this time they were able to use the graphing calculator during the test. Student achievement for the unit had risen and grades on the assessments had increased due to the presence of technology. Student engagement and interest had also increased due to the presence of technology.

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Chapter One: Introduction

Technology is the technical means people use to improve their surroundings. People use technology to improve their ability to do work. Classrooms around the world have implemented many forms of technology to enhance student interest and achievement. The NCTM Position Statement (1996) states:

“Research and experience have clearly demonstrated the potential of calculators to enhance students’ learning in mathematics. The cognitive gain in number sense, conceptual development, and visualization can empower and motivate students to engage in true mathematical problems solving at a level previously denied to all but the most talented. The calculator is an essential tool for all students in mathematics.”

Technology can be seen in many forms. From the basic four function calculator or graphing calculator to assistive technology for students with learning disabilities.

“Technology is a major catalyst for increasing learning” (Isernhagen, 1999, 30).

Much has been written about how to use technology to increase student achievement.

A number of new technologies are emerging to support and enhance learning in our schools. Many of these technologies are not used to replace traditional teaching methods, but instead used as simple methodologies to enhance student learning (Riley, Beard and Strain, 47).

Research has shown both positive and negative affects on student achievement through the implementation of technology. This area of research is very significant due to the changing world of technology. Teachers and administrators are constantly

searching for new ideas to make classrooms more technology-friendly. Mastering technology can transform a classroom (Davis, 1997, 49). Can we make better students through the use of technology? “Skills cannot be acquired through simply teaching facts but, instead, can be acquired by providing the learner with an opportunity to interact with the content, define learning goals, and explore new understandings through authentic, challenging tasks” (Isernhagen, 1999, 30). The purpose of this study is to compare the affects that technology has on student achievement. More specifically, the areas of inquiry include positive and negative affects on student achievement and the various types of technology that can increase or decrease a student’s ability to do work in the classroom.

Chapter Two: Literature Review

Various studies have sought to determine the affects of the use of technology on student achievement. Studies have found both positive and negative affects of technology on student achievement. The ideal goal for educators is to implement technology in the classroom and see definite positive affects on student achievement. June Jones from the University of Georgia conducted a study on problem-solving using graphing calculators. The purpose of the study was to see how the use of graphing calculators affected problem-solving (Jones, 1997, 1). Fifty-six students were chosen from three freshman pre-calculus algebra classes at Macon College. Their ages ranged from 18 to 68 and the only prerequisite for the course was high school Algebra II or College Developmental Studies Algebra. The survey consisted of three parts. Part I was a series of personal information questions. Part II was an attitude survey and Part III consisted of six problems complete with instructions (Jones, 1997, 3). Each of the six questions was analyzed in relation to difficulties and the students were also asked for each question if they used a calculator. The results of the survey indicated that problems that involved easy arithmetic, students did not use the calculator or in some cases students just used the calculator to mainly check their answers. Question six had involved a question with domain and range and asked the students to produce a graph of the function. The students that used the graphing calculator were apparent because they produced a solid line when in turn they were just asking for five sets of points. Those forty students were obviously lacking comprehension of what the problem was asking and instead relied on the

calculator for a response. This study found that students do not instinctively use and understand graphs just because they have a graphing calculator (Jones, 1997, 5).

Students had seemed to just rely on the calculators for checking basic arithmetic.

Technology is a great tool to enhance student achievement, but is it actually being used in classrooms and is it being used properly? A study conducted by Eric Milou in 1997 examined whether algebra teachers were currently using graphing calculators in their classrooms, their perceptions toward the technology, and any changes in the curriculum or instructional practices. The participants in the study were high school and middle/junior high school teachers in a large northeastern US city (Milou, 1997, 2). The region was selected solely because of its diverse population, including urban and suburban schools. The study involved surveys that were to be completed by teachers in the 51 out of 61 school districts that were asked to participate. Of the 243 surveys, 146 were returned, for an average return rate of 60% (Milou, 1997, 2). The findings indicated that the use of the graphing calculator is still controversial to many algebra teachers. The majority of the teachers did respond in saying that the graphing calculator is a great motivational tool for students (Milou, 1997, 4). The study also found that the successful integration of the graphing calculator into the mathematics classroom cannot take place without the aid of enthusiastic teachers. Teachers' perceptions of the graphing calculator and its use in the classroom are paramount (Milou, 1997, 4).

Garthwait and Weller (2005) conducted a study on the effects of one-to-one computing in constructing curriculum and delivering instruction. More than 17,000

seventh grade students and their teachers in 243 middle schools received laptops. The researchers had sought to examine the effects of using laptops in the classroom. The study also looked into examining the facilitators and barriers for teachers using laptops in the classroom (Garthwait and Weller, 2005, 362). The study found that students were more willing to think through conceptual mistakes and make the requisite changes on their laptops. Teachers found themselves conducting brief and clear introductions so that students could quickly begin using their laptops to complete the active learning assignments (Gathwait and Weller, 2005, 362). This study provides evidence that students are more eager to learn due to the presence of the laptop. Motivation is the key to students increased ability to learn and promote academic achievement. In Harold Wenglinsky's National Study of Technology's Impact on Mathematics Achievement, Wenglinsky found that students who used higher order thinking software showed gains in math scores of up to fifteen weeks above grade level as measured by NAEP (Wenglinsky, 1998). Wenglinsky controlled for socioeconomic status, class size, and teacher characteristics. Thus, all relationships between technology and educational outcomes reported represented the value added by technology for comparable groups of students with comparable teachers in comparable class sizes. The study consisted of a national sample of 6,227 fourth graders and 7,146 eighth graders on the National Assessment of Educational Progress. Another finding was that higher order uses of computers and professional development were positively related to students' academic achievement in mathematics for both fourth and eighth grade students. Use of computers mainly for

simulations and applications resulted in higher math achievement (Wenglinsky, 1998).

Computers seem to be the big craze of the century. Computers are in almost every classroom around the world, whether at each students desk or at least at every teachers desk. In the James Kulik Study (1994), the researcher used a technique called meta-analysis to aggregate the findings from more than 500 individual studies of computer-based instruction. Computer based instruction individualizes the educational process to accommodate the needs, interests, and learning styles of each student (Kulik, 1994, 4). The study found that students who used computer-based instruction scored at the 64th percentile on test of achievement compared to students in the control conditions without computers who scored at the 50th percentile. This study helps to show that student achievement can be affected positively especially through assessment scores. Students also tend to like their classes more and develop more positive attitudes towards learning which results in positive academic achievement. Jay Sivin-Kachala (1998) reviewed 219 research studies from 1990 to 1997. Sivin-Kachala assessed the affects of technology on learning and achievement. The only downfall to this review is that the actual studies are not at our fingertips. The article just focused on the review of the studies. The article also does not provide the specific types of technology being researched. The positive findings were that students in technology rich environments experienced positive affects on achievement in all major subject areas and they showed increased achievement in preschool through higher education for both regular and special needs children (Sivin-Kachala,

1998, 5). Further research could involve students in a smaller setting and with various types of technology to improve its credibility.

Technology is not just a device to make a classroom come more alive, but can also come in the form of “Assistive Technology.” An Assistive Technology Device is any item, piece of equipment, or product system that is used to increase, maintain, or improve functional capabilities of students with disabilities (Riley, Beard and Strain, 2001, 47). Assistive Technology is available for students with disabilities as well as students who don’t have identifiable disabilities. This type of technology can promote positive student achievement for those students that lack the basic mathematical skills. The article states that there are many forms of technology that can promote academic achievement. These students are unable to take advantage of important learning tools such as: colored tiles, cubes, pattern blocks, and geoboards. The article explains that virtual manipulatives are offered to classroom teachers as a technology alternative. This provides students with the opportunity to work with on-screen manipulatives similar to those found in most classrooms. That way all students can be accommodated with the proper technological tools to enhance student achievement. This article relates to the current study because it provides the necessary technology devices and services for students with learning disabilities. These devices obviously can help to improve a student’s academic achievement. These technology devices can be further researched specifically to determine the actual outcomes on student achievement. Can students benefit from these on-screen

manipulatives? If so what methods are necessary to research the academic achievement of students with disabilities?

Researchers have also sought to find the negative impacts on student's achievement through the use of technology. Technology has not always been promising within the classroom. Technology is a tool that should enhance student learning and achievement. Computer-assisted instruction (CAI) is a widely studied and supported method of teaching. Numerous review articles have been published showing small but positive effects on student achievement (Vogel, Greenwood-Ericksen, Cannon-Bowers, Bowers, 2006, 105). A subcategory of CAI is learning games that provide motivation, reward, interactivity, score, and challenge. The study involved 44 children ages 7 to 12 from a public elementary school in Florida. The control group was taught with the CAI Program and the experimental group was given the opportunity to experience virtual reality. The school was chosen because of its unique computer lab devoted to virtual reality programs for educational settings. Teachers had received no instruction on the computers; however, students were given basic directions. Students were given pre and posttests that were fifteen questions in length. Researchers were comparing the affects of computer programs with gaming attributes or virtual reality. The study found that the control group performed better on the math posttest compared to the pretest. Using a 2-tailed test, which compared the control group versus the experimental group in the math section, there was a significant difference in changed scores. This suggests that the children using the traditional CAI Program learned more than the experimental group with the gaming

attributes (Vogel, Greenwood-Ericksen, Cannon-Bowers, and Bowers, 2006, 110).

Therefore the study showed that the learning-game format not only failed to improve math skills, but actually negated the improvement resulting from the use of the CAI system altogether. Technology overall in this study did not seem to result in positive student achievement. Previous studies had shown positive results in student achievement due to the presence of the CAI Program. Further studies could compare the use of technology compared to the use of traditional teaching and there might be more promising outcomes and results.

Technology has proven to increase student achievement. In an article by Charles F. Kiehl and B. Ann Harper of SUNY Brockport, hand-held calculators were the main focus. The article provided advantages and disadvantages on the use of the calculator in the classroom. Some educators are afraid that children will not learn the basic mathematical skills and will become dependent on the calculator to perform those operations (Kiehl and Harper, 2001, 18). This article relates to the current study by giving a framework on the advantages and disadvantages of using technology in the classroom. Are we actually helping students by providing them with calculators to enhance student achievement or are we replacing the learning process with a hand-held device? The article focuses on the various techniques that teachers could use to improve a students understanding of the mathematical content. Calculators should be used to enable students to perform operations more quickly and accurately. Educators can find many things to do with the calculators. Some activities can become less appealing if the calculator is absent. The calculator itself

does not promote academic achievement. Future research should show the affects the calculator has on children's learning of mathematics.

Chapter Three: Applications and Evaluation

Introduction

The target group for this research study was a class of urban eighth grade math students. These students were in a ninety minute block schedule and scored either a 1 or 2 on the Math 7 State Test. These students had been given block scheduling to try and create higher achievers within a longer class time. These students were very motivated and eager to learn in math class.

I decided to involve these students in my study because of the longer class time which would mean that the unit of Solving Systems of Equations by Graphing would only take up about three or four days instead of a whole week. A ninety minute block would mean two lessons per day. This class was also very eager to learn about the graphing calculators. They had seen me using them with the Integrated Algebra class and wondered if they could try some graphing in class. This drove my research of using graphing calculators in the eighth grade class to help to enforce the concept of graphing systems of equations and seeing if and where two lines will intersect.

Participants

The participants were nineteen multi-racial students enrolled in an urban middle school eighth grade math class. There are thirteen females and six males, ranging from ages thirteen to sixteen, when all students are present. These students are in a College Preparatory School. Students are required to wear uniforms and the school is designed so students will already have some college credits before they start

their college career. The class is designed around a “Coach Book Curriculum.” The Coach Books are designed to align the units and lessons around the New York State Standards.

I am a math teacher with my provisional certificate in secondary mathematics. I have been teaching eighth grade math for one year but have been teaching math in this urban middle school for six years.

Procedures of Study

I decided to use technology as a means to drive this study because of the frustration students would possess with the lack of technology in our classrooms. Math 8 students are only allowed to use calculators on the Short and Extended-Response questions on their exams. With this in mind, the students were given a survey at the start of the study to actually see what they know about technology and what types of technology they would like to see used in the classroom. These students had only been exposed to the basic scientific calculator in which they were able to use on the State Test and on in-class exams. I felt that as an educator and knowing my students that they would be able to handle using the graphing calculators that I had already been using for my eighth grade honors students (Integrated Algebra).

Students were first introduced to a five day unit on Solving Systems of Equations by Graphing in March. They were able to graph two linear equations using pencil and graph paper and had to determine, if any, points of intersection (solutions

to the systems of equations). Students were then tested on their knowledge of the content and grades were entered in the grade book.

Graphing calculators were then introduced as a means of technology and to enhance student achievement as a review unit on Solving Systems of Equations. The review unit was presented to the students in May. This time when the unit was presented, students were able to use the calculators to graph and check points of intersection through use of the intersect feature on the calculator. Students were also introduced to the table feature in which they could see what the point of intersection was for the two lines. Students were also able to use the technology on the review test given at the end of the unit. The assessment used was the same test used in March. Those grades were also entered in the grade book during the review unit. The grades were then compared to see if student achievement had increased due to the presence of technology.

Instruments for Study

Technology surveys were given before the research to actually see what students knew about technology inside and outside the classroom. The focus was to get students opinions about different forms of technology and what they think would enhance and increase student achievement in the math classroom. These surveys also had provided valuable feedback on how to make my lessons more interesting for the upcoming school year. The survey results would also be discussed in upcoming staff or department meetings that would help the implementation of technology in the future.

Tests were also very important in this study to actually determine if student achievement would increase due to the presence of technology compared to the absence of technology for the same unit of study. The same test was used at the end of both units of study. Comparisons were made between grades earned on the assessments at the end of both units. These grades were used to demonstrate any academic affects of the presence of graphing calculators in the math classroom.

Chapter Four: Results

I started this action research in my eighth grade math classroom because I had observed the interest that students had possessed when they had seen that the Integrated Algebra students were using graphing calculators. I decided to implement the use of technology into the classroom to observe any changes in academic performance and student achievement.

Academic Data Analysis

The following table in Figure 1 indicates the results of test scores during the unit on Solving Systems of Equations without the use of calculators. Students were given pencil, paper and rulers to be able to solve the short and extended response questions. The results show that seventeen of the students were present to take the test.

<i>ID #/Test Score</i>	Student #9/ 70%
Student #1/ 65%	Student #10/ 75%
Student #2/ 75%	Student #11/ 50%
Student #3/ 70%	Student #12/ 80%
Student #4/ 75%	Student #13/ 95%
Student #5/ 85%	Student #14/ 90%
Student #6/ 95%	Student #15/ 50%
Student #7/ 90%	Student #16/ 65%
Student #8/ 50%	Student #17/ 60%

Figure 1. A chart displaying the test scores for each student without the use of graphing calculators.

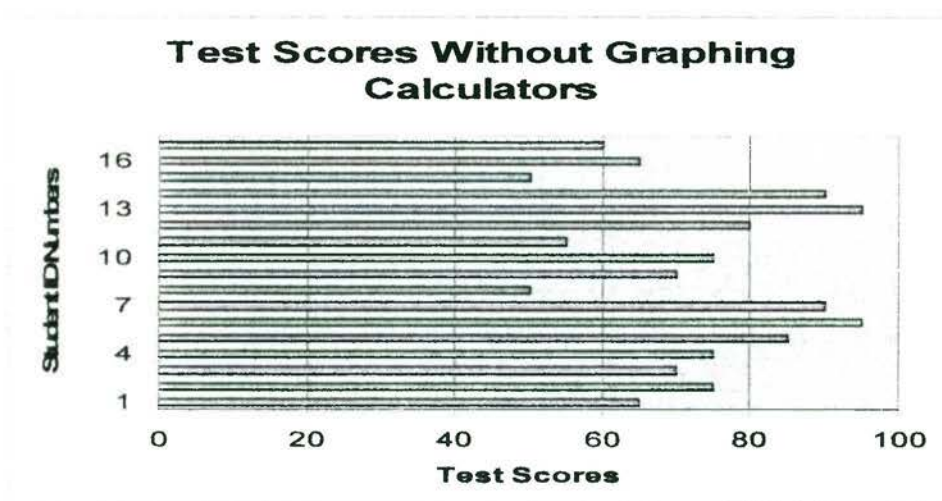


Figure 2. Test results without the use of graphing calculators (using ID numbers).

The above bar graph in Figure 2 shows the results of the test scores without the use of graphing calculators. The mean of the test score results was 73.2%. The results in Figure 1 and Figure 2 show that 76% of students had passed the exam. The test scores were adequate even with the lack of technology present during the unit of study. As an educator, I still wanted to see if student achievement would increase with the presence of graphing calculators to assist students in the graphing process.

Figure 3 shows the results from the test scores during the review unit on Solving Systems of Equations by Graphing with the presence of graphing calculators. The mean of the test score results was 76.4%. Fifty percent of the students had scored above the mean and 50% of the students scored below the mean score.

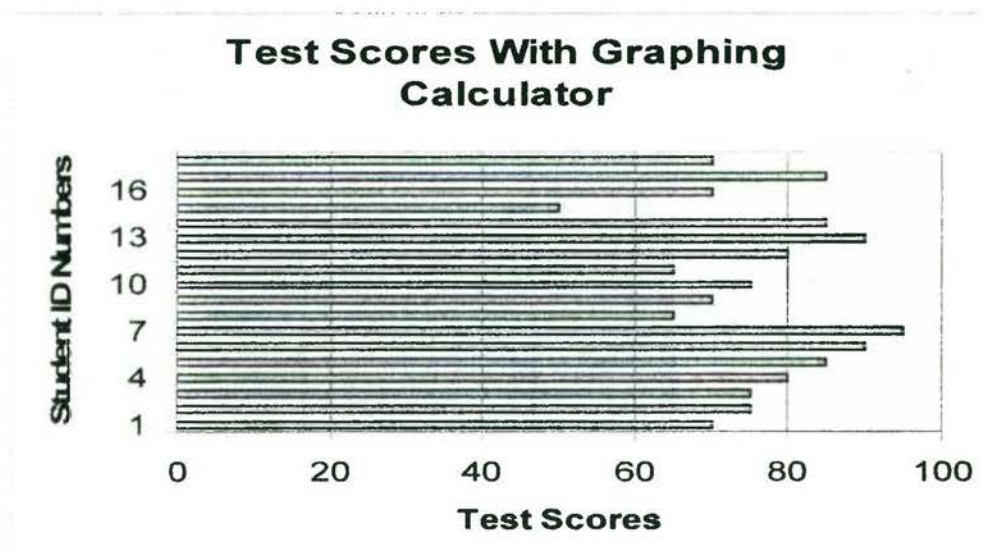


Figure 3: Test results with the use of graphing calculators (using ID numbers)

The results do show an increase in student test scores at the end of the review unit with the presence of graphing calculators. The test scores show that 17 out of 18 students or 94% of the students had passed the exam. One student was present for the second exam and not for the first exam due to a suspension. The results from Figure 3, clearly provides supportive evidence that there was some academic improvement in concurrence with the implementation of technology in the classroom.

Figure 4 shows the results of each student on both exams. The graph is a comparison of both test scores to show whether or not a students performance decreased, remained the same or improved on the second exam. The results show that 44% of the students improved on their exam, 33% of the students had received the same score, 17% had received a lower score and 6% or one student had only taken the second exam. Overall 77% of the students had either improved their test score or received the same test score on the second exam.

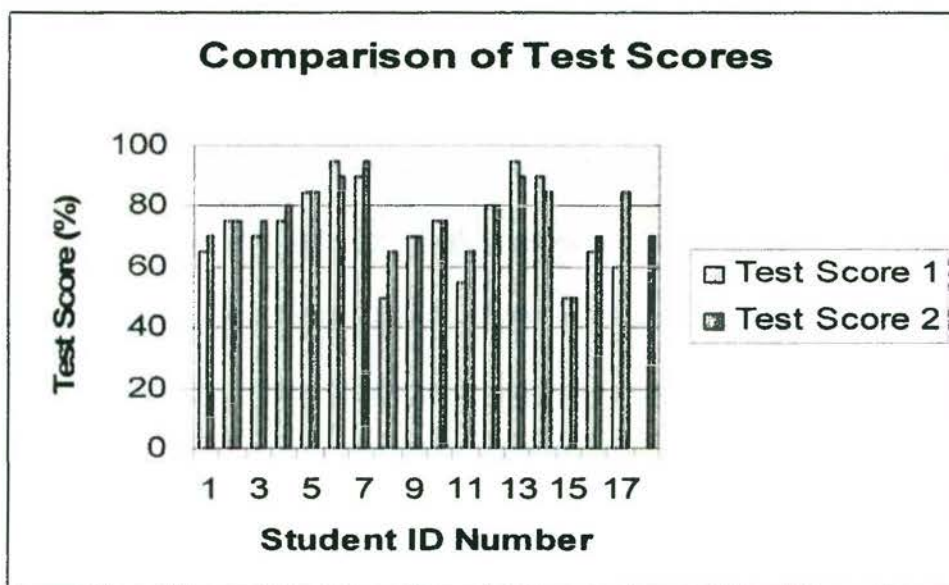


Figure 4: Comparison of test scores for each student (using ID numbers)

Summary

The responses to the surveys prior to the study that were given to students as shown in Appendix provide evidence that technology is a very important tool for students. Technology is ever-changing inside and outside the classroom, which indicates that schools and educators need to implement more technology in the classroom. The surveys also provided evidence of what forms of technology are already being used in the classroom and students also provided suggestions of various types of technology that could be used in the classroom. The results from the surveys can be observed in Appendix D. Many students had said that the only form of technology that they have used in math class was the calculator. This provides evidence that many teachers either do not have access to various forms of technology or that they are hesitant to use technology in the classroom. Many students were also

interested in seeing different forms of technology that could be used in the classroom. Students had provided many suggestions that could be used inside the classroom.

Figures 1 – 4 provide evidence that with the implementation of technology (graphing calculators), academic achievement in this urban eighth grade math class was improved. These figures clearly show that students had either improved their test score or received the same grade on the second exam compared to the first exam on Solving Systems of Equations. Overall 77% of the students test scores improved or remained the same on their second exam. Among those students, 44% had improved on their exams, which leads to believe that more students had increased their understanding of the math concepts with the presence of technology. I believe this is due to the introduction of graphing calculators in the classroom, which in turn added to student interest in the math classroom.

Chapter Five: Conclusions and Recommendations

Discussion

Technology is all over and it's going to be replacing a lot of traditional methods in the classroom. Technology affects student achievement in positive and negative ways. There are many tools that can increase or decrease a students' ability to want to do work in the classroom (calculators, computers, software, etc.). Various forms of technology can be an enhancement to student learning but can also be a crutch that may hinder a student's knowledge of basic skills. A major goal of the education system is to make mastery learners out of all students and to increase their motivation to learn. Technology can be a means to accomplish this goal.

In this urban eighth grade math class, the graphing calculator was used as a tool to increase student achievement and interest in doing work in the Solving Systems of Equations unit. Students were first introduced to the unit traditionally using pencils, rulers and graph paper. They were able to graph two lines and were then able to find, if any, points of intersection. Students were then given the same unit but in a form of review in which they were able to use the graphing calculator to assist in checking to make sure their lines were graphed correctly and to see the actual point of intersection. Students were still using the traditional graphing methods but the technology was used to increase achievement and interest in the content.

Recommendations for Future Research

Future research should look at the effect of technology on student improvement at all levels of education. I believe that students should be exposed to

technology at an early age since technology is changing everyday around us.

Technology should be necessary in all math classrooms to be able to improve student interest and student achievement in the subject. The data in this project was only collected for one unit of study. The time period should be increased to an entire school year to really observe the true effectiveness of technology in a classroom. Also technology should be implemented in all subject areas. There are many forms of technology that could be used across curriculum. Teachers could be able to differentiate more within the classroom and across all subject areas if more technology is tangible in the classroom.

Another suggestion for future research would be to introduce the unit using the graphing calculators. Based on the findings in this research, students performed better during the research unit with the presence of technology. The unit would still involve the traditional way of teaching Systems of Equations by Graphing, but the calculator would be used as a tool to check students work. This way students would have two methods during the same unit to learn how to solve Systems of Equations. The only downfall would be that students can not use calculators for the multiple choice part of tests. Every class would also need to have access to graphing calculators during their exams which may be too cost-effective for the school.

Another suggestion would be to compare two different math classrooms of the same curriculum. You could have a control group that only uses traditional forms of teaching and an experimental group that uses various forms of technology to enhance the traditional teaching methods. Researchers could then compare the positive and

negative affects that technology has compared to the classroom that only received traditional methods such as pencil and paper. Researchers could compare grades on assessments and also interview students from each group to see if interest in the subject had increased and if students felt more at ease and could perform tasks quicker through the use of technology.

Many schools only think about implementing technology in the regular education classrooms. Many self-contained classrooms are “looked over” when technology is brought into schools. Special education students are in need of much assistance that could be eliminated due to the presence of technology in the classroom. Technology in these forms could be highly expensive for schools, but researchers could look at the positive and negative affects on student achievement at the self-contained level.

Action Plan

In light of this research, I plan to expand the use of technology throughout all my three classes in the upcoming 2008-2009 school year. I plan to implement as many forms of technology as possible with my students. This data that I have created will be shared with my administrators and principal. I will encourage them to lead a professional development workshop on the implementation of technology in all subject areas. I will also share these results with fellow teachers in all subject areas to encourage the use of any form of technology in the classroom. Too many educators fear the use of technology, not because they are against it, but because they don't

know how to use it. Our school just received money from a grant that will provide ten Smart Boards and ten LCD projectors in the upcoming 2008-2009 school year. Staff and students will benefit from this technology if implemented and used in appropriate ways.

Conclusion

In this research an urban eighth grade math class was selected to implement graphing calculators as a form of technology to improve student interest and achievement. Students were first introduced to a unit on Solving Systems of Equations by Graphing and were taught using traditional teaching methods involving pencil and paper. Students were then given the same material in a review unit for the final exam that implemented the use of the graphing calculator. Students were assessed on both units and grades were compared to see if student achievement had improved, declined, or had remained the same.

The data collection included surveys that were given before the implementation of technology into the classroom. The results from the survey were a good indication where students' levels were on their understanding and knowledge of the various forms of technology in the world (not just in the classroom). The results from the surveys also indicated some suggestions to the educator on how to make math more fun and interesting. These suggestions will not only be brought to the attention of the researcher, but they will also be presented to the principal for the upcoming 2008-2009 school year. Students were also assessed after each unit and the grades were compared in graph format to indicate an increase in student achievement

with the presence of the graphing calculator. Grade reports showed that students had improved academically after the implementation of the graphing calculator. The overall results from this research have shown that technology is an effective way to increase student achievement and is also a way to intrigue and increase student interest in the math classroom.

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STATEMENT OF INFORMED CONSENT FOR MINORS

This form describes a research study being conducted with students about the positive and negative effects that technology has on student achievement. The purpose of this research is to compare the effects that technology has on student achievement; more specifically the positive and negative effects and the tools that increase or decrease a student's ability to do work in the classroom. The person conducting the research is a graduate student at SUNY College at Brockport. If you agree to have your child participate in this study, s/he will be asked to complete a questionnaire about her/his knowledge of technology inside and outside of the math classroom. Students will also be exposed to different forms of technology such as calculators, computers and math-related websites during the research. Students will also be given testing instruments to determine the effects of technology on your student's ability to do work in the classroom. The results will be displayed anonymously in spreadsheets and table or graph formats. The students will be tested on a review unit that involves Solving Systems of Equations by Graphing. The students will be using graphing calculators during the research and the testing instruments will help to determine whether or not there is an increase in student achievement due to the presence of technology in the math classroom.

The possible benefits from being in this study could be that information will be learned that would allow teachers to better a student's ability to do work in the classroom due to the presence of technology. Teachers will be able to enhance their classrooms in the future due to the information that prevail from this research.

Your participation in this study is completely voluntary. Being in it or refusing to be in it, will not affect your grades or class standing. You are free to change your mind or stop being in the study at any time.

I understand that:

1. My participation is voluntary and I have the right to refuse to answer my questions. I will have a chance to discuss any questions I have about the study with the researcher after completing the questionnaire at any time. If you chose to not participate in the study, you will still participate in the review unit and the grades on the tests will be included in your 6th marking period grade. The grades however will not be used in part of the study.
2. My confidentiality is guaranteed. My name will not be written on the survey. There will be no way to connect me to the

- written survey. If any publication results from this research, I would not be identified by name. Results will be given anonymously and in group form only, so that neither the participants nor their schools can be identified.
3. There will be no anticipated personal risks because of participation in this project.
 4. My participation involves reading a written survey of 10 questions and answering those questions in writing. It is estimated that this survey will take 10 minutes to complete.
 5. Approximately 20 students will take part in this study. The results will be used for the completion of a research project by the primary researcher.
 6. Data and consent forms will be kept separately in a locked filing cabinet by the investigator and will be destroyed by shredding when the research has been completed.

You are being asked whether or not you want to participate in this study. If you wish to participate, and you agree with the statement below, please sign in the space provided. Remember, you may change your mind at any point and withdraw from the study. You can refuse to participate even if your parent/guardian gives permission for you to participate.

If you have any questions you may contact:

<u>Primary Researcher</u>	<u>Faculty Advisor</u>
Jennifer Flanagan	Dr. Conrad Van Voorst
(585) 324-9273 Ext. 2530 Jennifer.Flanagan@rcsdk12.org	Education and Human Development (585) 395-5019 cvanvoor@brockport.edu

I understand the information provided in this form and agree to participate in this project.

Signature of Participant/Date

Birth date of participant

Signature of a witness 18 years or older/Date

STATEMENT OF INFORMED CONSENT FOR PARENTS

This form describes a research study being conducted with students about the positive and negative effects that technology has on student achievement. The purpose of this research is to compare the effects that technology has on student achievement; more specifically the positive and negative effects and the tools that increase or decrease a student's ability to do work in the classroom. The person conducting the research is a graduate student at SUNY College at Brockport. If you agree to have your child participate in this study, s/he will be asked to complete a questionnaire about her/his knowledge of technology inside and outside of the math classroom. Students will also be exposed to different forms of technology such as calculators, computers and math-related websites during the research. Students will also be given testing instruments to determine the effects of technology on your student's ability to do work in the classroom. The results will be displayed anonymously in spreadsheets and table or graph formats. The students will be tested on a review unit that involves Solving Systems of Equations by Graphing. The students will be using graphing calculators during the research and the testing instruments will help to determine whether or not there is an increase in student achievement due to the presence of technology in the math classroom.

The possible benefits from being in this study could be that information will be learned that would allow teachers to better a student's ability to do work in the classroom due to the presence of technology. Teachers will be able to enhance their classrooms in the future due to the information that prevail from this research.

Your child's participation in this study is completely voluntary. Being in it or refusing to be in it, will not affect your child's grades or class standing. S/he is free to change her/his mind or stop being in the study at any time.

I understand that:

7. My child's participation is voluntary and s/he will have a chance to discuss any questions s/he has about the study with the researcher after completing the questionnaire. Refusing to participate in the study will have no effect on grades or scores in the class.
8. My child's confidentiality is guaranteed. Her/his name will not be written on the survey. There will be no way to connect my child to the written survey. If any publication results from this research, s/he would not be identified by name. Results will be

- given anonymously and in group form only, so that neither the participants nor their schools can be identified.
9. There will be no anticipated personal risks because of participation in this project.
 10. My child's participation involves reading a written survey of 10 questions and answering those questions in writing. It is estimated that this survey will take 10 minutes to complete.
 11. Approximately 20 students will take part in this study. The results will be used for the completion of a research project by the primary researcher.
 12. Data and consent forms will be kept separately in a locked filing cabinet by the investigator and will be destroyed by shredding when the research has been completed.

You are being asked whether or not you will permit your child to participate in this study. If you wish to give permission to participate, and you agree with the statement below, please sign in the space provided. Remember, you may change your mind at any point and withdraw from the study. Your child can refuse to participate even if you have given permission for her/him to participate.

I understand the information provided in this form and agree to allow my child to participate as a participant in this project. I am 18 years of age or older. I have read and understand the above statements. All my questions about my child's participation in this study have been answered to my satisfaction.

If you have any questions you may contact:

<u>Primary Researcher</u>	<u>Faculty Advisor</u>
Jennifer Flanagan	Dr. Conrad Van Voorst
(585) 324-9273 Ext. 2530 Jennifer.Flanagan@rcsdk12.org	Education and Human Development (585) 395-5019 cvanvoor@brockport.edu

Signature of Parent/Date

Child's Name _____

Appendix C: Technology Survey (student response)

Technology Survey

- 1) male or female (circle one)
- 2) grade level _____
- 3) Define technology (what does it mean to you?)
- 4) What forms of technology have you used in the classroom?
- 5) What forms of technology do you use outside the classroom?
- 6) What types of technology do you use in math class?
- 7) Do calculators make your job easier in math? Why?
- 8) What types of technology would you like to see used in school?
- 9) Do you feel more confident in math class when you can use calculators to help you?
- 10) Give some suggestions as how to make math more fun. (list 3 ideas)

Appendix D: Results from technology survey

Results from Technology Survey

1) 10 Females, 4 Males

2) All 8th graders

3) Define Technology (What does it mean to you?)

- Something to do with hands
- No response
- Computers, calculators, television, projectors
- The use of objects made by mankind
- No response
- Electric devices; examples: computers, calculators, projectors, t.v.
- Technology to me means things that are related to school like calculators, computers and many other things
- To use a computer, calculator, projector, and to help you study or cheat
- The study of different electronics
- When you use a calculator
- Technology means hands-on activities “created” by man. It makes life easier and was built to help people.
- Computers, MP3 Players, IPODS, Television
- An advanced form of electronics
- Something that someone made that makes stuff better and easier

4) What forms of technology have you used in the classroom?

- T.V.
- Projector
- Calculators
- Computers
- Pencil sharpeners
- Electric Stapler
- Electric Hole Puncher
- Cell Phones
- Radios
- Overheads

5) What other forms of Technology do you use outside the classroom?

- Vehicles
- Cell Phones
- PSP

- **IPODS**
- **MP3 Players**
- **CD Players**
- **DVD Players**
- **T.V.**
- **V.C.R.**
- **Computers**
- **Video Games**

6) What types of technology do you use in math class?

- **Calculator**
- **Overheads**
- **Projectors**
- **Computers**
- **T.V.**

7) Do Calculators make your job easier in math? Why?

- **Yeah because you are just putting the numbers in.**
- **Yes; because it does the work for me. It's easier to check work. 99.99% accurate.**
- **Sometimes. You should use when need and just want. But if you don't know it from the top of your head. Yes, they are easier.**
- **Yes because you have a correct answer.**
- **Yes, because it does the work for you.**
- **Sometimes.**
- **Yes, because I can just plug the things in and don't have to think about things.**
- **Yes, because I can get done quicker and no because I can work quicker with my brain and I get confused with the calculator.**
- **Yes because when I have a calculator it's easier to solve the math.**
- **Yes because you can check your answer to make sure it's right.**
- **Yes because it helps you do a problem with less work.**
- **Yes because you don't have to think hard.**
- **Yes because when you have large numbers it's hard to use your head to multiply or divide them.**
- **Yes because some types of math are hard and your brain is working so fast you forget to think and it just helps with harder questions.**

8) What types of Technology would you like to se used in school?

- **I don't know.**
- **I don't know.**
- **More computers.**
- **No response.**
- **Computers, phones, DVD's, T.V.**

- Smart boards
 - I don't know. Does not really matter.
 - A new projector and computers.
 - Computers
 - More computers.
 - No response.
 - Our own computers.
 - Computers.
 - Science-microscopes, telescopes, t.v., computers Social Studies – laptop, projector Spanish – computers Math – calculators, laptop, t.v., overhead Health – radio, t.v., projector
- 9) Do you feel more confident in math class when you can use calculators to help you?
- 12 yes responses
 - A little.
 - Not too much. I try not to use it as much unless I really need it (or lazy).
- 10) Give some suggestions as how to make math more fun.
- Group work, around the world and flash cards.
 - Play around the world as a quiz grade, get a t.v. to watch math-related movies and let us go to the computer lab.
 - I don't have none.
 - Group work, partner work and math games.
 - Movies, computers and music.
 - Play more games and have fun with the math.
 - Math games, group work week and we give teachers a test.
 - Give easier work to do so everyone can understand it and make sure everyone understands it.
 - Group work and stations.
 - Use calculators on test, play math games and have no homework.
 - Play math-related games.
 - We can play math games to make learning more fun and interesting, we can get rewarded and our teacher can decide what can make us have more fun.
 - Play math-related games.
 - Do more activities and work with computers.

Appendix E: Unit Plan without the Use of Calculators

Day One: Introduction of Solving Systems of Equations by Graphing

Name _____ Date _____
Math 8 _____ Guided Notes (student copy)

SOLVING SYSTEMS OF EQUATIONS BY GRAPHING

Essential Question: What does it mean to solve a system of equations?

Brainstorm Activity: Map Activity (map of a section of Rochester)

Name 2 streets that intersect once:

a) _____ b) _____

Name 2 streets that intersect more than once:

a) _____ b) _____

Name 2 streets that NEVER intersect:

a) _____ b) _____

Vocabulary:

SYSTEM OF LINEAR EQUATIONS:

INTERSECT:

PARALLEL LINES:

SOLUTION OF THE SYSTEM:

I. Solving Systems with ONE SOLUTION:

Example #1:

Directions: Solve the system of linear equations by graphing

$$y = 2x - 3$$

$$y = x - 1$$

m =

b =

m =

b =

Steps:

- 1) _____
- 2) _____
- 3) _____
- 4) _____
- 5) _____

Point of Intersection: ()

Check:

Example #2:

$$y = x + 5$$

$$y = -4x$$

m =

b =

m =

b =

Point of Intersection: ()

Check:

On Your Own:

Directions: Solve each system of linear equations.

1) $y = x$
 $y = 5x$

Point of Intersection: ()

Check:

2) $y = -x + 4$
 $y = 2x + 1$

Point of Intersection: ()

Check:

Day One: Steps to Solving Systems of Equations by Graphing

SOLVING SYSTEMS OF EQUATIONS BY GRAPHING

Step #1: Draw and label x and y axes on coordinate grid (graph paper)

Step #2: Find the slope (m) and the y-intercept (b) of both equations

Step #3: Plot the y-intercept (b) of the first equation on the y-axis

Step #4: From that point use your slope (m) and plot your second point

Step #5: Connect the two points and extend to make a line using a ruler or straight edge

Step #6: Now repeat steps #3 – 5 for the second line

Step #7: Do the lines intersect?? If so find the coordinates of where the lines intersect?

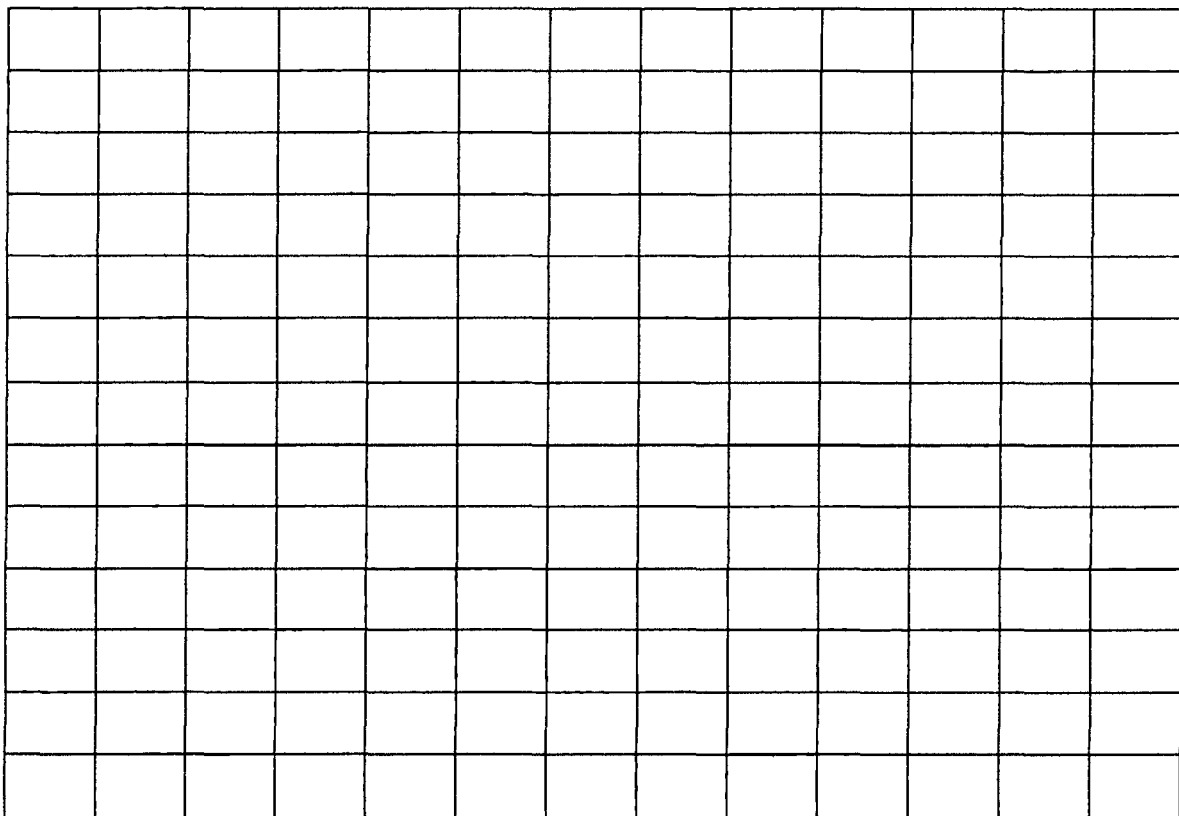
Day Two: Bell work (review previous days lesson)

Name _____

Solve the following system of equations graphically and **check**.

$$y = 2x - 1$$

$$y = -3x + 4$$



Point of Intersection: ()

Check:

Day Three: Bell work (review of previous days lesson)

Name _____

Directions: Solve the following systems by graphing. If there is no solution write NS, and if the solution is Infinitely Many Solutions, write IMS.

$$y = 2x - 3$$

1)

$$y = x - 1$$

Point of Intersection: ()

Check:

$$x + y = -1$$

2)

$$x + y = 1$$

Point of Intersection: ()

Check:

Appendix F: Unit Plan with the Use of Calculators

Day One: Review Unit using graphing calculators – Steps to graphing for pencil and paper and calculator

Solving Systems of Equations by Graphing

1. Draw and label your X and Y axes
2. Find slope (m) and y-intercept (b) of both equations
3. Using the first equation, plot b on the y-axis
4. From that point rise/run (+) or fall/run (-) and plot second point
5. Connect the two points and form a line
6. for the other line complete steps #3 – 5 again
7. Find the coordinates of where the two lines intersect

Solving Systems of Equations Using a Calculator

1. Clear the screen
2. Press the $\langle y = \rangle$ button
3. Type in your first equation
4. Scroll down with arrow button
5. Type in your second equation
6. Press the $\langle \text{graph} \rangle$ button
7. Press $\langle 2^{\text{nd}} \rangle$, $\langle \text{trace} \rangle$, $\langle 5 \rangle$ and then press the $\langle \text{enter} \rangle$ key 3 times until it says
intersection

Appendix G: Test Used to Determine Test Scores

Student # _____

Test Used to Determine Scores

Solving Systems of Linear Equations by Graphing

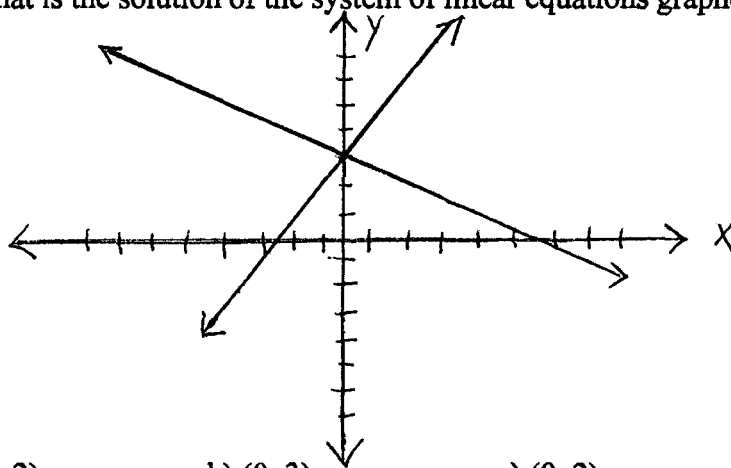
I. Multiple Choice

Directions: Read each question carefully. Choose the best response to the question. Circle the letter that corresponds to the correct response. No partial credit will be given. (1 point each)

1) If two lines are parallel, what do you know about their equations?

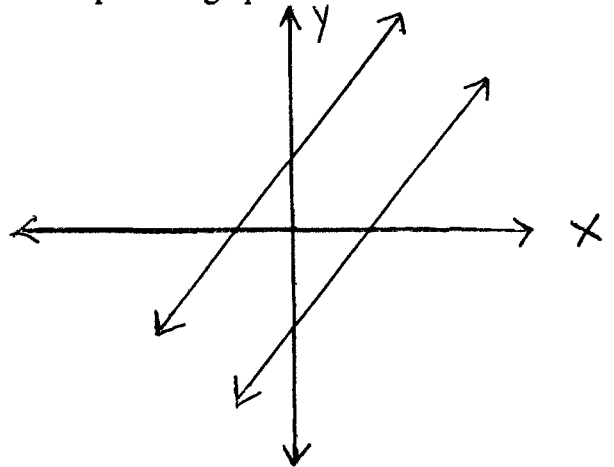
- a) They have all their solutions in common.
- b) They have no solutions in common.
- c) They have exactly one solution in common.
- d) They have exactly two solutions in common.

2) What is the solution of the system of linear equations graphed below?



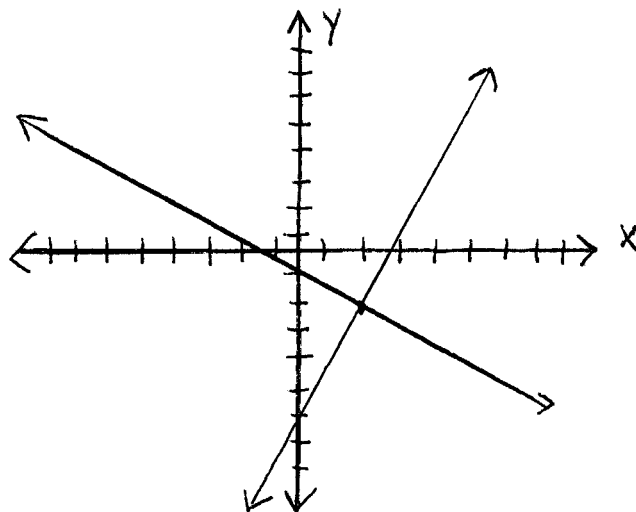
- a) (4, -2) b) (0, 3) c) (0, 2) d) (-2, 4)

3) What is the solution of the system of linear equations graphed below?



- a) All ordered pairs on both lines
- b) There is no solution
- c) $(0, 2)$
- d) $(0, -3)$

4) What is the solution of the system of linear equations graphed below?



- a) $(2, -2)$
- b) $(-2, 2)$
- c) $(2, 2)$
- d) $(0, 4)$

5) Roland has to find the solution of this system of linear equations.

$$2y = 4x - 2$$

$$3y = 6x - 3$$

Without graphing, what is the solution? [Hint: Divide both sides of the first equation by 2, and divide both sides of the second the equation by 3. Then compare the equations]

- a) all ordered pairs on both lines
- b) There is no solution.
- c) (0, -2)
- d) (0, -3)

II. Short Response Questions

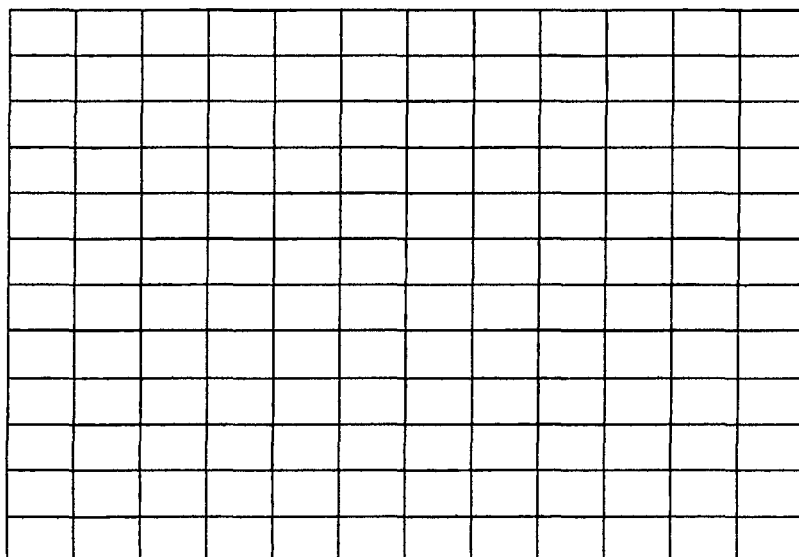
Directions: Read each question carefully. Make sure to show work when necessary. If a correct response is given and no work is shown, then question will receive only 1 point.

(2 points each)

6) **Part A:** Graph this system of equations on the coordinate grid.

$$y = \frac{1}{2}x + 4$$

$$y = \frac{1}{2}x - 3$$



Part B: What is the solution of the system?

Answer _____

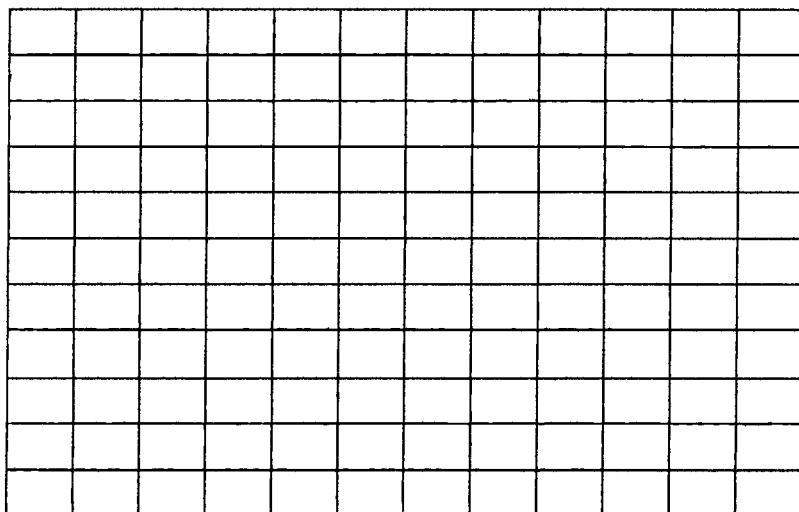
7) What is the solution of this system of linear equations?

$$y = x + 4$$

$$y = \frac{1}{3}x + 2$$

Point of Intersection: ()

Use the grid to sketch the graphs below.



Appendix H: Miscellaneous Worksheet Used During Both Units

ALGEBRA QUIZ

Systems of Equations

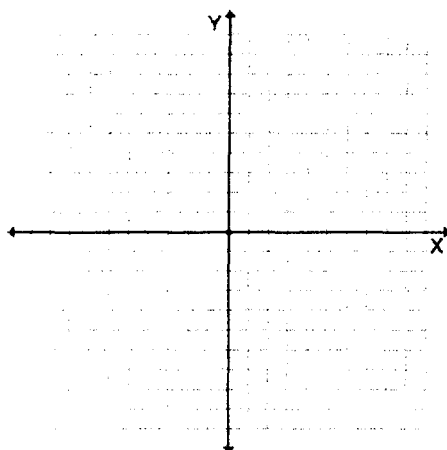
Graphing & Substitution

Name: _____

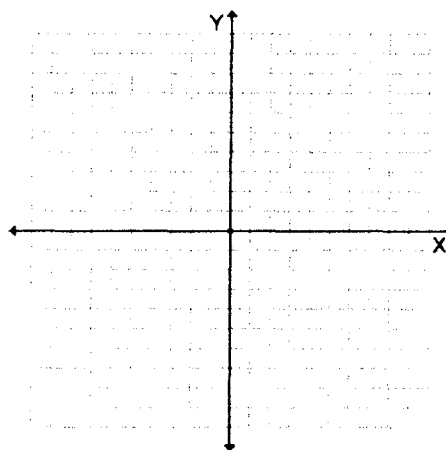
Period: _____ Date: _____

Solve the following systems of equations by graphing. If necessary, indicate whether there is no solution or infinitely many solutions.

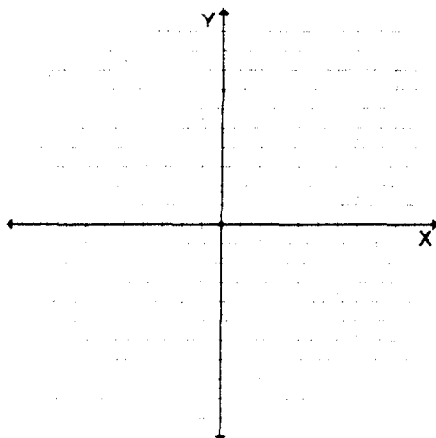
1. $\begin{cases} y = x + 3 \\ x + y = -5 \end{cases}$ Solution: _____



2. $\begin{cases} y = \frac{2}{3}x + 2 \\ y = \frac{5}{3}x - 1 \end{cases}$ Solution: _____



3. $\begin{cases} y = 3x + 1 \\ y - 3x = -3 \end{cases}$ Solution: _____



4. $\begin{cases} 2x + 4y = 8 \\ y = -\frac{1}{2}x + 2 \end{cases}$ Solution: _____

