A Study of the Relationship Between Use of Technology in Math and Higher Test Scores

Mary Ann Grooters

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A Study of the Relationship Between Use of Technology in Math and Higher Test Scores
Mary Ann Grooters
Winter, 1996

MASTERS THESIS
Submitted to the graduate faculty at Grand Valley State University
in partial fulfillment of the Masters of Education
ABSTRACT

This thesis explored the relationship of a technology enhanced curriculum to higher test scores and higher student motivation. This thesis involved two seventh grade math classes in Kentwood, Michigan. A control class received instruction including lectures, written assignments, and projects. The test group received similar assignments and projects and in addition were given technology supported exercises. A survey given to the test group examined motivation levels, and end of chapter tests compared achievement scores of both groups. The findings indicate that a technology enhanced curriculum does not lead to higher test scores but does impact student motivation to learn math.
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CHAPTER 1--THE PROBLEM

This thesis examines the problem of determining whether or not a middle school math curriculum supported with computer software is more effective than one without such support. The field of technology has promised to motivate learning for all. Still, not everyone is convinced that computer enhanced curriculum means bringing the computer into all areas of the curriculum. In an article written for the Journal of Economic Issues, Baldwin Ranson, a leading economist, fears that educators are making a push for going back to the three R's (Ranson, 1986, p. 1053). He states that "Educational planners show their ignorance of the principle of technological determination by going back to basics...rather than by providing advanced technology education for all" (p. 1060). He believes that the ability to adapt to evolving technological opportunities will "maximize educational excellence" (p. 1065). Few people deny the importance of computer training in our school curriculum. However, many more need to be convinced that using the computer across the curriculum is effective and desirable.

IMPORTANCE AND RATIONALE FOR THE STUDY

Every profession looks for ways to improve itself. This is especially true in education because its services affect the entire population. Not only educators are involved in the search for better methods, but also legislators, business leaders, and the public in general.
The focus today is to improve education for students at all levels of ability, not just the gifted or college bound.

In the late 1950's, after Sputnick, the main concern of our national educational policy was to encourage only the best students for math and science study and to provide them with the most enriched curriculum. Today the U.S. is faced with technological competition from countries like South Korea and Taiwan, and the national policy goal has shifted to math and science literacy for all students (Waks, 1989, p. 204). The question then becomes "What changes can we make in the curriculum and in the classroom to provide the kind of education the students will need in the work force?"

A research project called "A Study of High School" by Theodore R. Sizer, former Dean of the Harvard School of Education, provides some insight into some suggested changes. The study concluded that students do not learn as much or as well as they should in order to prepare them for future jobs. Mr. Sizer argues that many classroom practices make learning problems inevitable (Sizer, 1983, p. 7). For example, class time is typically structured in a way that precludes the learning of higher-level skills, starting with too much teacher talk. "The average instructional day in a junior or senior high school includes 150 minutes of talking. Of this, only seven minutes is initiated by students" (p. 8). This study
supports a change that will decrease teacher talk time and increase activities that require students to use higher level thinking skills.

It is important for the field of education to continually look for ways to improve its services. When improving curriculum, schools must be at the cutting edge in order to prepare students for future jobs.

BACKGROUND

The importance of technology training in our schools is most often supported by school curricula (Michigan Association for Supervision and Curriculum Development, 1994). Computers symbolize the age we live in and the future for which we must prepare. According to an editorial in Social Policy, computers "are as inevitable in education as they are in the rest of society" (Dollor, 1983, p. 4). But by itself, the computer is no magic solution to learning in the classroom. Its value is determined by the uses to which it is put and the quality of the software. There are three identifiable uses of the computer in today's classrooms as noted in this editorial (p. 13).

1.) tutor This is computer-assisted instruction, or CAI. The use of the computer program is to reinforce basic skills. It is a drill and practice while freeing teacher time. More that 90% of current mathematics software packages currently on the market are for drill and practice. There is some research evidence that
students who use computer based instruction do better than students who do not use computers (p. 13).

2.) tutee This is the teaching of programming, commonly referred to as "computer literacy." Some experts question the emphasis on programming skills. There are many technological devices we use today (ie. phone, car) that do not require any sophisticated technical knowledge to use.

3.) learning tool When used as a learning tool, the computer has real educational potential. It would strengthen the skills of information gathering, analysis, and application. With the right software, teachers can become coaches giving support, guidance and direction.

Most school curriculum centers around the second use, that of computer literacy. But in today's high-tech world, that training is too limited for our students. Two separate research studies have shown that using the computer as a tutor and as a learning tool benefit the learner.

One study involved electronics students in the Air Force. Students trained via CAI had achievement scores comparable to those of a control group where students were trained in a regular classroom situation. But this training was accomplished with a 34% reduction in instruction time. High ability students had significantly higher achievement scores using CAI and reduced training time by 25% (Sachdeva, 1989, p. 1195-1197).
In another research study, 112 college juniors and seniors studying business finance were exposed to curriculum supported by software while a control group received regular classroom instruction. These 112 students felt that the computer facilitated their understanding of problems and difficulties in commercial band management. They demonstrated higher motivation and more interest in learning. There was also less absenteeism (Sachdeva, 1989, p. 1197-1198).

While we have learned that use of computers can have an impact on student learning, research on specific benefits to students should continue. We need to know if computers have a significant impact on achievement scores for students.

STATEMENT OF PURPOSE

The purpose of this thesis is to test the hypothesis that incorporating appropriate software into a seventh grade math curriculum will increase the knowledge and interest of the students. It is my intent to put this idea into practice in my own classroom of seventh grade math students, using software that fits the objectives of my given curriculum. It is my hypothesis that incorporating appropriate software into a math curriculum and making applicable changes in teaching methods (i.e. less teacher talk) will improve student knowledge and increase student interest in the subject area. A standard assessment will support or refute
this hypothesis. It may be that seventh grade math students, like Air Force recruits or college juniors and seniors, benefit greatly from software designed to support the established curriculum. Motivation, interest level, and achievement will be the criteria that test the hypothesis that regular computer use in math class produces measurable benefits.

Should this study suggest a relationship between a computer-supported math curriculum and higher test scores, I will change the way I teach seventh grade math. With positive results, I can share this information with other teachers who seek to make changes that benefit their students.

More specifically, the study will:

1.) demonstrate how to incorporate software into chapters 8 and 9 in the seventh grade Transition Math book
2.) provide a list of software supportive of the objectives in chapters 8 and 9 in the Transition
3.) compare the test scores of a control group with those of a group having access to corresponding software for chapters 7 and 8 in the Transition Math book
4.) survey the interest levels of the control group and the experiment group in regards to the materials covered in Chapter 8 and 9

The final report of my study will be a comparison between the test scores of two seventh grade classes. The students have comparable math ability as measured by their
1995 MEAP scores in math. One class will receive regular teacher instruction and assignments that require students to practice the desired skills presented. The other class will receive less teacher instruction and assignments will include computer programs that reinforce the desired skills. The evaluation tool will be the chapter test supplied by the TM series to measure academic achievement and a survey to determine interest level on the material covered.

LIMITATIONS OF THE STUDY

The identifiable limitations of this thesis are as follows:

1.) The experiment covered a short time period (approx. 6 weeks).
2.) Software supply was limited by accessibility.
3.) A small number of students were involved (55-60 total).
4.) Higher motivation may be a result of a "getting out of the routine" method of instruction.
5.) Peer training may affect test results (there will be 2 students per computer).

Few people deny the importance of computer training in our school curriculum. However, many more need to be convinced that using the computer across the curriculum is effective and desirable. This thesis puts the computer to the test in one seventh grade pre-algebra classroom and
attempts to answer the question "Is learning math more effective when the curriculum includes computer software?"

TERMS

Familiarity with the following terms will assist the reader:

TM  Transition Math book used in 7th grade at Pinewood Middle School, Kentwood, MI

technology  the use of machinery (ie. calculators, computers)

CAI  Computer assisted instruction is instruction and practice presented on software

computer enhanced curriculum  a curriculum designed to include use of computers in all areas of study
CHAPTER 2
REVIEW OF LITERATURE AND RESEARCH

In recent years, the role of technology in education has been explored. The focus of this chapter is to examine studies of the necessity, usefulness and effectiveness of infusing technology in school curriculums. First, research in the area of the benefits of technology to teachers and students will be addressed. Second, an examination of literature concerning how technology can benefit the study of mathematics specifically will be discussed. Third, research on how to include technology in the classroom will be presented.

BENEFITS OF TECHNOLOGY TO STUDENTS AND TEACHERS

One reason why schools should use technology in education is to prepare the students for a future job. In an article written for Social Policy titled "What is Really Going On in School," researcher Bruce Dollar reported that the U.S. threatens to fall behind in the race for economic dominance because "the school system doesn't produce enough future workers with the high level skills required by an advanced technological society" (p. 7). Additional support for infusing technology into schools in order to prepare students for the future comes from an article written for the American Journal of Sociology by Sheila Slaughter. She states that "...high-
tech development is the primary path for economic development" (1991, p. 109). Economist Baldwin Ranson concurs. He reported on a study by the Committee for Economic Development in 1985. The study found that schools frequently fail to produce a skilled, adaptable, and knowledgeable work force (p. 1050). He believes that the traditional school curriculum has been determined "...without examining the technology of modern industry" (p. 1055). The Michigan Association for Supervision and Curriculum Development printed a report also calling for change in Michigan schools to meet future job demands on students. The report stressed that schools "must recognize the new technological skills needed by current and future workers" (1994, p. 34).

More and more homes and workplaces have access to computers as well as other technologies. It is important for students to have a basic knowledge about the computer including the how and why of its use. Many schools are revising their curriculum and even their philosophy to reflect the need to prepare students for a technologically advanced society. Grandville Public Schools, in Grandville, Michigan, recently devised a technology plan because the district believes that "...in order for students to become effective citizens in an 'information society,' schools must teach about the role of microcomputers and other technologies..." (1994, p.4). Overbrook School, an elementary school in Connecticut was
honored by the Connecticut Business and Industry Association for making improvements to help prepare students for the future, including the use of technological tools for learning (Hartford, 1993). Clearly, we need to determine the skill demands of society and make adjustments in the school curriculum specifically in the area of technology.

A second reason for schools to use technology involves learning. The computer can facilitate learning in many ways. One way the computer benefits learning is by accommodating a hands-on learning style. Traditionally, students were required to be passive learners, the lecture being a main medium. In a report titled *Principles for Changing Public Education* published in 1994, the Michigan Association for Supervision and Curriculum Development suggests a restructuring of the old system of learning to a more active one where students participate more in the learning (p.32). In a paper presented at the New Horizons Conference for the Virginia Community College System Raymond Bowen reported results of a study by Ruth Lebovitz, a student services professor at LaGuardia Community College in Richmond, Virginia. She tested over 750 students at the college to determine their learning styles. By using the Myers-Briggs type indicator, she found that over 80 percent of the students were "sensing" types (1992, p.5). They process information and learn
most effectively through hands-on activities. The computer effectively accommodates this learning style.

Another study which supports use of computers to accommodate the hands-on learning style was done at Consmimnes River College in California in 1994. In this study some instructors used lectures alone, others used a combination of lecture, discussion, cooperative learning, and computer-assisted instruction. The study found that while students over 25 years old earned higher grades in lecture-based courses, students under 25 years old earned higher grades in classes using a mixed repertoire (Caston, 1994). Clearly, the learning style of younger learners in this experiment requires variety and activity. The computer can fulfill both needs.

A second benefit the computer brings to education is the ability to individualize learning. Schools are expected to educate all students at their highest level of academic performance despite the wide disparity of abilities that can be present in any one classroom of students. The Michigan Association for Supervision and Curriculum Development supports the goal of enabling "all citizens to be contributing participants who possess the knowledge and skills formerly deemed essential only for the few" (1994, p.31). The computer allows for individualized programs where students work at their own level and rate of learning. Joseph Stinson interviewed several experts in the field of technology and math for an
One expert, Hale Bryson, who is Associate Superintendent for Shelby City Schools in New York, sees a real attraction to using computers for this purpose. "Computers truly facilitate individual learning. Students seem more interested in their work, so they stay on task longer" (1993, p. 26). Computers enable teachers to offer the same quality of education all learners.

A third benefit of incorporating computers into education is that computers can make learning more meaningful and thereby more interesting. Competition in the educational technology field has encouraged the production of meaningful programs. Therefore, the use of technology has the potential to enhance, enrich, and extend the curriculum. Programs that connect students with the astronauts, simulation programs, and programs to demonstrate geometric principles are just a few examples of how computers can bring meaning and real life application to students. It is exciting for students to learn on their own. Students at Dalton School, an elite private academy in New York City, have enjoyed the benefits of being on the cutting edge of technology in education. In an interview by C. Wallis for Welcome to Cyberspace, Headmaster Gardner Dunnan says that the use of technology at Dalton "shifts education form adults giving answers to students seeking answers" (1995, p. 49). He believes that "we all understand and remember what we have
discovered for ourselves far better than what we have merely been told" (p. 50). Interest and meaning help secure knowledge.

A fourth benefit technology has for education is that it allows for peer instruction. As mentioned earlier, the goal of any school is to prepare students for the world in which they will live. Little groups around a computer is a perfect preparation for a world in which most problems are addressed by teams. The Secretary's Commission on Achieving Necessary Skills (SCANS) report of the U.S. Department of Labor lists collaborative skills among those skills most critical for the 21st century workplace (U.S. Department of Education, 1986, p. 26).

An additional benefit of peer instruction and collaboration is greater learning. Studies since the late 19th century have shown that cooperative efforts yield higher results in almost every content area (Strommen, 1995, p. 27). In an article written for Electronic Learning, Eric Strommen interviewed Susan Ellis, who is coordinator of staff development and program planning for the Greenwich, Connecticut Public Schools. She states that "There's evidence that cooperative groups are more effective for higher order thinking skills and higher achievement in general" (1993).

The technology revolution has given cooperative learning an even stronger impetus. In an article in support of cooperative learning Erik Strommen points out
that "Workers need to not only work together, but work together using powerful technological tools" (Strommen, 1995, p. 28). It makes sense, then, that schools would use technology to promote cooperative effort among students.

A fifth benefit of using technology in education is that it frees up teacher time. In a paper presented by Andrew Moore in 1993 at the Annual International Conference of the National Institute for Staff and Organizational Development on Teaching Excellence, one positive outcome of incorporating computers in a curriculum was reported to be saving teacher time (Moore, 1993, p. 9). Mr. Moore states that prior to his use of computers in the classroom, much of his time was spent in developing lessons that would teach particular concepts as well as motivate groups of students in the learning process. With computer programs he did not have to spend time motivating students. "In fact," he says, "through the computer network students were retrieving lessons and working in twelve different areas and were extremely self-motivated to learn the lessons" (Moore, 1993, p. 10). He believes that because the computer lessons kept students motivated, he had more opportunity to provide one to one attention to his students (1993, p. 10). Using computers has the potential to make the teacher more effective and efficient by allowing him/her to devote time and attention
to modelling, explaining, developing higher level thinking skills and teaching to small groups.

Technology can have a significant impact on the way people learn and work. It provides students with the knowledge and skills that will prepare them for the future. It can accommodate a hands-on learning style, provide individual lessons, make content more meaningful, encourage collaboration and peer instruction, and allow teachers more time for one to one or small group instruction.

**BENEFITS OF TECHNOLOGY TO THE STUDY OF MATHEMATICS**

Certainly, the benefits of using technology in education in general are also benefits to the study of mathematics specifically. Because technology may be used differently in the study of mathematics as opposed to language arts or science, it is necessary to examine this area more closely.

A report published by the Education Development Center in Newton, Maine states that technology "can influence how mathematics is learned and taught not only by making calculations and graphing easier, but by altering the nature of what is important to learn" (Education Development Center, 1995). New problems and new ways of investigating problems are more accessible.

Technology can benefit the study of mathematics in four main areas: i.) by bringing real settings to the
classroom (authentic learning), 2.) by connecting the classroom to the real world; 3.) by increasing students value of mathematics, and 4.) by helping a good math teacher be better.

First, technology makes it possible to have real-life applications of math facts and theories. Current research at Vanderbilt University and The University of Connecticut have accumulated evidence that supports the notion that technology can be used to bring real-life settings to the classroom (Wallis, 1995). In one computer program created at Vanderbilt, students follow a fictitious character as he travels up Cedar Creek to buy a new boat. Students use mathematical skills to solve problems that they encounter. Students working with this program were able to solve problems involving more than 15 separate steps. Teachers involved with the program reported that the program also stimulated interest in other projects in other curricular areas. They credit that fact to the program's ability to bring meaning to math and other subjects (Wallis, 1995, p. 49-51).

There are numerous software packages available that make mathematical concepts applicable to real-life situations. A review of software can help determine what materials are appropriate and can be used to explain and practice a certain concept. Some examples of applications include word processors, databases, spreadsheets and multimedia programs. Other software offers problem-
solving exercises with opportunities to use investigative skills. All of these technologies offer new ways to provide students with direct experience using skills needed in the job market.

Second, technology facilitates math instruction and learning by connecting the classroom to the real world. Students involved with projects or experiments can share their results to peers and research scientists in far-away places. National Geographic Society's Kids Network is a program that allows such a connection between the classroom and the outside (Wallis, 1993). Access to the Internet also enables sharing of ideas and can be used as a resource for solving problems.

Third, use of technology in the classroom can increase students' value of mathematics. A paper presented at the Annual Meeting of the Society for Research in Child Development in March, 1995, gave credence to this idea. Data was gathered from a sample of 577 students in grades three, four, and six in Indiana. This data supports the fact that students value mathematics more when they are in classrooms where teachers use computers in math instruction (Anderman, 1995, p.2). The report states that "...the use of technology is related to a greater sense of valuing mathematics and that will lead to a motivation to study mathematics in the future" (1995, p. 4).

Introducing technology into a math classroom does not guarantee students' success. It can, however, nurture a
positive attitude. Students can believe they can achieve and succeed and they can see the value of mathematics. On the surface, it appears that technology is used in mathematics only because of its power to perform mathematical tasks. More meaningful benefits are its power to authenticate the learning of math through real-life situations and connections and its power to motivate math students by increasing the value of mathematics to them.

INCLUDING TECHNOLOGY IN THE CLASSROOM

The benefits that a technology based curriculum offers to teaching and learning can only be realized if it is incorporated in a planned and purposeful way. Equipment needs, a review of software, teacher training, and effective teaching techniques are necessary ingredients to maximize utilization of technology. While it is not the purpose of this thesis to examine educational technology plans, it is important to include some research on how to include technology in the classroom once a plan is devised.

There are four main concerns when including technology in the classroom: 1.) equipment, 2.) reviewing software, 3.) teacher training, and 4.) effective teaching techniques. A look at literature concerning these four concerns provides a more detailed picture on how to incorporate technology into a curriculum.
The Office of Technology Assessment in Washington, DC printed a list of equipment it deemed necessary for a classroom in 1994. It included graphing calculators, one computer for every four students, an overhead computer monitor, network-access (telephone line and modem), and scientific calculators (1994). While this list is the ideal and not attainable for poorer school districts, it does set a worthy goal.

Once equipment has been acquired, it is necessary to review software. Because the demand for educational software programs has increased over the last few years, it may be overwhelming to look through catalogues without some idea of how to make a selection (Dyrli, Odvar, & Kinnaman, 1995). Rosanne Holton, director of The Department of Technology and Media Services of Kentwood Public Schools, in Kentwood, Michigan, helped published a booklet to serve as a guide to software selection (1995). It suggests a number of features to consider:

Content--Is the program relevant to the subject area and fill a necessary need?

Bias--Does the program show different ethnic groups and both genders?

Search Capabilities--Are keyword searches available?

Installation--Is this easy?

Access--Is it user friendly?

Documentation--Can the user easily understand the
manual?

Technology--Are there color, graphics, animation, and print options?

Vendor Support--Does the vendor have a good reputation for service?

Copyright/Price--When was the program developed?

When will an update be ready? Is it worth the price?

A plan to share information about programs or programs themselves within a school district or among neighboring districts can save both time and money.

Acquiring equipment and software is only a beginning to the inclusion of technology in a classroom. Teacher training is equally important (Office of Technology Assessment, 1994). Unlike their pupils, most of today's teachers did not grow up in a computerized society, so the success of educational technologies may depend to a great extent on teachers' ability to adapt. The Congressional Office of Technology Assessment reports that only one third of U.S. teachers have had even ten years of computer training, most of which is devoted to learning about computers rather than how to teach with them (Office of Technology Assessment, 1994). The report concludes that government support is needed in the form of grants for workshops or in-service training.

No matter how extensive the hardware and software technology resources that support a classroom curriculum,
they won't make a significant difference unless the use of technology is combined with effective teaching techniques. To a large extent, these techniques are the same as those used to encourage discovery learning in any context (Dyrli, Odvard, & Kinnaman, 1995).

An article titled "Teaching Effectively With Technology" in Technology Learning identifies 11 techniques that lead to effective teaching in this area (Dyrli, Odvard, & Kinnaman, 1995, p. 56-57):

First, relate the technology activity to student experience. Students need to understand the purpose of a technology-based activity. For example, an activity on graphing might use data taken from a class survey.

Second, provide unstructured time. If students are being given their first opportunity to use new hardware or software, they need exploratory time to try things and become comfortable with the materials. It is hard to focus on a planned activity while they are captivated by the material itself.

Third, introduce new terms. Students should be able to read and understand new vocabulary used in a lesson or activity.

Fourth, organize resources for easy distribution. It is important to organize materials for easy access and time efficiency.

Fifth, keep materials hidden until they are needed. Having materials on display at the start of an activity
can distract students when they should be listening. There can be a huge temptation to get started before listening to instructions.

Sixth, check all of the students. It is important that each individual gets started out on the right foot. Then direct attention to students who misunderstood instruction or are having equipment problems.

Seventh, avoid telling students anything they can find out for themselves. The teaching role is to coach and guide, not to think for the students.

Eighth, be an observer and encourage student discussion. Students need to talk about what they are doing.

Ninth, alert students to the approaching end of an activity. Technology-based activities are so involving that time passes quickly. An abrupt signal to end can catch students in the middle of an activity and feel like an intrusion. It is better to give a warning to the approach of an ending so they can plan to finish what they are doing.

Tenth, have a group discussion. Since many technology-based activities are done by individuals and small groups, it is important to have some time for everyone to share results and learning experiences.

Finally, involve parents. Very students have technology resources at home making it possible for the learning at school to be continued at home. Involving
parents and relatives gives support for classroom activities and programs.

Using good teaching techniques allows a teacher to be more effective with computer-based technology. While good teaching will always be more important than good technology, integrating the two will enhance the learning of students and the power of teaching (Bowen, 1992).

CONCLUSION

Technology enhanced curriculum is a way to make learning more accessible and more meaningful (Bryson, 1995). It accommodates an active learning style, allows for individualization, encourages collaboration and frees up teacher time (Ellis, 1995). Technology has changed the way in which a lot of mathematics is done. It allows students to focus more on ideas that are applicable to real-life situation (Wallis, 1995). Technology is used both as a tool and as a means for creating new teaching strategies.

Schools must prepare students for the 21st century when more and more jobs will require technological skills (Ranson, 1985). If educators are convinced of the benefits of a technology enhanced curriculum to learning and teaching, students will be better prepared for their future.

Chapter 3 of this thesis reports on a study to determine if a relationship exists between use of technology in math and higher motivation, interest, and
test scores. Should the use of computers be beneficial to students in this study, more teachers may be encouraged to incorporate technology into their lessons.
CHAPTER 3
A REPORT OF TEST RESULTS

The literature review supports including technology in all areas of the curriculum. Evidence that links computer use and higher test scores may help convince school administrators that including technology is beneficial across the curriculum. Chapter 3 tests the hypothesis that incorporating appropriate software into a seventh grade math curriculum will positively affect student achievement and motivation in my math curriculum.

This chapter contains a description of the methodology of the study, a summary of the data, supported by graphs, and an explanation of the results. Also included in this chapter are conclusions and suggestions for further research regarding the use of computers across the curriculum.

Methodology

The student sample for this study consisted of 56 seventh graders from Pinewood Middle School in Kentwood, Michigan. These students attend a regular math class (4th or 5th hour) which I teach using Transition Math (TM) from the University of Chicago Math series. Data for this study were collected from students who took the MEAP test at Pinewood in October, 1995. These MEAP scores indicate a moderate or satisfactory level of performance in math
(see Appendix A and Appendix B). The control group consisted of 27 students in my 4th hour class, 10 male and 17 female. They received regular math instruction and related assignments from the TM textbook. The study group consisted of 29 students in my 5th hour class, 12 male and 17 female. They received some regular math instruction with related test assignments in addition to some lessons presented with computer software.

The study covered chapters 8 & 9 in the TM book, which focus on graphing and geometry skills. Each chapter consists of lessons introduced with written explanations, one or more examples, and practice opportunities. Practice is divided into questions covered in the reading material, questions involving application and questions for review. Traditionally, each lesson is introduced by the teacher and is followed by practice assignments from the TM text or related projects designed by the teacher.

The ability levels of the test group and the control group were compared using math MEAP scores from October, 1995. Scores in the areas of geometry and statistic, skills covered during the test period, show a small level of difference in ability between the two groups. The graphs in Appendix E give a clearer picture of this difference. Statistically, the significant level of difference in the geometry category was \( .02 < -7.5 > .04 \) \(< .05 \) and in the statistics category it was \( .02 < -15 > .04 < .05 \).
The control group received traditional teacher instruction and were assigned practice work from the TM text covering both chapter 8 and chapter 9 in the TM book. The test group received some traditional instruction and some instruction with appropriate computer software. All computer work was done in a lab with two students per machine. A list of software used is in Appendix D.

Standard end of the chapter tests were given to both groups, and test scores were compared. Test copies are found in Appendix F and G. A close comparison was made on test questions directly related to lessons covered by computer software in the test group. An interest/motivation survey was given to the test group to gather data about attitudes concerning use of the computer to learn math (Appendix C).

Results and Data Analysis

Standardized testing for chapter 8 revealed a higher median score for the test group. The control group had an average score of 62% and the test group had an average score of 68%. A close look at questions on the test directly related to lessons covered by computer software with the test group show greater success for that group (.02< -60 >.1<.05). Table 1 shows the test scores for the control group (4th hour) and the test group (5th hour) for this chapter.
Table 1

Chapter 8 Test Results for 4th and 5th Hours

(100 Points Possible)

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<th>5th Hour Class</th>
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<td>Mean 68</td>
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<tr>
<td>62</td>
<td>Median 68</td>
</tr>
<tr>
<td>62</td>
<td>Mode 73</td>
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</table>

Standardized testing for chapter 9 did not produce the same results. The control group had a higher mean (75%) than the test group (67%). The test questions related to lessons covered by computer software were answered correctly by a larger number of students in the control group than in the test group (sd=.02< .05). Table 2 shows the test scores for both the control group and the test group for this chapter.

Table 2

Chapter 9 Test Results for 4th and 5th Hours

(100 Points Possible)

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<th>5th Hour Class</th>
</tr>
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A motivation/interest survey was given to the test group after the testing was done (see Appendix C). Participants remained anonymous to encourage honesty and forthright responses. Findings show that 85% of the
students in the test group liked doing some math on the computer. Some reasons given were the enjoyment of working with a friend, it's fun, it's easier to type than write, and it's visual. Those students who indicated they did not like doing math on the computer said it was boring or harder to understand. Most students thought the computer could help them learn math (95%). Reasons given were centered around working at their own pace and receiving instant feedback. Slightly over half (59%) of the test group reported a higher motivation to learn math when using a computer, while 30% were not sure. Many students reported that seeing math made it easier to understand and correcting errors on a computer was easier than with paper and pencil.

Interpretation

Test results from this study do not conclusively support the hypothesis that there is a relationship between use of computer software in a math curriculum and higher test scores. On the chapter 8 evaluation, the test group scored higher, but on the chapter 9 evaluation, the test group scored lower. The majority of students in the test group reported a higher motivation and interest in doing math on a computer, and this may have a positive result on test scores given over a longer period of time. Because past research has indicated a possible link between computer use and higher success, I am not discouraged by the results of my study (Anderman, 1995:
Dollor, 1983). Further research done over longer periods of time may prove a positive relationship between computer use and higher test scores.

**Dissemination of Findings**

I plan to share the results of my study with members of the math curriculum committee of Kentwood Public Schools at the next meeting (April, 1996). My school administrators have also expressed an interest in this study and I will share my information with them when my thesis is published. Because I believe using the computer to support the learning of math is a good idea, I hope this thesis will encourage others to incorporate technology in their curriculum.
References


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# Appendix B: MEAP Performance by Fifth Hour Students

## October 1995

### Classroom Listing Report

**Essential Skills Mathematics**

**Grade 7**

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Appendix C
Motivation/Interest Survey

1. Do you like doing some math work on the computer?

   YES       NO       NOT SURE

2. If yes, what do you like about it?

   If no, what do you not like about it?

3. Do you think the computer can help you learn math?

   YES       NO       NOT SURE

   If yes, how?

   If no, why not?

4. Are you more motivated to learn math when you use the computer?

   YES       NO       NOT SURE

   If yes, tell why.

   If no, tell why not.

5. What effect do you think using a computer has on learning math? Please be specific.
Appendix D
List of Software

Transition Math software----Chicago Math Project
Scott Foresman

GoeExplorer----Chicago Math Project
Scott Foresman

SkillsBank 96: Math----Skills Bank Corporation
Fas-Track Computer Products

Middle School Math----Tandy

Intro to Algebra----Tandy

Alge-Blaster 3----Davidson
Appendix E  Graph of MEAP Scores

Average Statistics MEAP Scores 1995

Average Geometry MEAP Scores 1995
Chapter 8 Test, Form B

1. List two reasons for using a graph to display information showing population changes in the 50 states over a 50-year period.

In 2–6, use the graph shown.

2. What does the heavier solid black line represent?
3. What is the interval on the vertical scale?
4. During which 10-year period did service/sales workers become the largest group of employees?
5. Did the difference between clerical workers and service/sales workers increase or decrease between 1950 and 1960?
6. Put the following information into a bar graph.

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<td>D</td>
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</tr>
<tr>
<td>F</td>
<td>3</td>
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</tbody>
</table>

7. Use the graph at the right. Which island is nearly the same size as Baffin?
Chapter 8 Test, Form B  (page 2)

8. Graph these points: A (0,4), B (-5,0), C (2,-1), D (-3,-5), E (6,5).

9. Graph the line \( x + y = 3 \).

10. a. Plot this information on the grid at right.
   If a ticket costs $2, Ann will buy 10.
   If a ticket costs $2.50, Ann will buy 8.
   If a ticket costs $4, Ann will buy 5.
   If a ticket costs $5, Ann will buy 4.

   b. If a ticket costs $10, Ann will buy __?__.
Chapter 8 Test, Form B (page 3)

11. Draw the reflection image over the given line.

In 12–15, draw a capital letter below with the given number of lines of symmetry. Show answers below questions.

12. one   13. none   14. infinite   15. two

16. $P'$ is the reflection image of $P$ over line $l$. If $PQ = 5$, then which other segment in the figure has length 5?

In 17–19, use the transformation $(x, y) \rightarrow (x + 3, y - 2)$.

17. Give three instances of this pattern.

18. Graph the preimage points $(-1,3), (2,3), (1,1),$ and $(0,0)$ and connect them in order. Then graph the image points and connect them in the same order.

19. What kind of transformation is this?

20. If triangle $R'S'T'$ is the translation image of triangle $RST$, is triangle $RST$ congruent to triangle $R'S'T'$?

21. A regular hexagon can tessellate. Name two other regular polygons that tessellate.

22. Sketch a tessellation using a figure of Question 21 as a fundamental region. Your sketch should show enough to make the tessellation clear.

Now check all your work carefully.
Chapter 9 Test, Form B

1. \((2 \cdot 3) \cdot 4 = 2 \cdot (3 \cdot 4)\) is an instance of what property?

2. \(-5 \cdot 4 = 4 \cdot -5\) is an instance of what property?

3. What unit would be appropriate to measure the amount of carpeting needed to cover the floor of a room?

4. What unit would be appropriate to measure the amount of sand in a sandbox?

5. Write \(a + b + a + b\) in another way.

6. Similar figures have the same \underline{ }?, but not necessarily the same \underline{ }?

7. You buy 3 loaves of bread at $1.19 per loaf. Show two different ways of calculating the total cost.

8. Dividing by \(\frac{2}{3}\) is the same as multiplying by \underline{ }?

9. Give an instance of the Property of Reciprocals.

10. Write a number that does not have a reciprocal.

In 11 and 12, use the picture of the box of raisins.

11. How much cardboard is needed to make the box? (Assume no overlap of cardboard.)

12. Will 50 cm\(^3\) of raisins fit in the box? Explain.

In 13–17, simplify.

13. \(3 \cdot 5 \cdot 6 \cdot 8 \cdot 1\)

14. \(3 \cdot \frac{5}{18}\)

15. \(-a + a + 2a\)

16. \(7 \cdot \frac{5}{8} \cdot \frac{3}{7}\)

17. \(\frac{8}{9} \cdot 1 \cdot \frac{8}{9}\)

18. Find the area and perimeter of a rectangle with length 15.2 cm and width 23.5 cm.
Chapter 9 Test, Form B (page 2)

19. In a middle school there are 3 seventh-grade homerooms with \( s \) students in each room and 4 eighth-grade homerooms with \( e \) students in each room. If 5 students visited the school on Monday, how many students were in school that day?

20. If you have a fair coin, what are the chances of tossing three heads in three tosses?

21. There are 15 apples on a plate. If \( \frac{3}{5} \) of them are eaten, how many are left?

22. A reporter earns $20 per hour for a regular workday from 8:30 AM to 4:30 PM. After that, she earns time-and-a-half. If she took a 30-minute lunch, what did she earn on a day when she worked from 8:30 AM to 6:30 PM?

23. a. Graph the points (2, 8), (4, 6), (0, 0), and (-2, 2). Connect the points to form a parallelogram. Then draw the image of this parallelogram under the expansion 1.5.

   b. The sides of the image are ___?___ to and ___?___ as long as the corresponding sides of the preimage.

   c. The angles of the image are the ___?___ as the corresponding angles of the preimage.

In 24 and 25, a size change has magnitude of \( \frac{r}{s} \).

24. If \( s > r \), the size change is called a(n) ___?___.

25. If \( s < r \), the size change is called a(n) ___?___.

26. In the flag at the right, the number of stars represents the number of members in the organization. How many members are in the organization?

27. Picture the product of \( \frac{1}{2} \) and \( \frac{1}{8} \) using a rectangular array.

Now check all your work carefully.
Appendix H Copyright Permission UCSM

Scottr Foresman and Company
1900 East Lake Avenue
Glenview, Illinois 60025

To Whom It May Concern,

I am a mathematics teacher in Kentwood, Michigan. My district currently uses the UCSMP textbook series.

Currently I am writing my master's thesis, comparing the achievement and motivation of students who receive traditional teacher instruction and students who receive additional instruction and practice using appropriate software. One of my evaluation tools is the chapter tests in the TM Teachers’ Manual. Specifically, I used the tests from chapters 8 and 9. Therefore, I request permission to reprint those items needed to support the points of my thesis.

I have prepared the form at the bottom of the page for your convenience. Please note that the thesis will be placed on microfilm by UMI Dissertation Services and that they make single copies available upon request. Thank you for your time and consideration.

FAX # 616 455-2054 (Pinewood Middle School)

Mary Grooters has permission to reprint tests from chapters 8 and 9 of the UCSMP TM textbook series, published by Scottr Foresman, for inclusion in her master’s thesis.

Authorized Signature

Date

PERMISSION GRANTED

Acknowledged title, author and copyright notice.

P.02/02
NAME: Mary Ann Grooters

MAJOR: (Choose only 1)

X  Ed Tech       Ed Leadership       Sec/Adult
--- Elem Ed       G/T Ed            Early Child
--- Elem LD       Sec LD            SpEd PPI
---                          Read/Lang Arts

TITLE: A Study of the Relationship Between Use of Technology in Math and Higher Test Scores

PAPER TYPE: (Choose only 1)  SEM/YR COMPLETED: Winter, 1996

X  Thesis
--- Project

SUPERVISOR'S SIGNATURE OF APPROVAL

Using the ERIC thesaurus, choose as many descriptors (5 - 7 minimum) to describe the contents of your paper.

1. technology
2. math
3. learning
4. computers
5. motivation
6. achievement
7. computer-enhanced curriculum
8. 
9. 
10. 

ABSTRACT: Two to three sentences that describe the contents of your paper.

This thesis explored the relationship of a technology enhanced curriculum in a math class to higher test scores and higher motivation. Findings indicate that a technology enhanced curriculum does not lead to higher test scores but does impact student motivation.

**Note: This page must be included as the last page in your master's paper.
Grand Valley State University  
School of Education  
Assessment for EDG 695/EDR 695/EDS 695  
Research Applications

Student Name: Mary Ann Grooters  
Social Security #: 366-54-9207

CHAPTER ONE  
(Objective 2 An understanding of current issues in their field.)

Demonstrates in-depth understanding of at least one issue in their field.
1. Describe why this problem/issue is worthy of study.
2. Identify resources that strengthen the case.
4. Describe options for addressing the problem/issue.
5. Articulate why the option selected was chosen.

CHAPTER TWO  
(Objective 1 An understanding of the recent research in their field.)  
(Objective 4 Demonstrate the ability to critically analyze and synthesize existing and emerging knowledge and pedagogy in their major area.)

6. Includes recent and seminal sources in review of literature.
7. Includes statement of generalization that are supported by the cited research.
8. Finds, integrates and evaluates related work (compare/contrast, categorize).
9. Provides a summary of their literature.

CHAPTER THREE  
(Objective 3 Demonstrate the effective use of research methods appropriate to their field of concentration.)  
(Objective 5 The ability to communicate concepts germane to their major area effectively to others through various kinds of literacy e.g. numeracy, graphics, printed text, computers and electronic data.)  
(Objective 6 Demonstrate the ability to adapt their work to the needs of their clients.)

10. Gives insight into the methods of other researchers.
11. Systematic and comprehensive description of the development/design of the project.
12. Communicates findings in the context of past work.
13. Written in a style that addresses the needs of the clients (students, teachers, administrators, parents, school board, etc.)
14. Provides recommendations for further research and/or dissemination.

Faculty Signature:  
Date Reviewed: 12/19/95

Approved SOE Graduate Committee: 2/14/94