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A Study to Determine the Relationship between Students who Excel in Mathematics and Students who Excel in Technology Education

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A STUDY TO DETERMINE THE RELATIONSHIP BETWEEN STUDENTS

WHO EXCEL IN MATHEMATICS AND STUDENTS WHO EXCEL IN

TECHNOLOGY EDUCATION.

A Research Paper

Presented to

The Faculty of the School of Education

Old Dominion University

In Partial Fulfillment

of the Requirement for the Degree

Master of Science in Education

by

Kevin L. Pace

August 1994

This research paper was prepared under the direction of the instructor in Problems in Education OTS 636. It is submitted to the Graduate Program Director for Occupational and Technical Studies in partial fulfillment of the requirements for the Degree of Master of Science in Education.

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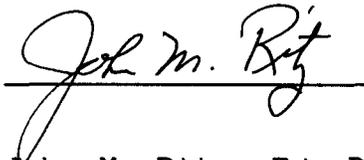
John M. Ritz, Ed. D.
Graduate Advisor

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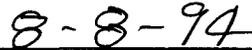
Graduate Program Director

Occupational and

Technical Studies

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CHAPTER I

INTRODUCTION

The purpose of this study was to determine if
success in mathematics at the high school level is a
predictor of success in technology education. The
relationship between mathematics and technology has
always existed. Even biblical passages give the
measurements of Noah's Ark and the Temple of Solomon.

The importance of mathematical and technical
skills cannot be separated. They have become an
integral part of the talent required for the working
force in our present society as well as that of the
future.

We can trace the importance of mathematics as it
was used in developing technology in some of the early
computing machines. Around 3000 BC, the Abacus was
developed (1). It is believed to be among the first
mechanical computing devices or machines.

It was many years later when Blaise Pascal
developed a calculator prototype that would lead the
way to the development of mathematics and the computer.
In 1833, Charles Babbage developed the "Analytical

Engine" which was a computer prototype that was programmed using punch cards (2).

Other methods of numerical calculation and manipulation were used following the discovery of logarithms. One method consisted of a set of wooden sticks called "Napier's Bones" which were marked with logarithmic scales allowing the user to perform simple multiplication and division. This was followed by the slide rule and eventually the principles were applied through electronics to produce the first computer - the "differential analyzer" built at Harvard in 1930 by Vannevar Bush (3). Bush built the first truly reliable analog computer and became one of many in this century to show the need for mathematical skills in the fields of technology. Just as the Analog Computer was the outgrowth of Napier's Bones, the Digital Computer was the outgrowth of the Abacus.

The first true digital computer was the dial telephone system used throughout the United States. Its first installation was in 1922 in New York City. The first actual computer used telephone relays for its operating mechanism and was called the MARK I (4).

In 1947, a group of scientists at Bell Laboratories paved the way for new technological developments when they invented the transistor for the

Bell Telephone company. This led to the integrated circuit which is the basic building block of the modern digital computer.

Within the past two centuries developed countries have made great strides toward becoming a totally technological society. Also a large number of computer jobs have been created due to the invention of the microcomputer. Most of the computer jobs in this century will require mathematical and technical skills with a heavy emphasis upon the use of the computer. To be an independent and self-supportive part of our growing technical society, citizens must be able to consider mathematics and technology skills as fundamental content. These are the basic skills that are taught in the high schools of America to help students grow to be a productive part of society.

PROBLEM STATEMENT

The problem of this study was to determine if there was a correlation between the achievement of high school students in mathematics and their achievement in technology.

HYPOTHESIS

This study was used to gain information about the
success of high school students in mathematics and
technology. The goals established for this research
are:

H_1: Students who excel in mathematics courses
will also excel when studying technology education

BACKGROUND AND SIGNIFICANCE

The technology teacher of today must possess a
variety of skills in order to educate the technological
leaders of tomorrow. In the past, manual skills such
as hammering nails, cutting wood, building furniture
and turning metal were taught so students could find
employment in the work force upon graduation. These
were the industrial or vocational skills needed for
employment at that time.

The craftsman of the past relied upon mathematical
and manual skills to perform his or her job. Today,
the skills needed for employment have increased, but
the mathematical and technological emphasis has become
even more essential to job performance. Computers are

often associated with the technical advancement observed during the past two decades.

The computer, in many ways, has changed the way people do business, the way people communicate and the way teachers educate. The computer has been more frequently found than a set of encyclopedias in the home. People can earn a living today by doing nothing more than operating a computer.

Microcomputer sales are at their highest levels and there seems to be no end in sight. It is the tool of the future and the skills for the future will include programming, building and repairing technical computer systems. Obviously, the people who hold these jobs will need significant mathematical and technical skills.

Schools are trying harder to help develop better trained young people to become a part of the new technological work force. Many vocational training centers have been established all over the country to help meet the needs of the students and the employers.

Technical careers can now be started in the tenth grade of high school at a vocational training center. Students can still get traditional training, but the VO-TECH centers are emphasizing other fields such as

electronics, computer programming, computer repair and computer derived automotive repair and maintenance. These are the fields that will offer employment to those students who are technically proficient.

If a significant link between mathematics skills and technology success exists, it could benefit students who are proficient in mathematics to consider working in the field of technology. Their skills in mathematics could link them to a career that they would be better suited for. This could mean better personnel on the job and better performance in different job areas due to enhanced enjoyment and better acquired skills due to a strong mathematics background.

LIMITATIONS

The following limitations have affected this study:

1) The students in mathematics and technology courses are limited to past and present students enrolled at Deep Creek High School, Chesapeake, Virginia.

2) There is no way of knowing how the final letter grades were established by the individual instructors. The scores could

individual instructors. The scores could
have come from tests, class work,
homework or any variety of classroom
activity.

ASSUMPTIONS

The following assumptions were made concerning
this study:

1) The content validity of this study will
   cover the scores generated by high school
   students enrolled in general mathematics
   courses and technology education courses.

2) The students who achieve higher grades
   in mathematics will also score higher
   grades in technology classes.

PROCEDURES

The completion of this study will contain research
about student's grades at Deep Creek High School in
mathematics and technology courses. Approximately
seventy-five students will be used to complete the
study. The students selected for this study were
randomly selected with the only criteria being their
enrollment in a basic mathematics course and a

technology course. The scores will be analyzed by determining the correlation between mathematics and technology education grades.

DEFINITION OF TERMS

Following is a list of terms that are relevant to the research in this document. A basic knowledge of these terms will assist the reader in understanding this study.

Technology education - An educational program devoted to helping students develop skills related to technology with an emphasis upon hands - on activity.

Predictor - A declaration of what is to come.

Analog - being a mechanism that represents data by measurement of a continuously variable quantity.

Digital - providing information by numerical digits.

Correlation - To show a connection between two variables.

Mathematics skill - The ability to reason

out mathematical concepts and ideas.

SUMMARY

The nature and purpose of this study has been

explained in Chapter I. A need for the study has been

established as well as the goals, limitations and

assumptions about the study.

In Chapter II, a review of the literature was

completed to give data about previous studies in this

area. Chapter III explains the methods and procedures

that were used to collect the data. The findings of

the study will be revealed in Chapter IV and the

summary, conclusions and recommendations were made in

Chapter V.

CHAPTER I END NOTES

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CHAPTER 2

REVIEW OF THE LITERATURE

This chapter presents a review of literature that gives educator's view points toward mathematics and technology integration. This integration is a key factor that reveals the correlation between mathematics success and technology education success. Within this chapter are sections on Integration of Mathematics and Technology, National Assessment of Education Performance, and Successful Technology Programs.

INTEGRATION OF MATHEMATICS AND TECHNOLOGY

Many factors contribute to the success of technology education students. Over the past 10 years, many educational institutions have made improving the quality of mathematics, science and technology education a priority. In Illinois, a project known as PHYS-MA-TECH integrated math, technology and science together in five high schools. The project was highly successful in completing an integration of the three subjects, developing academic content related to the three subjects and initiating a strong classroom delivery with support from teacher colleagues and administration (5).

The school systems of Vermont have been working toward a similar goal and began a reform of its vocational programs in 1992. In order to reach the performance level that was desired, four goals for improvement were written.

The first goal involved helping students become productive, competent and caring members of society. They identified problems such as drug abuse, pregnancy, poverty, and poor student health as obstacles to this goal. Secondly, the improvement of the math, science and technology programs was needed to boost the skills of the students who enroll in these programs. The third goal was hiring the nation's most effective teachers and school leaders. Finally, it was the goal of the Vermont state educational system to form partnerships among parents, teachers and community leaders to support student endeavors and increase learning in every community (6).

These ideas for improvement have come at a time when many states in this country have found a need for improving relations and integrating math and technology together. The National Board of Education set standards when it established goals for a program known as "America 2000". There were six goals established to guide this government initiative. The goals were:

readiness for school, high school completion, student achievement, math and science achievement, adult literacy and safe disciplined, drug - free schools.

Ohio was another state looking for educational reform for math and technology and patterned its six goals very close to the goals of America 2000 (7). The program that was developed for Ohio involved preparing the students to advance successfully in the working world and make competent, informed choices in their lives. Six goals were established to help their students reach this performance level.

Goal one was student readiness for school. In child care vocational programs, students are being taught developmentally appropriate skills to help in the adjustment between pre-school and first grade.

At the high school level, programs were provided to allow for at-risk students to gain employment through vocational training, occupational work adjustment, and eventual graduation. These areas were developed to reach Goal Two which was high school completion.

Goal Three involved student achievement and citizenship. In this area, students were given competency tests for vocational programs to provide them the chance for a high success rate. Also, a

statewide system of core standards and performance measures were planned.

Goal Four was achievement in math and science with an emphasis on the new Tech Prep requirements. It was discovered that applied academics integrated with principles of technology courses would help strengthen math and science skills. Adult literacy and lifelong learning problems were addressed in Goal Five.

Competency analysis profiles were completed on program completers and used to help advance the skills of the adults that are working in Ohio. Full service adult education centers were established to enhance the work force on their job performance and improve the quality of their work life for the people of Ohio.

The final goal of the program involved maintaining drug-free schools. Vocational student organizations are now active in anti-drug and alcohol abuse campaigns (8).

NATIONAL ASSESSMENT OF EDUCATIONAL PERFORMANCE

A study completed by the state of Louisiana identified mathematics processes and concepts that were being taught in their Industrial Arts/Technology Education programs by reviewing literature, completing

phone interviews with nationally recognized technology teacher educators and evaluating state curriculum guides. A questionnaire was developed and mailed to two-hundred and forty-eight Louisiana technology instructors. The following information was found:

1) Louisiana teachers should continue to incorporate math related ideas and concepts into their courses.

2) Mathematics related content in technology curriculum guides should be easily identified.

3) Administrators should be aware that math concepts and ideas are being taught in technology courses and no technology courses should be eliminated to provide room for required math programs (9).

It is important to note that math and technology are not only being integrated at the high school level but at the elementary level as well. An article from The Technology Teacher, a nationally recognized source for literature about technology, has identified elementary level technology as an appropriate way to enhance personal growth, creativity, and help students gain an understanding of the world. The article states: "The manipulation of materials can make abstract mathematical concepts concrete (10)."

SUCCESSFUL PROGRAMS

In order to complete a successful review of the literature, it is necessary to include programs that have integrated math and technology into their instructional content. In the "Journal-of-Epsilon-Pi -Tau", a study was completed involving one hundred-seven graduates of teacher education programs. A statistically significant relationship was discovered between math and verbal scores on the Scholastic Aptitude Test (SAT). Jack W. Wescott concluded that these parts of the SAT test were the most significant factors associated with the success of Technology Education majors (11).

A second program was started by the University of Massachusetts, the Massachusetts school system and private corporations. Their goal was to recruit into teaching technology a group of academically talented graduates of math, English and science. The project known as MESTEP was a fifteen month masters program in which students would prepare themselves to move into teaching or industry (12).

This was a collaborative partnership designed to get talented recruits and was heavily supported by local industry. One part of that support involved

local companies hiring the MESTEP graduates for summer employment.

The partnership was a successful one as many outstanding Bachelor of Science and Bachelor of Arts graduates were recruited into the teaching profession. Eight factors were identified as critical to the success of this program and are listed as follows:

1) Clarity and perceived priority of objectives.

2) Short and long term measurability of success.

3) Service to self-interest of each partner.

4) Indispensability of each partner.

5) Power and authority of each partners representative.

6) Recognition of different capacities of and constraints upon each representative.

7) Benefit of ambition and risk taking.

8) Commitment to coordination and management.

SUMMARY

The literature revealed that there have been many attempts to integrate math and technology in the search for vocational reform. Most systems have set up goals for program success and many even modeled their goals after the National Educational Assessment. It was found that the integration of math and technology was beneficial at the high school level and at the elementary level as well. It was also recognized that partnerships between school and industry have been established and have been successful in recognizing the importance math and technology have on one another.

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        Success in a
        School-University-Industry-Partnership
        for Teacher Education."

CHAPTER III

METHODS AND PROCEDURES

Chapter III provides the strategy used to complete this study. The procedures used to acquire the information needed for this study and the evaluation information are listed in this chapter under the sub-headings of: population, selection of subjects, conditions of data collection, research variables, measuring instrument and data analysis.

TARGET POPULATION

The students that were selected for this study were chosen randomly from a group of students who attended Deep Creek High School during the school years 1992 through 1994. The students chosen had taken a course in mathematics and a course in technology during the same school year. The mathematics courses that could have been taken included, General Mathematics, Algebra, Algebra II, Geometry or Trigonometry. The technology courses that were selected by the students could have included, Manufacturing and Construction, Basic Drawing, Architectural Drawing, Electronics I, Electronics II, Communications I or Communications II. All of the classes selected for the study were one year programs and students were selected from each of the

classes offered in technology and mathematics. In this
way, this study was able to produce a cross sectional
study of the two fields and students involved in them.

SELECTION OF SUBJECTS

The students selected for use in this study were
those who had taken the Scholastic Aptitude Test (SAT)
and the Literacy Passport Test prior to the completion
of their high school education at Deep Creek High
School.

CONDITIONS OF DATA COLLECTION

Permission was obtained from the guidance director
at Deep Creek High School prior to the collection of
data. Grades for the individual subjects in technology
and mathematics were gathered on the seventy-five
random students.

RESEARCH VARIABLES

The mathematics and technology grades were
selected from each students record from the same school
year and comparisons were made between the two
subjects.

DATA ANALYSIS

The measuring instrument used to correlate the factors of Technology success and Mathematics success was Pearson product-moment correlation. The formula used to compute Pearsons r is:

$$r = \frac{N \Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{(N \Sigma X - (\Sigma X)^2}\ (N \Sigma Y - (\Sigma Y)^2}}$$

The data in this study was analyzed to determine if mathematics success was a predictor of success in technology education. Interpretation was made through statistical measurements.

SUMMARY

This chapter described the population to include students who have attended Deep Creek High School between the years 1992 - 1994, were enrolled in a mathematics class and a technology course during that time and have taken the Scholastic Aptitude Test and the Literacy Passport Test. This chapter also describes the methods used to determine if a significant correlation existed between mathematics success and technology success.

CHAPTER IV

RESEARCH FINDINGS

This study was designed to determine if a student's success in mathematics could be a predictor of the same student's success in technology education. For purposes of this study, information was gathered from a random selection of seventy five Deep Creek High School students who graduated between 1992 and 1994. All of the students in the study had taken the Scholastic Aptitude Test (SAT) in the twelfth grade.

Letter grades for each of the seventy-five students were gathered in the areas of mathematics and technology education. A comparison of the mathematics grade and the technology grade was made using the Pearson product-moment method of determining the coefficient of correlation.

The information that follows in this chapter describes the relationship between math grades and technology grades and how math success is a substantial predictor of success in technology education.

Table 1 indicates the Pearson product-moment correlation coefficient between math grades and technology grades. An r of .283 is needed to be predictable at the .01 level therefore, an r of .399

shows a moderate correlation but substantial

relationship that exists between math and technology.

TABLE 1

$Supplementary$ $Information$	$Computation$ of $"r"$
$\Sigma x = 190$ $\Sigma y = 223$ $\Sigma xy = 598$ $\Sigma x^2 = 574$ $\Sigma y^2 = 737$ $N = 75$	$r_1 = \dfrac{75(598) - (190)(223)}{75[(574) - (190)^2][75(737) - (223)^2]}$ $r_2 = \dfrac{44,850 - 42,370}{(43,050 - 36,100)(55,275 - 49,729)}$ $r_3 = \dfrac{2480}{(6950)(5546)} \qquad r_5 = \dfrac{2480}{6208}$ $r_4 = \dfrac{2480}{\sqrt{38,544,700}} \qquad r_6 = .39948$

Figure 1 indicates another relationship that

exists between student grades in the two courses. The

purpose of the study was to determine if math is a

predictor of success in technology education. The

following comparisons were made to determine other

relationships that exist. Seventy percent of the

students who scored an A in a mathematics course scored

an A in a technology course. Another 17 percent who

scored an A in a mathematics course also scored a B in

a technology course. Also, no student who scored an A

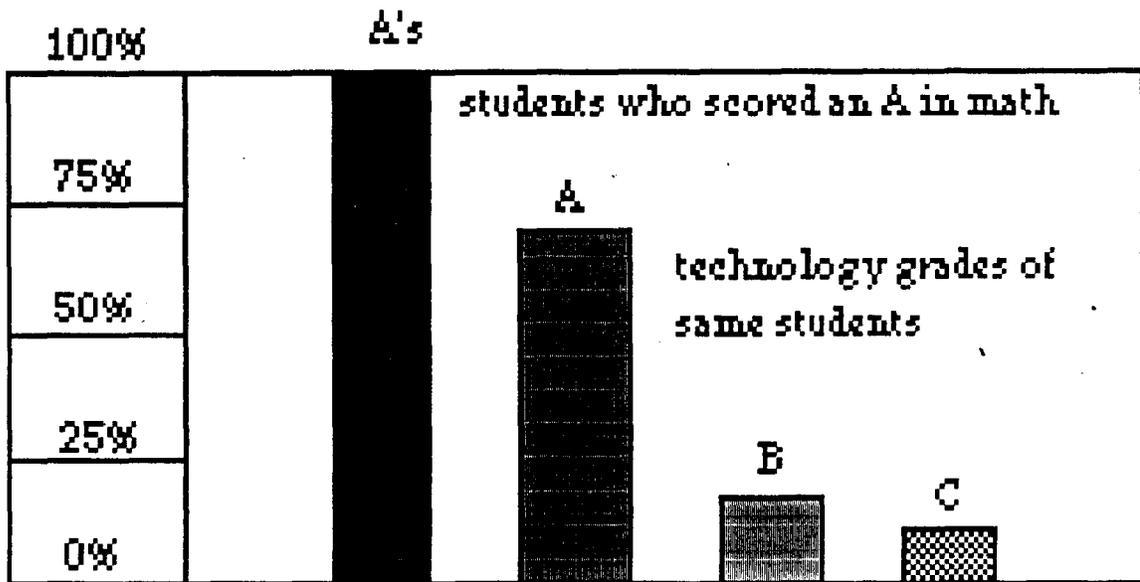in mathematics scored less than a C in a technology

course.

FIGURE 1

Figure 2 recognizes other similar comparisons in grades between math success and technology success. It is shown that 37 percent of the students who scored a B in a mathematics course scored an A in a technology class.

Furthermore, 41 percent of the students who scored a B in mathematics scored a B in a technology course and the other 22 percent who scored a B in a mathematics course scored a D or better in a technology course. Again, no student who achieved a grade of a B or higher in mathematics failed a technology course.
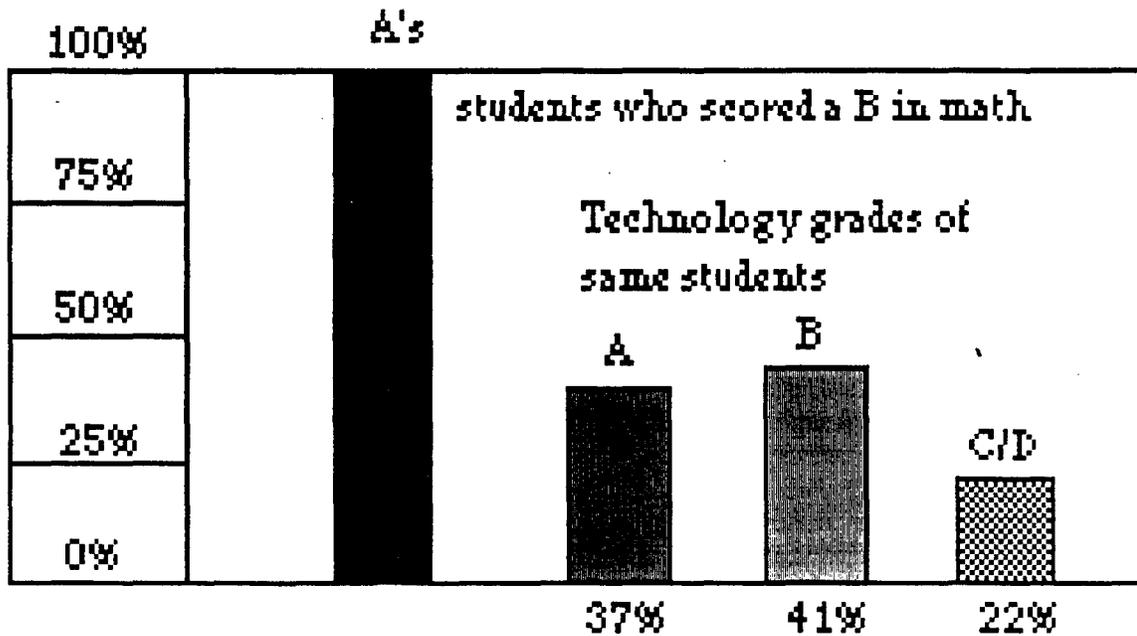
FIGURE 2

Figure 3 shows a comparison of Scholastic Aptitude test scores and math and technology success. Since the scholastic aptitude test is a widely used test to determine a students potential for academic success in post high school education, it could be assumed that students who score well on the SAT in mathematics have genuine mathematics ability. The figure shows that 100 percent of the students who scored 900 or better, which is above average, on the SAT test, scored A's in mathematics and technology.

FIGURE 3

students who scored 900 or better on the SAT test

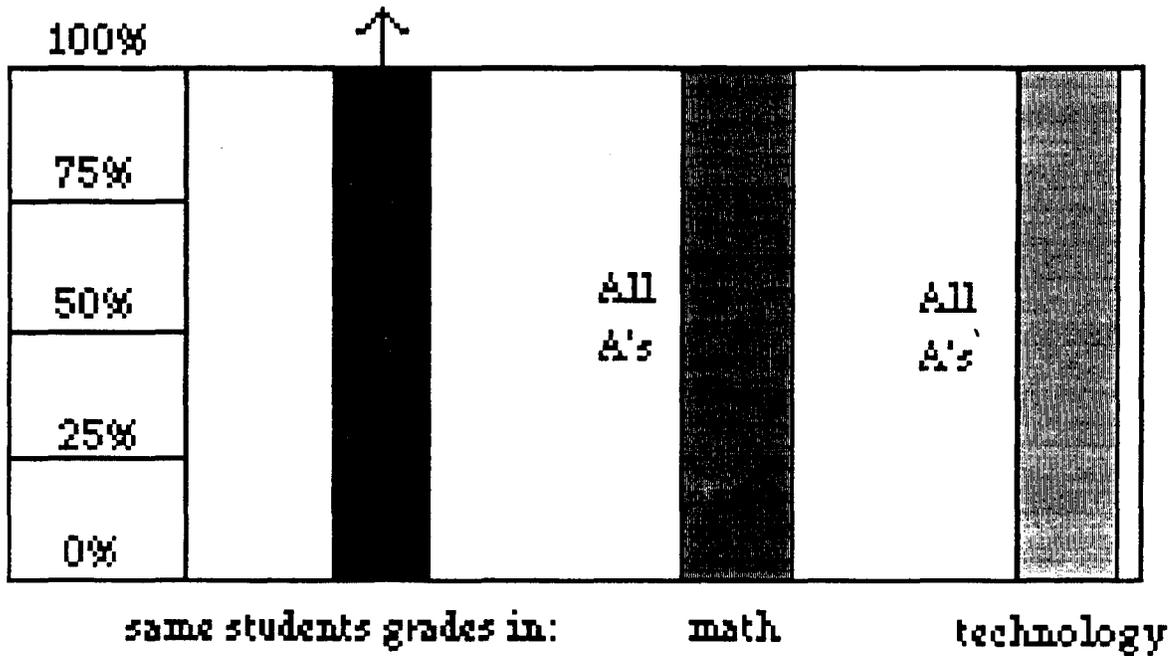same students grades in: math   technology

Figure 4 continues with information from the SAT test and recognizes the percentage of students who scored 800 or better. Of the 75 students polled for this research, 38 percent scored 800 or better on the SAT test and of that 38 percent, 87 percent scored no lower than a B in a math or technology course. It was also found that the remaining 13 percent scored no lower than a C in a math or technology course.

FIGURE 4

75 SAT test students

students who scored 800 or better on the SAT test

students who scored no lower than a B in math or technology.

students who scored no lower than a C in math or technology
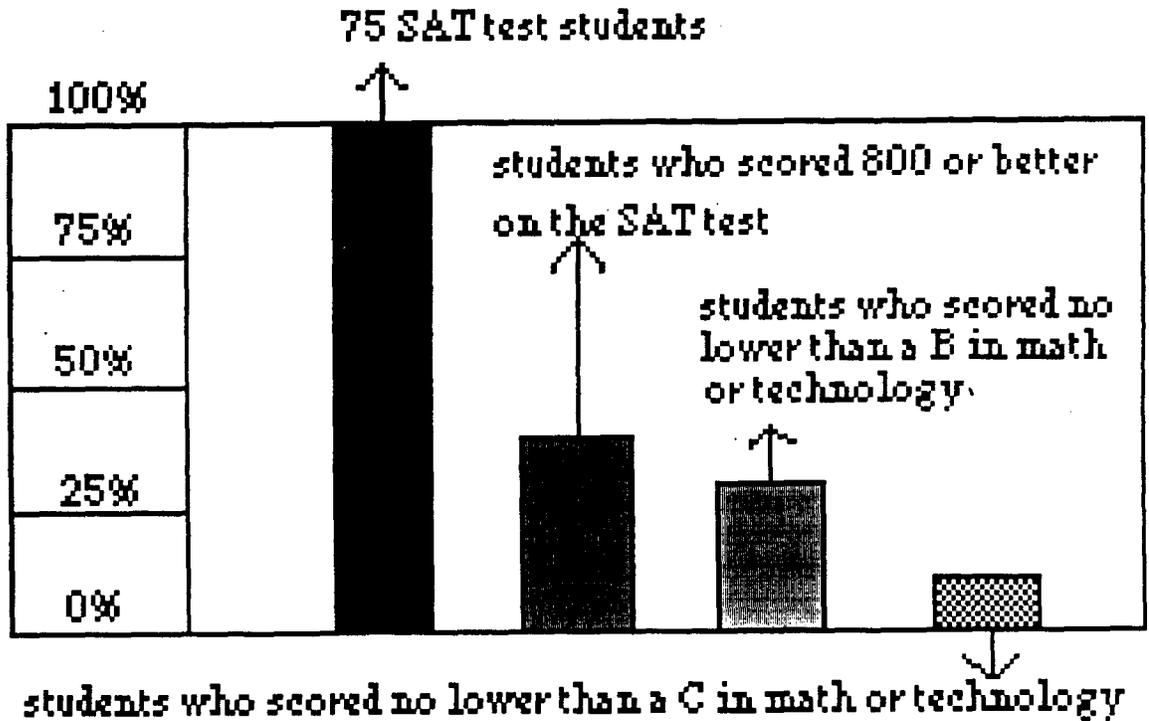
SUMMARY

The statistical method that has been used to evaluate the data in Chapter IV is the Pearson product-moment method of coefficient correlation. It was used to determine a moderate correlation but substantial relationship that existed between a student's success in mathematics and success in technology education. Other findings in this chapter consisted of comparisons made between students grades in math and students grades in technology. In these comparisons, a high correlation was shown between successful mathematics grades and successful technology grades and a marked relationship was determined. Finally, scholastic aptitude test scores were used

because of their importance in the prediction of post
high school success and because half of the score
attained on the SAT test was based solely on
mathematics skill. It was found that students who
scored above average on the SAT test almost always
scored high marks in mathematics and technology.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The problem of this summary was to determine if there was a correlation between student success in mathematics and student success in technology education. The hypothesis of this study was to determine if students who excel in mathematics courses will also excel when studying technology education.

It is significant to mention that the leaders of tomorrow need to possess some technological skills to aid them in the jobs of the future. Mathematics has always been an important part of technology. In the past, craftsman were dependent upon mathematics skill to help them build and create things for essential use in the home or abroad. Now, computers are the tool of tomorrow and it is essential to have good math and technical skills to fill the jobs of the future with qualified personnel. To this end, this research was undertaken to determine a correlation between mathematics and technology. It was limited to 75 random student samples from Deep Creek High School, Chesapeake, Virginia.

In addition, the letter grades used to correlate the study were established by the individual

instructors and could have come from many types of
school work. The type of instrument used to measure
the information gathered for this study was the Pearson
product-moment coefficient of correlation and the
information was gathered with permission from the local
school system.
All subjects selected for the study were selected at
random.

CONCLUSIONS

The findings of this study have revealed a true
hypothesis. The hypothesis stated that students who
excel in mathematics will also excel in technology
education. There is a relationship between mathematics
success and technology education success. This was
shown using Pearsons product-moment coefficient
correlation. When the math grades and the technology
grades were compared and analyzed a significant
correlation existed. It was discovered that there was
a high correlation and a marked relationship between a
student who is successful in mathematics and one who is
successful in technology education.

Seventy percent of the students who scored an A in
mathematics also scored an A in technology education.

Also, another 17 percent of the students who scored an A in mathematics scored a B in technology education.

In another comparison, the SAT test score which was used to predict the success of students in post high school education and was used as a major factor in a college selection of students was used to show a comparison. It was discovered that 100 percent of the students who had a combined SAT test score of 900 or better scored and A in mathematics and an A in technology. Secondly, using just the math portion of the SAT test, it was discovered that none of the students who received an A in mathematics and technology scored lower than 400 points on the math portion. This would place most students in the above average category in mathematics.

RECOMMENDATIONS

In the future, studies should be conducted on the same topic using a wider variety of subjects. Some particular mathematical subjects could be singled out to determine their importance to skills in technology. Algebra, for instance is the math skill that the new curriculums want every student to achieve success in. It may be interesting to see if Algebra is a predictor of technology success based upon it being the basic

requirement for all students to graduate. This applies

most recently to the new "Tech Prep" program being set

up in Chesapeake, Virginia.

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CHESAPEAKE CENTER FOR SCIENCE AND TECHNOLOGY
NEW COURSES 1994 - 1995

COMPUTER APPLICATIONS: (817) This course replaces Advanced
Programming and is a one-year, three elective - credit course.
It is not a completer class. Students learn "C" programming
language, FoxPro, Networking Applications, Telecomputing, and
Authoring Multimedia Software. Students who enter this course
should be comfortable with the keyboard and with computers.
This course will involve working with new Networking equipment
and some of the latest technology.
THE THREE CREDITS GRANTED FOR THIS COURSE ARE WEIGHTED CREDITS.

LANDSCAPE DESIGN AND MANAGEMENT: (820) A one-year completer
course in which students learn to identify and operate
equipment used in the landscaping field, to utilize computer
software in the layout and design of landscapes, and to
implement the designs into landscaping projects. Applicants
must meet specific requirements to qualify for this program
(Disadvantaged population).

COMPUTER LANGUAGES AND APPLICATIONS IS NOW A ONE YEAR COMPLETER
COURSE (Beginning with the 1994-1995 school year).

ALGEBRA 1 OPTION: Beginning in the fall, 1994, Algebra 1 will
be offered to students at the center. It will be taught over a
period of two years, which will allow more time for mastering
the subject. Students are encouraged to take advantage of this
opportunity, since Algebra 1 is often required for
apprenticeships and technical fields of work. Students will

earn five vocational credits and one Algebra 1 credit after successfully completing two years at the center.

The new CCST application asks the students to specify whether they wish to take advantage of this option. It is not mandatory, but is certainly encouraged for students who plan to enter apprenticeships or who plan to pursue further technical training. It is designed for students who plan to spend 2 years at the Center since it is completed in a two-year period.