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Effects of Instructional Technology on the Mathematics Achievement of Eighth Grade Students

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EFFECTS OF INSTRUCTIONAL TECHNOLOGY ON THE MATHEMATICS ACHIEVEMENT OF EIGHTH GRADE STUDENTS

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Approved by

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CHAPTER I

INTRODUCTION

"Properly used, technology helps teachers present concepts to students more efficiently and helps students learn with more convenience. Technology has also allowed students to learn math in a more dynamic way" (Ferguson, 2000, p. 18). Students are surrounded by technology, at school and at home. Students are drawn to technology, whether it is their iPod, cell phone, or computer; they are almost constantly using some form of technology. Using technology as a teaching tool to increase students desire to learn and understand mathematics naturally feeds off their desire to be engrained with technology, which can result in better learning and improved performance on standardized tests.

The "old" style of teaching, strictly in front of the class on a chalk board, is no longer capable of effectively reaching all students. Prensky (2001) coined the term "Digital Natives" to describe students who are "native speakers" of the technology they are surrounded by which has many teachers cringing due to their lack of technological vocabulary. Yet, to reach all students, teachers need to embrace the technology, becoming "Digital Immigrants, those who were not born into the digital world but have, at some later point in our lives, become fascinated by and adopted many or most aspects of technology" (Prensky, 2001, p. 1). If teachers do this, they will capture the attention of students and enhance their learning environment.

Probably not surprisingly, the other "futuristic" topic identified by a substantial number of the colleagues we interviewed was technology. Research into the

> impact of technology is likely to flourish, according to our respondents, who saw the question of what students are learning from technology as being pivotal. A particular concern was how computers might be used not only in the mathematics classroom but also in society "in a humane and sensible way". (Silver & Kilpatrick, 1994, p. 752)

In the past, using computers as a teaching aid was not normally considered when formulating a curriculum. However, students have changed in the way they learn and teachers need to take the most effective methods of reaching the most students when developing curriculum and utilize the tools that students are confident in using. In the end, students will be able to learn, retain, and apply more of what was taught, thus students will perform better on standardized tests.

STATEMENT OF THE PROBLEM

The problem was a study to determine how Norfolk Middle School Mathematics teachers' use of instructional technology in their classroom affected student's success on the 8^{th} grade Standards of Learning (SOL) test.

HYPOTHESIS

The hypothesis of this study was:

H_1: Mathematics teachers who use instructional technology to support their teaching will have students who score higher on the 8th grade Mathematics Standards of Learning assessment.

BACKGROUND AND SIGNIFICANCE

In an effort to reach students with a style of teaching that captures their attention and enhances their learning requires teachers to look to new instructional ideas that appeal to students. CEO Forum (2001), a partnership between technology based companies and educators, believes that teachers will use technology as effectively and seamlessly as they employ chalkboards today. In his review of 219 research initiatives, completed from 1990 to 1997, Sivin-Kachala (1998) found these positive effects from integrating technology into the classroom:

- Students in technology rich environments experienced positive effects on achievement in all major subject areas.
- Students' attitudes toward learning and their own self-concept improved consistently when computers were used for instruction.

Virginia Department of Education has a five year plan to ensure every school in Virginia is prepared to use technology in the classroom. This plan looks at how students are evolving and the best method of reaching them in the classroom.

> While preparing children for this rapidly changing world, educators must incorporate technology that helps students better learn the skills they will need to participate fully in the global community. In the last six years, research (Hefzallah, 2004; Brown, 2006; Harwood & Asal, 2007) has revealed new realities about how the brain works and how people learn best; these studies not only reinforce Virginia's focus on technology integration but encourage greater use of the most recent technological advancements. (2010-2015 Educational Technology Plan for Virginia, 2011, p. 5)

Today's teachers need 21st century instructional technology in the classroom to be able to reach students. Effectively using technology in the classroom will not only help enhance the learning environment of students, it will help improve their performance on standards of learning tests. More so, however, it will help prepare students to be ready to enter society as a productive member, capable of effectively and efficiently using the advanced technology that is yet to come.

LIMITATIONS

This study was limited specifically to 8th grade mathematics programs at middle schools in the Norfolk City School District of Virginia. It limited the instructional technology to computer related technologies, mathematics software, or online website applications. This study did not delve into the socio-economic status of the schools. Additionally, the study did not consider the entering proficiency of the students who entered 8th grade. This is a limitation as the researcher did not know the pre-study level of proficiency of the students when they started 8th grade.

ASSUMPTIONS

This study made the assumption that Norfolk Middle School 8th grade mathematics classes have access to computers, which will use software or online website applications as a method to enhance instruction and student learning. The web-based mathematics applications are used during class time by all students and at home by a majority of the students. The students are capable of adequately using the computer-based instructional technology on their own, without over the shoulder assistance from the teacher. The teachers include and engage the instructional technology to enhance

instruction and learning opportunity of their students. Additionally, the assumption was made that the demographic diversity of Norfolk middle schools would not significantly affect the findings and conclusions of this study.

PROCEDURES

This research was conducted through a research instrument. The research instrument was a survey that was conducted with 8th grade mathematics department heads in each of Norfolk's Middle Schools. The survey collected information on the types of instructional technology used to aid in teaching mathematics and the amount of time that was dedicated to using the instructional technology. SOL test score data were collected from the Virginia Department of Education (VDOE) website. The survey responses and SOL data were analyzed and the results of the study were reported.

DEFINITION OF TERMS

The following terms were used in the conduct of this study:

1. 8th grade mathematics – Algebra and Geometry.
2. Digital Immigrant – those who were not born into the digital world but have, at some later point in our lives, become fascinated by and adopted many or most aspects of technology (Prensky, 2001).
3. Digital Native – students capable of speaking in digital terms as related to computers, video games, and the Internet (Prensky, 2001).
4. Failed – Virginia Standards of Learning test score 399 and below.
5. Instructional technology – the use of various technology tools to teach or enhance learning. This report does not include calculators.

6. Pass/Advanced – Virginia Standards of Learning test score between 500 and 600.
7. Pass/Overall – Virginia Standards of Learning test score between 400 and 600.
8. Pass/Proficient – Virginia Standards of Learning test score between 400 and 499.
9. Technological literacy – the ability to understand, learn, and effectively and efficiently use technology.
10. Technology – process by which humans modify nature to meet their needs and wants.

OVERVIEW OF CHAPTERS

Chapter I is an introduction to the study and the rationale for carrying out the particular research. The problem being researched was stated as a study to determine how Norfolk Middle School Mathematics teachers' use of technology in their classroom affected student's success on the 8th grade Standards of Learning (SOL) test. The hypothesis of the study states that mathematic teachers who use instructional technology to support their instruction will have students who score higher on the 8th grade Mathematics Standards of Learning assessment. The significance of the research is learning the effects of using technology as a teaching aid in mathematics to help show the importance of reaching students in ways that they are familiar and confident.

Chapter II will cover a Review of Literature to enable the researcher to obtain a deeper knowledge of the subject being researched and to compare and contrast other

research on the topic. Chapter III will cover Methods and Procedures in which the researcher will describe methods that will be used to collect and analyze data. This will include defining the population for the study, listing the research variables, describing the instrument being used and the instrument design, the method of data collection, and the statistical analysis.

Chapter IV will cover findings of the study after reviewing the results of an analysis of the data. Chapter V will detail conclusions based on the findings and how they relate to the hypotheses guiding this study.

CHAPTER II

REVIEW OF LITERATURE

The content of this review of literature is to provide background information on the role of instructional technology in the classroom and how it has been integrated with curriculum to improve student learning and performance. The first section of this chapter will answer the question of the role of instructional technology in the mathematics classroom. The 2010-2015 Educational Technology Plan for Virginia will be examined to determine the schema for implementing technology in the classroom. While there is research on this topic, this experiment will provide a basic snapshot of how instructional technology in Norfolk middle school mathematics improved student performance on standardized tests.

Role of Instructional Technology

Before instructional technology can be discussed, the essentials of technology must be understood. The Committee on Technological Literacy defines technology as "the process by which humans modify nature to meet their needs and wants" and explains technological literacy as "encompassing three interdependent dimensions – knowledge, ways of thinking and acting, and capabilities" (Technically Speaking, 2002, pp. 2-3). The requirement of students entering society is that they are technologically literate, able to efficiently and effectively use today's technology in completing tasks.

Students are surrounded by technology from the time they get up in the morning and get ready for school, until they lay their heads back on their pillows at night. They brush their teeth with sonic toothbrushes, communicate non-verbally with a new language, and complete their homework on computers. They absolutely embrace this

technology as a way of life; using technology is as natural for students today, as playing outside until the street lights came on was for past generations. It is this constant immersion in technology that allows students to effectively employ the technology much easier than many adults. Therefore, it is no surprise that students desire to employ technology in their learning in the classroom and even find it easier to learn using technology over the old paper and pencil method.

In a position paper, The National Council of Teachers of Mathematics (2008) supports the use of instructional technology in teaching and learning mathematics:

> Technology is an essential tool for learning mathematics in the 21st century, and all schools must ensure that all their students have access to technology. Effective teachers maximize the potential of technology to develop students' understanding, stimulate their interest, and increase their proficiency in mathematics. When technology is used strategically, it can provide access to mathematics for all students. (p. 1)

The Council discusses the importance of using technology to provide a high-quality mathematics education. Integrating instructional technology into the classroom gives teachers additional resources and options to use and provides the ability to present difficult material in multiple ways to reach the most students, which is a great capability as the size of classes and the diversity of the students' increase. It is imperative that schools provide access to computers, mathematical software, the internet, and other instructional technologies. This further requires teachers to formulate curricula, lesson plans, and day-to-day activities to employ the technologies in an effective manner to enhance the teaching and learning experience of all students.

2010-2015 Educational Technology Plan for Virginia

The 2010-2015 Educational Technology Plan for Virginia is a comprehensive framework centered on student achievement and 21st century skills and knowledge. "While preparing students for this rapidly changing world, educators must incorporate technology that helps students better learn the skills they will need to participate fully in the global community" (p. 3). The plan has five focus areas: environment, engagement, application, tools, and results. Each focus area is designed to advance technology in the classroom to help students develop the skills needed to show their conceptual understanding of a topic through the utilization of technology in an effort to best prepare them for the rapidly advancing workforce of today.

The environment in the school not only needs to be safe, but also needs to be flexible and provide a learning atmosphere for all students. This means it has to be able to reach students in a way that invigorates and challenges students to want to learn, which in today's technologically savvy youth requires instruction to quench their thirst for instruction beyond paper and pencil. The quality of instruction and instructional tools has to keep pace with the advancing student body it is supporting, in real and virtual learning environments.

To better engage a 21st century student in a lesson requires that the curriculum purposefully and effectively uses technology to enhance the significance of instruction. Teachers need to come up with innovative ideas of how to integrate instructional technology in a lesson to present a concept in a manner, which "digital native" students will comprehend and be able to learn and apply. This also lends itself to the option of

individualizing the learning process. Students will be able to use technology to aid in their learning.

Application of the knowledge is the third focus area. This requires students to demonstrate understanding of a subject through assessment. Students can solve problems, collaborate, and use technology to accurately present facts and demonstrate skills to effectively use technology to show comprehension. This helps prepare students for what will be expected of them as they enter the work force.

The fourth focus area is tools. Students are required to be able to develop confidence in using the tools that will make the completion of tasks easier. To begin with, schools need to provide authentic resources and support to ensure all students have access to the tools. Pedagogical support of the tools, integrated into the classroom and lessons, must be provided to ensure all students are capable of effectively applying the tools in the proper manner to complex situations. The activities must go beyond basic skills that could be completed with paper and pencil.

The final area is results, which are more than simple assessments, but rather data that drives decisions on how to improve teaching and learning. As the technology advances, the method of assessing knowledge and understanding must advance along with it. This not only includes the technology to conduct the assessment, but also the capability to disaggregate, interpret, and apply the results to improve teaching and learning.

The 2010-2015 Educational Technology Plan for Virginia lays the framework, but it will only be achievable if all levels of education, administrators, teachers, and students, endeavor to learn from and advance with technology.

> While technology can generate new and innovative opportunities, the more important consideration is its value and applicability to meeting each school's goals and objectives. This occurs through understanding these goals and objectives, learning about the capabilities of the technology, and carefully planning for technology use and application in the educational environment. By understanding these factors thoroughly, schools will use time and resources efficiently and effectively while creating opportunities for student academic success. (p. 15)

Understanding how instructional technology improves the ability of students and keeping pace with advancements is required to keep the curriculum accurate and relevant.

Past Research

Instructional developers have worked for decades to improve mathematic education and the inclusion of computer-based technology into the curriculum. Nevertheless, the research into the benefits of instructional technology in mathematics is rather sparse. The following information was extracted from studies conducted in 1999 and 2002.

The study by Middleton and Murray (1999), The Impact of Instructional Technology on Student Academic Achievement in Reading and Mathematics, examined the relationship between the implementation of instructional technology in the 4th and 5th grade classrooms and the achievement on standardized tests in reading and mathematics.

The study employed a Level of Technology Implementation (LoTi) instrument developed by Moersch (1994) to determine how much technology the teachers thought they were using in their classrooms. Following completion of the LoTi, standardized test scores were analyzed to determine if there was a significant relationship between the amounts of instructional technology used had an influence on achievement on the standardized tests. Middleton and Murray determined, "Based on the findings of this study, the level of technology used by the teacher did have a significant effect on the mathematics academic achievement of the fifth grade students, but not on the fourth grade mathematic students" (p. 3).

Kulik (2002) prepared an InfoBrief for Science Resource Statistics, titled School Mathematics and Science Programs Benefit from Instructional Technology, which examined 36 evaluation studies of computer applications in mathematics and science. The report was divided into four types of applications that include integrated learning systems in mathematics, computer tutorials in science, computer simulations in science, and microcomputer-based laboratories. Kulik's review (2002), "found that most evaluation studies reported significant positive effects of instructional technology on mathematics and science learning, but not all technological approaches appeared to be equally effective" (p. 1).

SUMMARY

This chapter presented the role of instructional technology in the mathematic classroom, the six-year plan Virginia has to integrate more technology into the classroom, and some research reports that indicated the positive relationship between instructional technology and achievement on mathematic standardized tests. As a result, additional

research is required to present updated data that projects the status of how instructional technology can positively affect students' ability to learn and apply mathematics and its associated principles. The methods and procedures used to complete this study will be reviewed in Chapter III.

CHAPTER III

METHODS AND PROCEDURES

This chapter contains the methods and procedures used to conduct this experimental study. Technology is a tool that is an essential part of learning for students. To help maximize their efficiency and effectiveness schools should employ instructional technology in the classrooms to ensure they reached students in a manner that will make them successful when taking the Virginia 8th Grade Mathematic SOL tests. This study examined the types of instructional technology and amount of time schools dedicated to using it in the classroom and the effect it had on scores of the 8th Grade SOL Mathematics tests. In addition, this study compared the data received from Norfolk middle schools to determine which Norfolk middle schools used instructional technology at a greater level over other Norfolk middle schools. This chapter provided the population of the study, research variables, research procedures, methods of data collection, and statistical analysis of the instructional technology and test scores.

POPULATION

The population of this study was limited to Norfolk middle schools that had students who participated in the 8th Grade Mathematics Standards of Learning test. There were seven Norfolk middle schools included in the study. This study collected data on a school-wide basis for 8th grade mathematics programs and did not concentrate on individual classes.

RESEARCH VARIABLES

The independent variable of this study was instructional technology middle schools chose to include in their classroom instruction of eighth grade mathematics. The

experimental aspect of the study was to determine how the types of instructional technology and amount of time using instructional technologies enhanced the learning capacity of eighth grade mathematic students. Instructional technology was designated as the independent variable due to middle schools had discrete choices on which technology they used and how much time would be dedicated to using technology to enhance teaching and learning environments for the eighth grade mathematics classes.

The dependent variable of this study was the 8th Grade Mathematic SOL test scores. All subjects of this study participated in the Virginia 8th Grade Mathematic SOL test. Students were given the same mathematics SOL test at the same time and with the same time limitation as directed by administration of the SOL test. The SOL test was the instrument to determine the success of students in learning eighth grade mathematics. The Pass, Proficient, and Advanced scores of the Mathematics SOL test were used in conjunction with the data on what types and amount of time students were engaged with instructional technology to improve their mathematic skills to determine if there is a correlation between the two.

RESEARCH PROCEDURES

Eighth-grade mathematic instruction was completed in each Norfolk middle school as part of a regularly scheduled class for students. There was no control group designated at the beginning of the study. Each middle school was assigned to one of two groups based on the amount of instructional technology used and on the time spent utilizing instructional technology to assist in teaching and learning inside the classroom. Group assignments were based on the survey responses received from the middle

school's 8th grade mathematics department heads. The schools remained segregated from each other as different schools used different technology and each school had varied degrees if inclusion of technology in teaching and enhancing the mathematical skills of their respective students.

The Senior Coordinator in the Department of Strategic Evaluation, Assessment, and Support (SEAS) for Norfolk Public Schools was contacted to obtain permission to complete the study of Norfolk middle schools. Due to the timeframe of when the study was completed, at the end of the 2010-11 school year, the Senior Coordinator recommended that the survey be emailed from the SEAS Office to the Norfolk middles school 8th grade mathematics department heads. This was done to help ensure the survey would be completed. As a result, responses were received from all eight middle schools for 100% participation.

Additionally, completed surveys were returned via email to the SEAS Office and then forwarded to the researcher. The completed surveys were only identified by which school it was received from to protect the identity of the department head that completed the survey.

INSTRUMENT DESIGN

To collect data for this study, a survey was designed to investigate the instructional technology used in Norfolk Middle Schools. The survey was designed with open-form questions to allow for complete explanation of answers.

Survey Question 1 was written to determine the instructional technology, beyond a calculator, that were being used in teaching 8th grade mathematics Norfolk middle

school. Survey Question 2 was written to determine which websites and software were utilized in teaching 8th grade mathematics in Norfolk middle schools. Survey Question 3 was written to determine the amount of time dedicated to utilizing instructional technology to assist in presenting mathematical lesson in Norfolk middle schools. Survey Question 4 was written to determine the amount of time instructional technology was utilized for self-paced practice. A sample of the survey is found in Appendix A.

METHODS OF DATA COLLECTION

The cover letter and survey were emailed to the SEAS Officer Senior Coordinator, who then emailed them to each Norfolk middle school 8th grade mathematics department heads. The completed surveys were returned through email via the SEAS Office. This method was used to collect the data in regards to the types of instructional technology used and the amount of time dedicated to using the instructional technology to enhance students' learning.

The SOL test score data were retrieved from the Virginia Department of Education (VDOE) school, division, and state online report cards website. The SOL test score ratings were based on students' performance. Students that participated in the SOL test received a scaled score ranging from 0 to 600. Students that received a scaled test score of 400 or higher passed the test. For this study, these students were annotated as Pass/Overall. Furthermore, students that passed the SOL test were additionally designated into aptitude levels based on their scaled test score. The two aptitude levels were proficient and advanced. Students that attained a scaled score of 400 to 499 received a Proficient level rating. These students were annotated as Pass/Proficient for this study.

Students that attained a scaled score of 500 or higher received an Advanced level rating. These students were annotated as Pass/Advanced for this study. A scaled score between 0 and 399 indicated the student failed the test.

STATISTICAL ANALYSIS

Analysis of the data was conducted to determine the validity of the hypothesis. The hypothesis predicted that the use of instructional technology in the teaching of 8th grade mathematics would result in increased success on the Virginia 8th Grade Mathematic SOL test. Statistical analysis was completed based on the amount of instructional technology middle schools used in their classroom, the schools were divided into one of two groups; the top three middle schools that had a greater variety of types of instructional technology and significant time in using the instructional technology were in the TECH Group. The four middle schools, which had fewer types of instructional technology or less amount of time using the instructional technology, were in the NON-TECH Group. A related sample t-test was used for this research since the means come from groups that were formed from the same sample divided into two groups. The related sample t-test was a one-tailed test. A t-test was calculated to determine if there was a significant difference in the 8th Grade Mathematics SOL test scores between the TECH and NON-TECH groups at the Pass/Overall, Pass/Proficient, and Pass/Advanced level of achievement.

SUMMARY

This chapter outlined the methods and procedures used to complete this experimental study to determine if there was a significant difference between the use of

instructional technology in teaching mathematics and success on standardized tests. The population was limited to the Norfolk middle schools who had students participate in the 8th Grade Mathematics SOL test. The independent variable was the instructional technology used by teachers and the dependent variable was the SOL test results. The data for the study were collected via an emailed questionnaire, which allowed for explanation of answers. Analysis of the data received was completed using the t-test. Findings of the analysis were documented in Chapter IV.

CHAPTER IV

FINDINGS

The intention of this study was to determine how Norfolk middle schools use of instructional technology in their classrooms affected student's success on the 8th grade Mathematics Standards of Learning (SOL) test. For the purpose of this study instructional technology data were collected from Norfolk middle school 8th grade mathematics department heads and were analyzed on a school-wide basis. SOL test score data were collected from the Virginia Department of Education (VDOE) school, district, and state online report cards website. Chapter IV is a presentation of the data obtained from the middle schools in the use of instructional technology in teaching 8th grade mathematics and SOL test score data were from the VDOE school, division, and state online report cards website. A summary of the findings will be presented at the end of this chapter.

RESPONSE RATE

The survey was emailed to seven Norfolk middle school mathematics department heads. Each department head returned a completed survey, for 100% response rate. The survey was conducted during the period of June 14, 2011, and June 22, 2011.

SURVEY RESULTS

The survey was comprised of four open-form questions and asked Norfolk middle school 8th grade mathematics department heads for the types of instructional technology used, the websites and software used, the time dedicated to teaching using instructional technology, and the time dedicated for self-paced learning using instructional technology. The responses were organized and ordered by frequency.

Question 1 asked: “What instructional technology, beyond a calculator, is used to teach and learn 8th grade mathematics?” The seven middle schools provided the following responses with the number of schools in parenthesis: Smartboard (5), Turning Point (3), Interwrite Smart Slate (4), Document camera (2), Multimedia projector (2), Esembler (1), Flip camera (1), Ti-navigator (1), Ti-smartview (1), and United streaming (1).

Question 2 asked: “What websites or software are utilized?” The seven middle schools provided the following responses with the number of schools in parenthesis: Carnegie Learning (5), Jefferson Lab (JLab) (5), Classzone (4), National Library of Virtual Manipulations (NLVM) (2), National Council of Teachers of Mathematics Illuminations (NCTM) (2), Cool Math (1), Discovery Learning (1), Edhelper (1), Fun Brain (1), Glencoe (1), Henrico County (1), Kutasoftware (1), Math Forum (1), Math-play (1), Mathsnet (1), McDouglas-Little (1), Microsoft Equation 3.0 (1), Smart Software (1), Study Island (1), and Teachertube (1).

Question 3 asked: “What amount of time is instructional technology utilized for teaching 8th grade mathematics?” The seven middle schools provided the following responses with the number of schools in parenthesis: 50% (2), 85% (1), 20% (1), 30 minutes per block (1), 15 minutes to entire block (1), and Daily (1).

Question 4 asked: “What amount of time is instructional technology utilized for learning/self-paced practice?” The seven middle schools provided the following responses with the number of schools in parenthesis: 60-90 Minutes per week (1), 60 Minutes per week (1), 30-45 Minutes per week (1), Daily (1), 40% (1), Once per week (1), and Minimal time (1). Table 1 reports the summary of survey responses.

Table 1

Responses to Survey Questions

School	Instructional Technology	Websites Software	Teaching Time	Practice Time
1	• Smartboard • Turning Point • Interwrite Smart Slate • Ti-smartview	• Math-play • Mathsnet • NVLM • Jlab • Classzone • Teachertube • Discovery Learning • Carnegie Learning	• 30 minutes per block	• 60-90 minutes per week
2	• Interwrite Schoolpad • Multimedia projector	• Jefferson Labs • McDougal-Little • Microsoft Equation 3.0	• 20%	• Minimal time
3	• Smartboard • Turning Point	• Carnegie Learning • Henrico County • Jefferson lab • Classzone • Glencoe	• 50%	• 60 minutes per week
4	• Smartboard • Projector • Ti-Navigator	• Carnegie Learning • Jefferson Lab • Cool Math • Study Island	• 50%	• Once per week
5	• Interwrite • Document camera • Esembler	• Classzone • Kutasoftware • Edhalper • Carnegie • Textbook CD	• Daily	• Daily
6	• Document camera • Flip camera • Smartboard • Wireless slate • United streaming	• Smart Software • NCTM's Illumination • Jlab/ePat • Fun Brain	• 85%	• 40%
7	• Smartboard • Turning Point	• Classzone • Carnegie's Bridge to Algebra • NCTM Illuminations • Math Forum • Virtual Manipulation	• 15 minutes to entire block	• 30-45 minutes per week

The middle schools were divided into two sample groups: those middle schools that incorporated instructional technology into their classrooms (TECH Group) and those middle schools that did not have the same level of incorporating instructional technology into their classrooms (NON-TECH Group). The researcher had to determine from the responses received which Norfolk middle schools used instructional technology as an aid in teaching mathematics to a greater extent over the other Norfolk middle schools. The

criteria for dividing the middle schools into two groups was focused on the variety of instructional technology used, websites or software used, amount of time utilizing the technologies to teach, and amount of time utilizing the instructional technology for self-paced practice. Due to the disparity of the data received, data not in the same measurement, the standard for dividing the middle schools into groups was subjective to the researcher's interpretation of the data received. TECH Group was determined to use more instructional technologies and devoted more time to its use. NON-TECH Group was determined to use a less amount of instructional technologies and devoted a lower amount of time to its use. SOL test score data were not used in the sorting of the schools into the groups. Based on the data received, the schools were divided into the following two groups (see Table 2).

Table 2

School Sample Groups

TECH Group	NON-TECH Group
1	2
5	3
6	4
-	7

SOL TEST DATA

The 8th Grade Mathematics SOL test score percentages were obtained from the VDOE schools, district, and state report card website. The scores were listed as percentages to avoid variation in school student population size differences from detracting from the analysis. The data indicate the percentage of students that scored Pass/Overall, Pass/Proficient, Pass/Advanced, and Failed. Pass/Proficient and Pass/Advanced were not separate groups of students, but were aptitude levels that

Pass/Overall students were designated based on their scaled test score. The Failed percentage was not used in the study, as it would only show an inverse relationship of the Pass/Overall percentage. SOL test score percentages are provided in Table 3.

Table 3

SOL Test Score Percentages

School	Pass/Overall	Pass/Proficient	Pass/Advance	Fail
1	47	37	10	53
2	44	32	12	56
3	52	41	11	48
4	46	35	11	54
5	69	47	22	31
6	54	34	20	46
7	32	25	7	68

PASS/OVERALL t-TEST

The data for the percentage of students passing the 8th Grade Mathematics SOL test were tabulated and compared using the t-test. The mean for TECH Group was 56.7 and 43.5 for NON-TECH Group. The t-value obtained was 1.796 at 5 degrees of freedom. The level of significance at $p > 0.05$ was 2.015. Table 4 shows Pass/Overall SOL data t-test information.

PASS/PROFICIENT t-TEST

The data for the percentage of students scoring proficient on the 8th Grade Mathematics SOL test were tabulated and compared using the t-test. The mean for TECH Group was 39.3 and 33.25 for NON-TECH Group. The t-value obtained was 1.179 at 5 degrees of freedom. The level of significance at $p > 0.05$ was 2.015. Table 5 shows Pass/Proficient SOL data t-test information.

Table 4

Pass/Overall SOL Data t-Test

N	TECH Group	$(x-M)^2$	NON-TECH Group	$(x-M)^2$
1	47	94.09	44	0.25
2	69	151.29	52	72.25
3	54	7.29	46	6.25
4	-	-	32	132.25
∑	170	252.67	174	211
M	56.7		43.5	
S^2	11.24		8.37	
T	1.796			
Df	5			
P(T<=t)	0.05			
t Crit One Tail	2.015			

Table 5

Pass/Proficient SOL Data t-Test

N	TECH Group	$(x-M)^2$	NON-TECH Group	$(x-M)^2$
1	37	5.29	32	1.56
2	47	59.29	41	60.06
3	34	28.09	35	3.06
4	-	-	25	68.06
∑	118	92.67	133	132.74
M	39.3		33.25	
S^2	6.81		6.65	
T	1.179			
Df	5			
P(T<=t)	0.05			
t Crit One Tail	2.015			

PASS/ADVANCED t-TEST

The data for the percentage of students scoring advanced on the 8th Grade Mathematics SOL test were tabulated and compared using the t-test. The mean for TECH Group was 17.33 and 10.25 for NON-TECH Group. The t-value obtained was 2.10 at 5 degrees of freedom. The level of significance at $p > 0.05$ was 2.015. Table 6 shows Pass/Advanced SOL data t-test information.

Table 6

Pass/Advanced SOL Data t-Test

N	TECH Group	$(x-M)^2$	NON-TECH Group	$(x-M)^2$
1	10	53.73	12	3.06
2	22	21.81	11	0.56
3	20	7.13	11	0.56
4	-	-	7	10.56
∑	52	82.67	41	14.74
M	17.33		10.25	
S^2	5.25		2.22	
t	2.101			
Df	5			
P(T<=t)	0.05			
t Crit One Tail	2.015			

SUMMARY

In this chapter, the researcher collected, organized, and tabulated the instructional technology data received from Norfolk middle school 8th grade mathematics department heads and 8th Grade Mathematics SOL data obtained from the VDOE website. Data were processed using a related sample, one-tailed t-test to compare findings. The researcher used the t-tests to compare each of the 8th Grade Mathematics SOL score levels,

Pass/Overall, Pass/Proficient, and Pass/Advanced, to determine if there was a significant difference between the two sample groups. Chapter V will provide an overall summary of the research, provide a conclusion to the research hypothesis based upon the data collected, and make recommendations based upon the results of the study for future research.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this chapter was to provide a summary, conclusions, and recommendations of the research. The summary will provide a synopsis of the background of the research. The conclusions provided in this chapter were based on the information collected by the researcher. The recommendations were based upon the results of the study and were provided to encourage further investigation of the effect and advantages of instructional technologies in reaching students.

SUMMARY

It was important to understand that students have a greater desire and ability to use technology over students in past generations. The advancements in technology conveyed new and innovative ways to present and teach knowledge to students, as well as the need to integrate instructional technology into the classroom. The instructional technology used at various levels in Norfolk middle schools helped prepare 8th grade mathematic students for the Virginia Standards of Learning Mathematics test. This was accomplished using computer technology, websites, and mathematics related software to enhance student preparation for the Virginia Standards of Learning Mathematics tests.

The purpose of this study was to compare how Norfolk middle schools 8th grade mathematics teachers' use of instructional technology in their classroom effected students' achievement on the Standards of Learning Mathematics test. The hypothesis stated that mathematics teachers who use instructional technology to support their teaching would have students who score higher on the 8th grade Standards of Learning Mathematics assessment.

The limitations of this research were population and instructional technologies that were assessed. The population for this research was seven Norfolk middle school eighth grade mathematics programs during the 2010-11 school year. Studying more programs, over a longer period of time, could have proven to be more effective and accurate when comparing student achievement. The instructional technology assessed was a limitation, as the study limited the scope of technology to computer related technology, which included mathematics related websites and software. Opening the research to include all types of technology, including the type of calculators used, may produce different results.

The survey used for this study was an open-form survey generated by the researcher to poll Norfolk middle school 8th grade mathematics department heads on the instructional technology used in the classroom. The survey investigated the types of instructional technology used and the amount of time dedicated to using the various types of instructional technology. The survey was vetted through and distributed by the Senior Coordinator in the Department of Strategic Evaluation, Assessment, and Support for Norfolk City Public Schools. Each of the seven Norfolk middle schools provided responses to the survey for 100% participation. The SOL Mathematics test score data were collected from the VDOE schools, district, and state report cards website.

A related sample, one-tail t-test was then used to determine if there was a significant difference between the two groups of students and their achievement on the 8th Grade Mathematics Standards of Learning test. The seven Norfolk middle schools were separated into two groups; the first group was designated as TECH Group and was determined to be the three schools that used more instructional technologies and

dedicated more time to its use. The second group was designated NON-TECH Group and was determined to be the four schools that used less instructional technologies and dedicated less time to its inclusion in the curriculum. The assignment of the schools into their respective group was based on the data received in the responses to the survey from the schools' 8th grade mathematics department heads.

CONCLUSIONS

This study was concerned with the use of instructional technology in mathematic classes and the effect it had on student's ability to achieve higher scores on the Standards of Learning Mathematics test. The hypothesis considered the relationship between the use of instructional technology and achievement. The hypothesis for this study was:

H_1: Mathematic teachers who use instructional technology to support their teaching will have students who score higher on the 8th grade Mathematics Standards of Learning assessment.

The researcher used a related sample t-test to test the hypothesis. The t-test was a one-tailed test. The Norfolk middle schools were divided into two sample groups: schools that used a greater variety and dedicated more time to the use of instructional technology (TECH Group = 3 schools) and those schools who used less of a variety or dedicated less time to the use of instructional technology (NON-TECH Group = 4 schools). The SOL test score data were analyzed in three separate categories: Pass/Overall, Pass/Proficient, and Pass/Advanced.

For the Pass/Overall analysis, TECH Group had a mean score of 56.7 and NON-TECH Group a mean score of 43.5. The standard deviation for TECH Group was 11.24

and 8.37 for the NON-TECH Group. After calculating the mean scores, the t-value obtained was 1.796 with a critical t-value of 2.015 at $p > 0.05$ level of significance. Since the t-value obtained was less than the level of significance (critical t-value) at $p > 0.05$ level, the researcher concluded that there was no significant difference between the Pass/Overall test scores percentiles for TECH Group and NON-TECH Group at $p > 0.05$ level.

For the Pass/Proficient analysis, the TECH Group had a mean score of 39.3 and the NON-TECH Group a mean score of 33.25. The standard deviation for the TECH Group was 6.81 and 6.65 for the NON-TECH Group. After calculating the mean scores, the t-value obtained was 1.179 with a critical t-value of 2.015 at $p > 0.05$ level of significance. Since the t-value obtained was less than the level of significance (critical t-value) at $p > 0.05$ level, the researcher concluded that there was no significant difference between the Proficient test scores percentiles for TECH Group and NON-TECH Group at $p > 0.05$ level.

For the Pass/Advanced analysis, the TECH Group had a mean score of 17.33 and the NON-TECH Group a mean score of 10.25. The standard deviation for the TECH Group was 5.25 and 2.22 for the NON-TECH Group. After calculating the mean scores, the t-value obtained was 2.101 with a critical t-value of 2.015 at $p > 0.05$ level of significance. Since the t-value obtained was greater than the level of significance (critical t-value) at $p > 0.05$ level, the researcher concluded that there was a significant difference between the Advanced test scores percentiles for TECH Group and NON-TECH Group at $p > 0.05$ level.

The Pass/Overall and Pass/Proficient test score analyses indicated that there was no significant difference in the means between the TECH and NON-TECH groups. The Pass/Advanced test score analysis indicated that there was a significant difference between the means of the two groups at the $p > 0.05$ level. However, the hypothesis was that students would score higher on the SOL test, therefore the Pass/Overall and Pass/Proficient would be required to have had a significant difference in the means to support the hypothesis. In conclusion, the researcher rejected the hypothesis that mathematic teachers who used instructional technology to support their teaching will have students who score higher on the 8th grade Mathematics Standards of Learning assessment.

The results of this study did not support the hypothesis that students who were exposed to a greater variety of instructional technologies and greater amount of time would achieve higher test scores on the Standards of Learning Mathematics test. Those students who were exposed to a greater variety of instructional technologies and more time had slightly higher test scores for the Standards of Learning Mathematics test, but not to the degree that supported the hypothesis. Based on the analysis of the data collected in this study, it was concluded that there was no significant difference in mean test scores on the Standards of Learning Mathematics test for students who were exposed at varying degrees of instructional technology.

RECOMMENDATIONS

Based upon the findings and conclusions of this study, the researcher recommended the following:

1. For future studies, expand the scope of the study to collect more data to enable a more complete comparison and conclusion. Researchers should conduct a study in all common core classes where instructional technology can be used to assist in teaching the class. The study should commence at the beginning of the school year and conclude at the end of the school year. The researcher should also provide an instrument for teachers to log the instructional technology used and the amount of time it is used. The measurement scale should be dictated at the beginning of the study to ensure all data are measured in the same manner and scale. The study should also be completed at the individual class and student level. The instrument designed to collect the data should be written with precise guidelines to ensure data collected will be specific enough to make accurate suppositions. This will provide more fidelity in the data collected and provide analysis that is more accurate.

2. Create an Instructional Technology Development Team (ITDT) to standardize instructional technology in each of Norfolk middle school mathematics programs. The ITDT would be charged with reviewing and determining which instructional technology, websites, and software were the best suited to assist in teaching in middle school classrooms to reach the maximum number of students. Training teachers in the proper implementation and use of the technology could be completed to ensure all teachers to be able to proficiently use the technology. Having standardized instructional technology across a school district will help ensure that each student is afforded the opportunity to equal application and benefits of instructional technology.

3. Factor in student ability levels before the study begins so that the amount of student learning can be determined. Providing a pre-test to all students prior to starting to

teaching new material will enable the researchers to determine the students' knowledge baseline. The pre-test should be similar to the SOL Mathematics test that will be administered at the end of the course. This analysis will provide information on the programs that are achieving the greatest level of knowledge growth which may not be evident by the students' success on the SOL test.

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APPENDICES

APPENDIX A

SURVEY QUESTIONS

A Study of the Effects of Instructional Technology on Student's Success on the 8th Grade Standards of Learning (SOL) Test.

Purpose: This survey will collect data concerning the inclusion of instructional technology in teaching 8th grade mathematics.

Directions: Please provide complete and detailed answers to the following questions.

1. What technology, beyond a calculator, did you use in providing instruction to your students or use to enhance instruction already received?

2. How much time was dedicated to using technology to assist in presenting mathematical lessons?

3. How much time was dedicated for students to use technology to enhance their mathematical skills in the classroom?

4. Were assignments utilizing technology used in conjunction with homework to provide individual paced practice at home?

APPENDIX B

SAMPLE COVER LETTER

The Effects of Instructional Technology on Student's Success

on the 8th Grade Standards of Learning (SOL) Test

Conducted by: Paul R. Burkhart
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Virginia Beach, VA 23456
757-471-5168

Dear Department Head,

I am seeking your assistance in a study to determine the effects of instructional technology on teaching and learning in 8th grade mathematics. This study is an important part of my masters program at Old Dominion University and its results will benefit future teachers and students.

Attached is a copy of the survey I would like you to complete to provide me with the data needed to complete my research project. Your participation will be kept anonymous.

Please answer the survey questions and send replies to this email or call me at the phone number above if you have any questions. I look forward to receiving your completed surveys.

Sincerely,

Paul R. Burkhart