CLASSROOMS WITHOUT WALLS:

BRAINCHILD PORTABLE TECHNOLOGY

AS AN EXTENDED LEARNING TOOL

INTO THE 21st CENTURY

A Study

by

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Classrooms Without Walls: *Extended Learning with Brainchild*
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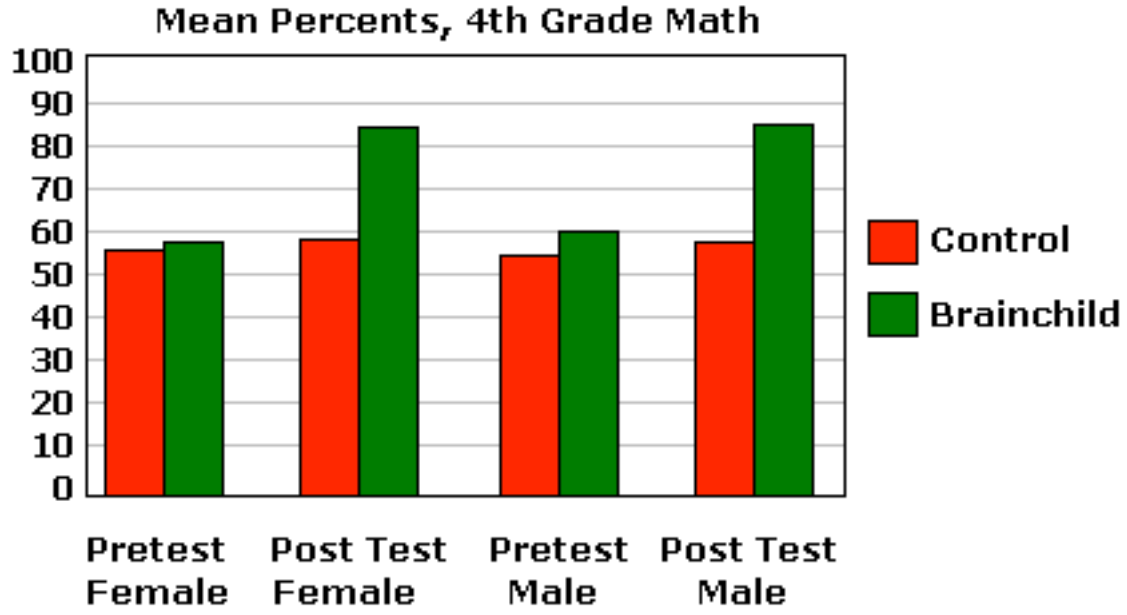
This study was conducted to ascertain the effects of Brainchild's extended learning techniques and products. Three of Brainchild's extended learning techniques were followed: I) Independent study; 2) Collaborative/team exercises in the classroom; 3) Take-home programs employing parental involvement.

The study focuses on students who scored under 50% in the 4th grade math TAAS (Texas Assessment of Academic Skills) Test. Carefully selected control and experimental groups were measured over a period of 3 weeks. Students were paired with matching characteristics. For example, if a male with discipline problems was assigned to the control group, he was matched with a male with similar problems in the experimental (Brainchild) group.



The experimental group showed 52.5% growth in math achievement with a mean score of 87.40, while the control group showed 3.4% growth with a mean score of 58.30.

ABSTRACT

Classrooms Without Walls: Brainchild Portable Technology as an
Extended Learning Tool into the 21st Century

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The field study utilized the control-group design, which employs two groups of subjects, one of which is called the *control group* and is included primarily to make it possible to measure the effect of extraneous factors upon the posttest. The study experimental design was "Pretest-Posttest Control Group Design." The essential features are the formation of an experimental treatment group and a control treatment group, and administration of a pretest and posttest to each group. The sample included ten fourth grade students in the control group and ten fourth grade students in the experimental group. Each group consisted of students randomly selected from the lower fifty percent of available fourth grade students. The lower 50 percent is defined as those students who scored in the lower 50 percent on the Texas Assessment of Academic Skills (TAAS), which is a competency examination designed to measure student performance in mathematics and language arts. The quantitative field study analyzed data collected from a

Texas Academic Assessment Skills (TAAS) test based on grade 4 math using the Brainchild TM hand-held Portable Computer Learning System and the associated TAAS software test cartridge. The examination tested the following categories: number concepts, addition, subtraction, multiplication, and division for the following purposes:

1) to measure the differences in the control group pretest and posttest scores.

2) to measure the differences in the experimental group pretest and posttest scores.

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

The American Association of School Administrators concluded a nearly two year study on preparing students for the 21st Century. "The project, which involved a council of 55 leaders in business, education, government, and other fields, focused on the knowledge, skills, and behaviors students will need to exhibit to be prepared for life in the New Millennium," (Uchida, 1996, p.1).

The study challenged school administrators and teachers to incorporate, marketplace technology into their teaching. "Students will need to know not only how to access information through existing and new technologies but also how to process and use the information, as well as develop new technologies and find commercial applications for them," (Uchida, 1996, p.2). The New Millennium will bring "an increased emphasis on standards and accountability," (Uchida, 1996, p.3).

Linda G. Roberts, an official in the Office of the Deputy Secretary of the United States Department of Education, stated "in the future, technology in education will consist of dedicated devices that will be used to improve student basic skills," (Roberts, 1., phone conversation, United States Department of Education, December, 1997). The Assistant Secretary, Office of Educational Research and Improvement, provided national statistics and comments on technology in the future, the seven national priorities, and the seven national

research priorities, (Robinson, 1997, p.1 - 3).

"In 1996, nearly 52 million students enrolled in the nation's elementary and secondary schools. Over the next decade, enrollment will increase by another 3 million students. Of these students, 89 % attend public schools. Computers are used in schools by 59 % of all students. ... Just to maintain the current level of class and school size in grades K-12, ... will need 190,000 additional teachers and more than 6,000 additional schools. By the year 2006, the nation will spend $321 billion per year on K-12 education," (Robinson, 1997, Ch.2, p.1). The United States Department of Education established seven national priorities. National priority Number 2 is mastering challenging mathematics, including foundations of Algebra and Geometry, by the end of grade eleven. See Appendix A for the other six national priorities. The mathematical base to prepare students to excel in high school math begins in elementary school. Additionally, national research priority Number 6 promoting learning in informal and formal settings, and building the connections that cause out-of-school experiences to contribute to in-school achievement. See Appendix B for the other six national research priorities.

The Problem

The test results clearly indicate that a problem exists in the area of mathematics in the Texas Assessment of Academic Skills (TAAS) test. Since test results indicate a trend in low math scores as compared to other areas of the

Statement of the Problem

The purpose of the field study was to determine the effectiveness of the Brainchild ™ Portable Learning System as an extended learning tool to raise the math test scores of fourth grade students participating in the experimental group. TAAS scores in the area of mathematics are much lower than reading and writing. To achieve the purpose of the field study and to measure the difference in pretest and posttest scores for the experimental and controls groups, the following quantitative research questions were formulated:

1. What effect does use of the Brainchild ® Portable Learning System by the experimental group have on significantly improving their posttest scores after a three week field study period?

2. What effect does not using the Brainchild ® Portable Learning System by the control group have on significantly improving their posttest scores after a three week field study period?

3. What significant difference exits between the pretest and posttest scores of the experimental group after using the Brainchild ® Portable Learning System?

4. What significant difference exits between the pretest and posttest scores of the control group without the use of the Brainchild ® Portable Learning System?

Null Hypotheses

In order to answer the research questions the following null research hypotheses were formulated:

Null hypothesis 1. There is no significant difference between pretest to posttest scores according to a student's gender (male or female).

Null hypothesis 2. There are no significant interactive effects on scores between group and gender.

Null hypothesis 3. There is no significant difference in scores according to a student's random assignment to the experimental or control group.

Delimitation of the study

The field study was a hypothesis-testing field study involving an experimental and a control group of fourth grade students. The field study was delimited to fourth grade students at the participating elementary school, and the field study results are applicable only to the participating elementary school.

The importance of the Study

The field study is important because the study documents the effectiveness of a portable technology system when used as an extended learning tool in and out of the classroom. The literature implies that technology is a means to extend learning outside the structured classroom. Emerging technology hardware and software may provide teachers with the means to assess individual student needs, and allow students the opportunity to continue the learning process based on their needs by the use of extended learning tools.

Definition of Terms

Selected terms used in this field study are defined in order to facilitate understanding. The following is a list of terms and the definitions used in the study:

E-mail (Electronic Mail) Messages, usually text, sent from one person to another via computer. E-mail can also be sent automatically to a large number of addresses.

FTP (File Transfer Protocol) A very common method of moving files between two Internet sites. FTP is a special way to *login* to another Internet site for the purposes of retrieving and/or sending files. There are many Internet sites that have established publicly accessible repositories of material that can be obtained using FTP, by logging in using the account name "anonymous", thus these sites are called "anonymous ftp servers".

Gender Gender refers to the student's sexual category; males or females as a group and is used as a variable in the Field Study Statistics (Webster's II: New Riverside Dictionary, 1984).

Gopher A widely successful method of making menus of material available over the Internet. Gopher is a *Client* and Server style program, which requires that the user have a Gopher *Client* program. Although Gopher spread rapidly across the globe in only a couple of years, it is largely supplanted by *Hypertext,* also known as WWW (World Wide Web). There are still thousands of Gopher Servers on the Internet and we can expect they will remain for a while.

Hardware Any electronic or mechanical equipment used in association with data processing with computers.

Host Any computer on a *network* that is a repository for services available to other computers on the *network.* It is quite common to have one host machine provide several services, such as *WWW* and *USENET*.

HTTP (Hyper Text Transport Protocol) The protocol for moving *hypertext* files across the *Internet.* Requires a HTTP client program on one end, and an HTTP *server* program on the other end. HTTP is the most important protocol used in the *World Wide Web* (*WWW*).

Internet (upper case I) The vast collection of inter-connected networks that all use the TCP/IP protocols and that evolved from the ARPANET of the late 60's and early '70s. The Internet now (Nov. 1994) connects roughly 30,000 independent networks into a vast global *internet*.

Internet (lower case i) Any time you connect 2 or more *networks* together, you have an internet - as an inter-national or inter-state.

Lower fifty percent This term refers to those students in the lower 50 percent according to the results of the TAAS test, as reported to the schools.

Mastered This term, when utilized in this paper, refers to the number of students that passed 90% of the test items in each lesson of the TAAS pretest or posttest using the Brainchild ™ software.

Modem (MOdulator, DEModulator) A device that you connect to your computer and to a phone line, that allows the computer to talk to other computers

through the phone system. Basically, modems do for computers what a telephone does for humans.

Newsgroups The name for discussion groups on *Usenet.*

Network Any time you connected two or more computers together so that they can share resources you have a computer network. Connect two or more networks together and you have an *internet.*

Passed This term, when utilized in this paper, refers to the number of students that passed 70% of the test items in each lesson of the TAAS pretest or posttest using the Brainchild ™ software.

Portable Learning System A hand held portable computer powered by batteries (may also be plugged in to an electrical outlet with an accessory). The teachers select the appropriate software cartridges for student individual study, review, and testing. Portable Learning System· refers to the Brainchild TM.

Software Written computer programs encased in plastic cases inserted in a computer drive to operate the computer.

South Texas Region South Texas region refers to Texas Education Service Regions I & II. According to the Texas School Directory: 1996-97.

TAAS The Texas Assessment of Academic Skills (T AAS) is a test that was created by the State of Texas as a criterion referenced test.

Telnet The command and program used to *login* from one *Internet* site to another. The telnet command program gets you to the *"login:"* prompt of another *host.*

Usenet A world-wide system of discussion groups, with comments passed among hundreds of thousands of machines. Not all Usenet machines are on the *Internet,* maybe half. Usenet is completely decentralized, with over 10,000 discussion areas, called *newsgroups.*

WWW (World Wide Web) Two meanings - First, loosely used: The whole constellation of resources that can be accessed using *Gopher, FTP, HTTP, telnet, Usenet, WAlS* and some other tools. Second, the universe of hypertext servers (HTTP servers) which are *servers* that allow text, graphics, sound files etc. to be mixed together.

CHAPTER 2

REVIEW OF THE LITERATURE

"The latest trends in school-based technology suggest some fundamental shifts in the way educators are viewing the entire subject. Technology must be intrinsic to learning, "(Larissa, 1997, p. 48). It must be utilized throughout a child's entire learning process. "[C]omputers technology cannot be treated as gold-locked up in some remote computer lab," (Larissa, 1997, p. -48). Computers must be accessible and integrated into all places where students learn, study and explore. Districts are purchasing computers that are cheaper, more portable, and integral to the curriculum. "Some schools are encouraging students to take inexpensive lap-tops home in their back-packs -- an integrated portable learning tool available for math problems, research reports, and even discovery exploration. The author explained various ways in which schools can obtain this technology for little money and at times for free," (Larissa, 1997, p.48).

In the book Three Years and Eight Days, the author states "information technology would playa dual role in the future of students. Two college presidents believed that portable technology would playa major role in the lives of their students and embarked upon a project to put information technology into the hands of their students and faculty," (Cartwright, 1997, p.52). Part of their plan would be to provide a laptop computer as well as unlimited access to e-mail, the Internet, and World Wide Web to each of their students. Another added benefit

would be, "24-hour availability afforded by the laptop computer," (Cartwright, 1997, p.53).

In December 1997, Dr. Jack Christi, a Houston chiropractor, said if he had his way, Texas would soon be purchasing 3.6 million laptops for its children. According to Dr. Christi, "state money would be better spent on low priced laptops armed with books on CD-Roms and wireless connections to school networks," (Cornwell, p.18). His argument is that Texas would spend 106 billion dollars replacing textbooks with eight-year old science books or 10 year old literature books. To help convince his fellow members on the State Board of Education in Texas, Dr. Christi was well prepared with his argument. He enlisted the assistance of Apple and Microsoft to develop something affordable and durable to meet the needs of the present day textbook. "[He] was simply following the lead of congress Speaker Newt Gingrich who called for a laptop for every child in the nation," (Cornwell, p. 18).

Computers are beginning to take their place, along side the chalkboard and textbook, as tools for classroom instruction. The author of this article stated Detroit Public Schools, "the technology plan (Achieving Excellence Through Technology) calls for deployment of computers and related technology in every classroom," (Cox, p. S3). The plan calls for one desktop computer for every teacher and five desktop computers for every classroom. According to the author, "the use of portable technology can positively impact instruction in four ways: (1)

interactive learning systems, (2) instructional management systems, (3) information retrieval and (4) computer tools, "(Cox, p. S3).

For years, leaders in education, business, and government have been predicting that computers will revolutionize teaching and learning in the schools. How does an educator use technology to enhance student learning? One area of educational reform has confounded many experts in the role of computer technology. "The author of this article proposes this barrier, as well as other barriers, would be overcome if principals and teachers were provided with a portable laptop computer to carry from home to school and vice versa," (Vann, p.50). The ones persons ultimately benefiting from the portable technology would be the students as they would be instructed better in the use of portable technology through the use of handheld computers.

Students could use portable computer technology for practical applications. Students could go to a track meet to immediately record and process data and share the results in the classroom. This can be possible if students are using notebook computers. "Different types of portable technology such as notebooks, keyboard word processors, and a new generation of handheld computing devices are turning these futuristic visions into today' s reality." Many learning ideas are possible if students are allowed to use portable technology in the classrooms. According to the author, Mobile technologies, are freeing students to learn

Technology plays a major role in allowing students to learn by being active participants. "Research tells us that learning improves by active participation of students. Teachers must incorporate technology into their classrooms. This incorporation will involve a change from the past." (O'Bannon, p. 127). Gone are the days when students were expected to recall facts, and do rote learning. Schools are expected to meet the challenges of the day. According to research conducted by Knapp and Glen (1996), "students learn, not by listening to information presented by others, but by actively manipulating and synthesizing information in such a way that it compliments and expands existing understandings," (O'Bannon, p. 128). Technology has a key role in creating the conditions that Knapp and Glen describe. How does technology play this key role? "A growing body of research indicates that technology allows students to create knowledge by giving them opportunities to explore, interact, problem solve, and collaborate," (O'Bannon, p. 128).

Summary

The review of the literature indicated that schools are beginning to purchase computers that are more portable and integral to the curriculum. Students are being encouraged by teachers to take portable computers home to continue lessons or to conduct exploratory learning. O'Donovan highlights two key points about technology: "a new generation of hand held computing devices are turning these futuristic visions into today's reality," (O'Donovan, p.30), "Research tells us that

learning improves by active participation of students," (O'Bannon, p.127). The field study uses the Brainchild TM Portable Technology Learning System. Brainchild TM was selected as the extended learning tool because it is portable, hand held, and involves the student as an active participant. All of these characteristics were mentioned in different articles during the review of the literature. In closing, mobile technologies allow students to learn anywhere, and anyplace both in and out of the classroom.

CHAPTER 3

METHODOLOGY

Technology and its use to increase student achievement is important to teachers and principals. A definite need for administrators and teachers to identify portable computers and associated software that may be used effectively to meet students needs. The results that claim to increase· student achievement must be measurable, track a student's success and progress, and identify areas that need improvement. With this information, district teachers and administrators were able to focus on particular student needs and work for improvement of those needs with an appropriate computer system and software.

The field study measured differences in the control and experimental groups. In order to explain the difference in control group and experimental group scores, the methodology is explained in this chapter under the following headings: I) General Design, 2) Population and sample, 3) Data Collection, 4) Analysis of Data, 5) Time Schedule, and 6) Summary of methodology.

General Design

The hypotheses-testing field study on Brainchild ® as an extended learning tool utilized the classic design, and employs the "true" experimental method. The experimental design of the field study is "Pretest-Posttest Control Group Design, it employs at least two groups of subjects, one of which is called the *control group* and is included primarily to make it possible to measure the effect of extraneous factors upon the posttest. The experiences of the experimental and

control groups are generally kept as identical as possible with the exception that the experimental group is exposed to the experiment treatment," (Borg and Gall, 1983, p. 664). This is the preferred method to conduct a true experiment. According to the book., "Campbell and Stanley observed that researchers often use the wrong statistical procedure to analyze data ... The preferred statistical method is analysis of covariance in which the posttest means are compared using the pretest scores as a covariant," (Borg and Gall, 1983, p. 666 - 667). The matching technique which is a variation of the pretest-posttest control group design was used. The matching technique is used, "to obtain additional precision in the statistical analysis of the data," and the standard error is reduced considerably by this technique, (Borg and Gall, 1983, p. 668).

R O X O
R O O

R = Subjects are randomly assigned to experimental and control groups.
O = Both groups are given the pretest.
X = The experimental group is given the treatment and the control group gets no treatment.
O = Both groups are given the posttest.

The research question is, "What effect does use of the Brainchild TM by the experimental group have on significantly improving their Math grade 4 TAAS posttest scores after a three week field study period." The review of the literature indicates students receiving portable technology extended learning tool-assisted math instruction exhibit greater achievement than students who receive only

regular instruction. The null hypothesis is "there is no significant difference in scores according to a student's random assignment to the experimental or control groups." The field study was delimited to those fourth grade students at the participating elementary school. The field study results are applicable only to the participating elementary school. Participants in the field study were randomly assigned to a control or experimental group, and both groups were pretested and posttested.

Population and Sample

The project setting for the field study is a local elementary school that is typical in size, student population, and faculty composition to other schools in the surrounding area. The subjects for the control and experimental groups were randomly selected from the lower 50 percent of available fourth grade subjects at the participating elementary school. The lower 50 percent is defined as those students who scored in the lower 50 percent on the Texas Assessment of Academic Skills (T AAS), which is a competency examination designed to measure student performance in mathematics and language arts," (Zirkel, 1993, p. 576). The population sample for the experimental and the control groups consisted of 5 males and 5 females in each group. Students assigned to the control and experimental groups were paired with matching characteristics.

Procedure

The field study was coordinated with Mr. Jeff Cameron, President, Brainchild Technology in Florida. Mr. Cameron allowed the use of the Brainchild ® Education System and associated software. The purpose of the field study was to document the effectiveness of portable technology at the fourth grade level.

Using portable technology, specifically the Brainchild ® Education System, students will acquire and internalize effective study techniques enabling them to succeed throughout their educational career. Subjects in the control group were paired with a matching member in the experimental group. For example, if a subject in the control group was a female, studious, and without discipline problems, she was matched with a female with the same characteristics in the experimental group. Another example was, if a male was assigned to control group and he was a discipline problem, he was also matched with a male with similar characteristics in the experimental group. Both groups were pretested and posttested. The pretest established the baseline for each student in each group. After the pretest was completed, the students in the experimental group received instruction using the Brainchild portable learning system. There are three interactive learning modes which let students study, review, or test. The study mode presents questions in a multiple choice format and provides instant feedback for correct and incorrect answers. Students were encouraged to press the **explain** button every time they answer a question for added reinforcement. If their answer

was wrong, the explain button would not give them the correct answer, it would simply provide information. However, they would still have to select another answer until they choose the correct answer. The **test** mode presents questions in a multiple-choice format. The questions are randomized and the test is timed. The explain button does not function in the test mode.

Grade 4 Math Core Knowledge Software ©

Students in the experimental group were provided with Grade 4 Math Core Knowledge software which included: **Multiplication** 2 and 3 digit numbers, word problems; **Division** by I and 2 digits, money and word problems; **Fractions & Decimals; Math Concepts** Place value, Arabic numerals, areas, volumes, yards and feet, and more.

Grade 3 Math Core Knowledge software ©

If a student was not at grade level, a Grade 3 Math Core Knowledge software was provided which included: **Addition & Subtraction** 4 digit numbers, regrouping, word problems, simplifying problems, estimating and rounding, Two-step problems; **Division** Introduction to the operation of division, Signs, grouping, remainders, number sentences; **Multiplication** Multiplication table up to nine, horizontal and vertical problems, regrouping; **Math Concepts** Word problems and division words, Standard & expanded notation, number sentences with> < =, and sentences.

Math Mechanics Level 4 ©

For those students in the experimental group who had mastered the basic multiplication and division facts and were ready to explore more complex problems. **Lesson 1** Multiplying by 2 and 3 digit numbers. **Lesson 2** Dividing by 2 and 3 digit numbers. **Lesson 3** Decimal & Money multiplication. **Lesson 4** Decimal & Money division.

Math Mechanics Level 3 ©

For those students in the experimental group who had not mastered the basic multiplication and division facts and needed remediation in basic multiplication and division. **Lesson 1** Basic multiplication up to 10 x 10. **Lesson 2** Basic division up to 100 divided by 10. **Lesson 3** Multiplying by I-digit numbers. **Lesson 4** Division by 1-digit numbers.

Educators must consider the education of students and not just the schooling of children. Education includes what happens inside and outside of the classroom. Parents must be involved to properly educate their children. The experimental group was allowed to check out and take home the' three Brainchild learning systems on a rotating basis. Participating parents were informed of their responsibilities when their children studied at home. They were allowed to use one Brainchild portable computer and software disks for use at home overnight. Participating students also used the portable computer during team study time. The control group participants only used the portable technology during the pretest and the posttest. The control group was not allowed to use

the Brainchild as an extended learning tool. In summary, after the baseline was established for the experimental group, they used the Brainchild in and out of the classroom during the three week field study period. Only the experimental group received intervention (the treatment) with the Brainchild.

Data Collection

The Pretest consisted of a twenty item test on the following five lessons: number concepts, addition, subtraction, multiplication, and division. Each lesson was graded and received a percentage test score. After all five lessons were graded, all five lesson percentage test scores were added together and then divided by five to arrive at a Pretest score for each fourth grade student participant in the control and experimental groups.

The Posttest consisted of a twenty item test on the following five lessons: number concepts, addition, subtraction, multiplication, and division. Each lesson was graded and received a percentage test score. After all five lessons were graded, all five lesson percentage test scores were added together and then divided by five to arrive at a Posttest score for each fourth grade student participant in the control and experimental groups.

Analysis of Data

The data gathered for this field study were analyzed using a statistical technique known as analysis of variance (ANOV A) General Linear Mode Simple Factorial. The assumptions for ANOVA are: normal distributions and

homogeneity of variances. Applications of the ANOV A General Linear Mode Simple Factorial were conducted through computer analysis using SPSS 7.5 ® for Windows 95. ANOV A was used to test the significance of mean differences between more than two groups simultaneously. A probability value of .05 or less would indicate that a significant difference exists among the various means. The level of significance used to decide whether to reject or not reject a null hypotheses was established at p = .05. Differences between samples that exceeded the given significance levels of .05 resulted in a rejection of the null hypotheses (Borg and Gall, 1989). The null hypotheses were as follows:

Null hypothesis 1. There is no significant difference between pretest to posttest scores according to a student's gender (male or female).

Null hypothesis 2. There are no significant interactive effects on scores between group and gender.

Null hypothesis 3. There is no significant difference in scores according to a student's random assignment to the experimental or control group.

Time Schedule

The time schedule for this study was as follows:

1. Develop concept for the field study - October 1997
2. Approval by Brainchild TM for use of equipment and software -April 98
3. Implement data gathering plan -April 98
4. Implement data analysis -April 98
5. Prepare research reports -May 98
6. Findings and recommendations -May 98

Summary of Procedure

The analysis of the data in the field study were used to determine the extent of effectiveness regarding the use of portable technology, specifically the Brainchild ® Education System, as an extended learning tool.

The initiation of the idea to select a portable technology device that could be used as an extended learning tool to increase student achievement was based on our review of the literature. A review of literature covered many topics dealing with technology. The review indicated a need for fundamental shifts in the way educators view the entire subject of technology, and that technology in education will consist of dedicated devices that will be used to improve student basic skills.

The prepackaged data gathering test instruments were developed by Brainchild ®. The design of the data gathering plan was developed for ease of response by participating fourth grade students, and for ease of compiling pretest and posttest results for the control and experimental groups.

The data analysis plan was developed in order to show a difference in means of samples of control and experimental groups. This plan investigated the significance of mean differences between the experimental and control groups. It also considered the 2-way interactions based on gender and group. The data analysis plan was implemented, the information was tabulated, and then a computer-generated statistical analysis program (SPSS for Windows 95) calculated the mean scores and the significant differences between those mean scores.

The research report information was given in narrative form with tabular illustrations of the results. Chapter 4 will present the field study's findings and an analysis of the data.

CHAPTER 4

ANALYSIS AND PRESENTATION OF DATA

The purpose of the field study was to determine if a significant difference existed in the Texas Assessment of Academic Skills (TAAS) Grade 4 Math pretest to posttest scores, according to a student's gender and group (experimental or control groups).

The goals of this study were to compare math posttest scores of students taught with the Brainchild ® portable system in the experimental group to those of students in the control group that received only regular instruction over the three week field study.

To gather the needed data for this study, an elementary school from a school district from Region II in Texas was invited to participate. Mr. Jeff Cameron, President, Brainchild ™ technology and his assistants, participated by training me in the use of the Brainchild portable computer system and its associated software. Additionally, Mr. Cameron provided the use of three brainchild's and software for the field study. The participating elementary school principal and the fourth grade teachers supported the field study, and randomly assigned fourth grade students to participate in the field study. The participating fourth grade students were identified as scoring in the lower 50 percent according to official TAAS results, and were randomly assigned to the experimental or control group. The students remained in the assigned group

during the 1997-1998 school year three week field study. The total sample of students participating in this field study was twenty students. Ten were in the experimental field test sample, and ten were in the control field test sample.

During the three week field study period, the experimental group received the intervention, with the Brainchild ® Portable Learning System, and the control group received only regular instruction.. At the end of the three week field study, both groups were administered a posttest in math on the fourth grade TAAS math examination.

Pretest Analysis of Data

The control and experimental groups participants were pretested in math on the fourth grade TAAS math examination which consisted of five lessons. The pretest scores were recorded and served as the baseline for each student. The pretest scores of the control and experimental groups are depicted in Appendix A and Appendix B respectively. The pretest data are as follows. The mean was 56.85, the medium was 58, and the standard deviation was 3.41. The range was from a low of 50 to a high of 64, which is a range of 14. The skew coefficient was - .141, which is normally distributed, therefore, the data was treated as normal.

Table 1

Pretest: Grade 4 Math TAAS Statistics by Gender in the Experimental Group.

GENDER	GROUP	PRETEST
		Mean
Male	Experimental	58.80
Female	Experimental	55.80

The data in Table I presents the comparison of means on the pretest by gender and group. 58.80 is the pretest mean for males in the experimental group, and 55.80 is the mean for females in the experimental group. There is no significant difference between gender in the experimental group.

Table 2

Pretest: Grade 4 Math TAAS Statistics by Gender in the Control Group.

GENDER	GROUP	PRETEST
		Mean
Male	Control	57.80
Female	Control	55.00

The data in Table 2 presents the comparison of means on the pretest by gender and group. 57.80 is the pretest mean for males in the control group, and 55.00 is the mean for females in the control group. There is no significant difference between gender in the control group.

Posttest Analysis of Data

The control and experimental groups participants were posttested in math on the fourth grade TAAS math examination at the end of the three week field study. The posttest scores for the control and experimental groups are depicted in Appendix C and Appendix D respectively. The posttest data were as follows: The mean was 72.85, the medium was 75, and the standard deviation was 15.1 L The range was from a low of 53 to a high of 89, which is a range of 36. The skew coefficient was -.058, which is normally distributed, therefore, the data was treated as normal.

Table 3

Posttest: Grade 4 Math TAAS Statistics by Gender in the Experimental Group.

GENDER	GROUP	POSTTEST
		Mean
Male	Experimental	87.60
Female	Experimental	87.20

The data in Table I presents the comparison of means on the posttest by gender and group. 87.60 is the posttest mean for males in the experimental group, and 87.20 is the mean for females in the experimental group. There is no significant difference between gender in the experimental group.

Table 4

Posttest: Grade 4 Math TAAS Statistics by Gender in the Control Group.

GENDER	GROUP	POSTTEST
		Mean
Male	Control	59.20
Female	Control	57.40

The data in Table 2 presents the comparison of means on the posttest by gender and group. 59.20 is the posttest mean for males in the control group, and 57.40 is the mean for females in the control group. There is no significant difference between gender in the control group.

The null hypothesis that no significant difference between pretest to posttest scores according to a student's gender (male or female) is accepted. There was not a significant difference between pretest to posttest scores of the experimental and control groups.

The null hypothesis that there is no significant interactive effect on scores between group and gender is accepted. According to the ANOV A Hierarchical Method posttest by gender and group with pretest, there were no significant 2-way interactions according to group and gender.

Posttest Total Comparison of Means

The posttest scores were analyzed using the SPSS 7.5 Program for Windows 95, using the general factorial ANOV A, providing an analysis of covariance calculated to adjust posttest scores for the initial pretest differences of the experimental and control groups.

Table 5

Total Posttest Comparison of Means of the Experimental and Control Groups.

GROUP	POSTTEST
	Mean
EXPERIMENTAL	87.40
CONTROL	58.30

The data in Table 5 presents the total posttest comparison of means of experimental and control groups. 87.40 is the posttest mean for the experimental group, and 58.30 is the mean for control group. There was a significant

difference in experimental group against control group mean scores.

The null hypothesis that there is no significant difference in scores according to a student's random assignment to experimental or control groups is rejected. There was a significant difference in mean scores between experimental and control groups, The Brainchild ® portable computer system, as an extended learning tool was very effective after only a three week period.

Summary

The significance in this data is in the growth of student achievement for the students in the experimental group over a three week field study period in achievement level on the Texas Assessment of Academic Skills (TAAS) Grade 4 Math test compared to students in the non-Brainchild ™ control group. No significant relationship between TAAS Grade 4 Math scores and gender were found.

The difference in sample means of control and experimental groups were analyzed to determine the significance of mean differences between control and experimental groups. A general factorial analysis with a 95% significant coefficient (.05) was run for each hypotheses.

The null hypothesis that there is no significant difference in scores according to a student's random assignment to experimental or control groups is rejected. Therefore, there was a significant difference in mean scores between experimental and control.

The null hypothesis that no significant difference between pretest to posttest scores according to a student's gender (male or female) is accepted. Therefore, there was not a significant difference between pretest to posttest scores of the experimental and control groups.

The null hypothesis that there is no significant interactive effects on scores between group and gender is accepted. Therefore, according to the ANOV A Hierarchical Method posttest by gender and group with pretest, there were no significant 2-way interactions according to group and gender.

This chapter presented the analysis of data necessary to statistically accept or reject the null hypothesis relating to significant differences in TAAS Grade 4 Math scores and a students gender, and the use or non-use of the Brainchild ® Portable Computer System. A more extensive summary of statistically conclusions, analysis and the researcher's recommendations are reported in Chapter 5 of this study.

CHAPTER 5

SUMMARY OF THE STUDY, CONCLUSIONS, AND RECOMMENDATIONS

The use of technology by educators, as educators prepare to enter the 21 st century, is expected to increase according to the review of the literature. There will be enormous pressures on teachers and administrators to incorporate technology into the curriculum and to produce people who can contribute to society and can help solve its problems. President Clinton and Goals 2000 stresses the need for school administrators and teachers to produce computer literate citizens who can easily access information available on the internet. Technology will make it possible for people to access massive amounts of information from CD-Roms and wireless connections to school networks.

The need for educators to incorporate commercially available technology into the curriculum has also been stressed by the United States Department of Education, as mentioned earlier in the review of the literature.

The State of Texas requires all students in public schools to pass all sections of the Texas Assessment of Academic Skills (TAAS) test. Students are required to master the test at the 70 % or above to graduate from a public high school. The measure of a schools success or failure in Texas, is determined by the number of students passing the TAAS test. Texas Schools are held accountable for the overall performance of students, and schools are compared to other schools of similar size and composition in Texas.

Schools are reluctant to incorporate strategies into the curriculum for fear of causing students to not perform well on the state-mandated TAAS test. A familiar comment in some schools is teachers teach to the test. Although the Brainchild ™ is only one of the available portable technology learning systems, it is very effective as an extended learning tool that could be used by students into the 21st century. The Brainchild software is tailored to the State of Texas mandated TAAS test, and the portable computer is easy to use and requires little training before use by students and teachers. Brainchild Portable Learning System has a low cost factor that makes it possible for school districts to purchase classroom sets. Initially, administrators and teachers can concentrate their Brainchild resources on lower achieving students. Teachers can easily transition to other categories of students as more Brainchilds are introduced into the school system.

Summary of the Field Study

The goal of this study was to compare TAAS grade 4 math scores of students taught by teachers using the Brainchild to those students taught by teachers not using Brainchild ™ technology. The hypotheses-testing field study determined a significant difference in the pretest to posttest scores between students in the experimental and control groups over the three week field study period.

The field study included an experimental group of 10 students enrolled in fourth grade who had valid TAAS scores during the 1996-1997 school year. The scores ensured the students selected for the field study were in the lower 50 % of their group, a criteria for selection to the experimental or control groups. The control group also included 10 students enrolled in fourth grade who had valid TAAS scores during the 1996-1997 school year. The scores ensured that the students selected were also in the lower 50 % of their group.

The students in the experimental and control groups were matched so the "standard error was reduced considerably by the matching technique," (Borg and Gall 1983, p. 669). Group size was affected by the series design of this study. The experimental group was limited to 10 students due to the availability of only 3 Brainchild ^{TM} computers. The results of this field study will prove the importance of "true" experimental designs in order to measure the effectiveness of the intervention on student achievement.

The design of the data gathering plan was developed for ease of response, and for ease of compiling pretest and posttest results for the experimental and control groups. The analysis of the purpose of the field study was accomplished quantitatively. Following the collection of the data, SPSS 7.5 for Windows 95 was used to conduct separate analysis to determine the difference in Grade 4 math TAAS scores, according to gender and group over the three weeks included in this study.

An analysis of covariance (ANOV A) test, general factorial analysis was performed on the experimental and control group's posttest results by gender and group with a pretest. The data resulted in the total posttest comparison of means of experimental and control groups. 87.40 was the posttest mean for the experimental group, and 58.30 was the mean for control group. There was a significant difference in experimental group against control group mean scores.

To summarize the quantitative data, a probability value of .05 or less would indicate that a significant difference exists among the various means. The level of significance used to decide whether to reject or not reject a null hypotheses was established at $p = .05$. Differences between samples that exceeded the given significance-levels of .05 resulted in a rejection of the null hypotheses (Borg and Gall, 1989). The results of these analysis found the following null hypotheses were rejected or not rejected at the .05 significance level.

Null hypothesis 1. There is no significant difference between pretest to posttest scores according to a student's gender (male or female). This null hypothesis is accepted. There was not a significant difference between pretest to posttest scores of the experimental and control groups.

Null hypothesis 2. There are no significant interactive effects on scores between group and gender. This null hypothesis is accepted. According to the ANOV A Hierarchical Method posttest by gender and group with pretest, there were no significant 2-way interactions according to group and gender.

Null hypothesis 3. There is no significant difference in scores according to a student's random assignment to the experimental or control group. This null hypothesis is rejected. There was a significant difference in mean scores between experimental and control groups.

In summary, the students in the experimental group showed a 52.5 % growth in grade 4 TAAS math achievement at the conclusion of the field study. Compared to the control group which yielded 3.4% growth over the three weeks studied.

Conclusions

The use of the Brainchild ® and the software © has a positive effect on the academic performance of students on the TAAS math test. This conclusion is supported in this doctoral level true experimental field study which documented an increase in student achievement.

The state of Texas has recognized percent growth of student achievement, and the study found significant growth in the experimental group participants. The analysis of percent growth of student's scores shows that the Brainchild has an impact on TAAS math achievement, which was doubled within the three weeks implemented in the experimental group. The control group made no significant gain in TAAS math achievement at the end of week compared.

The experimental group raised student achievement 52.5 % compared to the control group's 3.4% gain. The significant difference was found after the ANOY A test adjusted for the mean difference in the pretest scores. The State of

Texas does not adjust for differences when publicly comparing schools. Schools are compared according to demographic data only, and educators must contend with the public comparisons of schools.

The use of the Brainchild ™ does not differentiate success on the 4 grade TAAS test based on student gender. Both males and females in the experimental group showed significant improvement on their TAAS math scores. The study did not use student ethnicity as a variable. However, the South Texas Region does have a high Hispanic population ratio, and growth in this ratio was not documented.

Recommendations

The study provided quantitative data that links the use of portable technology and student achievement in math on the TAAS grade 4 examination. The experiences obtained and the insights gained from this study facilitated the formulation of implications for other possible areas of research. These research recommendations are presented below.

Most students have difficulties in the TAAS math word problems portion. Further research should conducted on the reading and writing portions of the TAAS tests. Reading and writing are interrelated, and impact on the TAAS math scores results. Research efforts should include the reading and writing portions of TAAS in order to increase TAAS math achievement.

To support the research on Brainchild, a quantitative study on student achievement, as measured by the TAAS examinations should prove useful for schools in the State of Texas. The need to link the use of Brainchild and student achievement at the elementary level is as important today as it is at the middle school and the high school level.

Replication of the Brainchild ™ field study in middle school, high school, special education, Chapter I and remedial classrooms at the doctoral level. Education effectiveness on the TAAS student learning and achievement would add an important dimension to present research. Further, true experimental research is needed at the middle school and high school level.

Recommend: more technology in general, more portable technology, more dollars budgeted and expended on portable technology, and more training in portable technology for teachers and administrators.

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APPENDICES

THE SEVEN NATIONAL PRIORITIES OF THE UNITED STATES DEPARTMENT OF EDUCATION

1. Reading independently and well by the end of third grade.
2. Mastering challenging mathematics, including foundations of Algebra and Geometry, by the end of grade eleven.
3. By 18 years of age, being prepared for and able to afford college.
4. All states and their schools will have challenging and clear standards of achievement and accountability for all children and effective strategies for reaching those standards.
5. A talented, dedicated and well-prepared teacher in every classroom.
6. Every classroom will be connected to the internet by the year 2000 and all students will be technologically literate.
7. Every school will be strong, safe, drug-free and disciplined.

A working document dated July 28, 1997. Contact the United States Department of Education for additional information at their e-mail address: *7priorities@edgov.*

THE SEVEN NATIONAL PRIORITIES FOR RESEARCH IN EDUCATION

Established by the Office oj Educational Research and Improvement, and the National Research Policy and Priorities Board, 1997.

1. Improving learning and development in early childhood so that all children can enter kindergarten prepared to learn and succeed in elementary and secondary school.
2. Improving curriculum, instruction, assessment, and student learning at all levels of education to promote high academic achievement, problem-solving abilities, creativity, and the motivation for further learning.
3. Ensuring effective teaching by expanding the supply of potential teachers, improving teacher preparation, and promoting career-long professional development at all levels of education.
4. Strengthening schools, particularly middle and high schools, as institutions capable of engaging young people as active and responsible learners.
5. Supporting schools to effectively prepare diverse populations to meet high standards for knowledge, skills, and productivity, and to participate fully in American economic, cultural, social, and civic life.
6. Promoting learning in informal and formal settings, and building the connections that cause out-of-school experiences to contribute to in-school achievement.