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Graduate faculty

Thomas F. Sherman
Ed.D., University of Colorado, 1980
M.Ed., Colorado State University, 1975
B.S. in Ed., State University of New York, College at Buffalo, 1970
A.A. Liberal Arts, Paul Smith's College, 1967

Heather Klees
M.S., Winona State University, 2001
B.S., Winona State University, 1995
B.A. Saint Olaf College, 1993

Cheryl Moertel
M.S., Winona State University, 1997
M.S., Mayo Graduate School of Medicine, 1992
B.A., Saint Olaf college, 1981

Graduate Assistant

John Weibel
B.A., University of Wisconsin-Stout, 2002

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DOES GESTURING INCREASE STUDENTS' LANGUAGE LEARNING IN A SPANISH II CLASS?

by

Kelly B. Marín

B.S. Minnesota State University, Mankato 2000

A capstone submitted to the Faculty of the Graduate School of
Winona State University

In partial fulfillment of the requirement for the degree of

Master of Science

Department of Education

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This capstone entitled:

Does gesturing increase students' language learning in a Spanish II class?

written by Kelly B. Marín

has been approved for the Winona State University Department of Education by

_____	_____
Ryan Haraldson	Margaret Hongerholt
_____	_____
Andrew Wieme	Colin Atkinson
_____	_____
Heather Klees Classroom Facilitator	Cheryl Mortel Classroom Facilitator

_____
Dr. Thomas Sherman
Faculty Advisor

The final copy of the capstone has been examined by the signatories, and we find that both the content and the form meet acceptable presentation standards of scholarly work in the above mentioned discipline.

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To all who have helped me during this interesting year. Who would have thought that graduate school, teaching, and cancer could mix so well? Also to my students who continue to teach me.

Marín, Kelly B. (M.S., Education)

Does gesturing increase students' language learning in a Spanish II class?

Capstone directed by Tom Sherman

Abstract

Does gesturing increase students' language learning in a Spanish II class? The investigation looked at the difference between the use of gesturing and the absence of that practice. Gesturing, defined as a movement of the hand or body to represent language, was not found to produce a significance increase in student learning. Student learning was tested by administering three quizzes and one test. The results of this study did indicate that gesturing was an acceptable form of supplying comprehensible input, but not a superior form.

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CHAPTER I

INTRODUCTION

Need and Purpose for the Study

After taking two years of high school Spanish students are often asked, “Do you speak Spanish?” To that many reply, “I took it in high school, but I did not learn anything.” This unfortunately is a common response. The researcher even heard one of her students answer the question the exact same way. Being shocked, it seemed necessary to find a way that could reach all of her students. Spanish teachers want to offer students a learning environment that will allow them to answer, “Yes, I speak Spanish.”

To that end, the researcher has been informally experimenting with a technique called Teaching Profiecieny through Reading and Storytelling (TPRS). The technique was once called Total Physical Response Storytelling. Now with the emphasis off of the movement and gesture phase, factual evidence was needed to guide teachers and the use of gestures in the classroom.

Statement of the Problem

The gesturing phase has been deemphasized in the new three steps of TPRS. Research should be conducted to confirm the validity of this change. The gesturing phase is a time for students to practice. Students hear the word many times, and connect the word to meaning through the gestures. It is also a low stress learning time and allows students to feel successful with the language, and builds an ear for it. Since these have been the perceptions and feelings of the

researcher, she wants to see if the same results can be achieved by her students.

Statement of the Question

Does gesturing increase students' language learning in a Spanish II class?

Statement of the Hypothesis

Gesturing will increase students' language learning in a Spanish II class.

Definition of Terms Used

Affective filter- A termed defined by Stephen Krashen to talk about things that "prevent input from reaching those parts of the brain that do language acquisition (Krashen, 2004)."

Comprehensible input – A term used to talk about all written or aural language that a student understands.

Gesture – Any hand or body movement used to represent language.

Multiple intelligences- A term created by Howard Gardner to discuss different styles of learning.

Total Physical Response (TPR)- A teaching technique created by James Asher that asks students to give a physical response based on what the teacher says.

Teaching Proficiency through Reading and Storytelling (TPRS)– A teaching technique invented by Blaine Ray. Formally it was called, Total Physical Response Storytelling.

Variables

Independent Variable

Students will be exposed and participate in two to five minutes of gesturing during each class period.

Dependent Variables

This study will look at the change in quiz scores, test scores, and attitude towards learning. Students' attitudes towards learning will be monitored only in the variable group.

Control Variables

The setting for this study is a small, middle class town in the Mid-West. The school population is fairly homogenous racially speaking. The classes are approximately the same size. Students within the classes are mostly college bound. One student in the control group has an individual education plan. Another student in the control group is on a 504 plan for hearing deficiencies. An additional student was under going medication changes for Attention Deficit Hyperactivity Disorder (ADHD. The three before mentioned students' results will not be part of the final results in this study. Both classes will be taught the same material. Both classes are held at the end of the day.

Moderator Variables

The researcher has used gesturing in the past and liked the informal results. The researcher had also experienced gesturing as a student and enjoyed it. She is confident that this method will work, and shows great enthusiasm about gesturing. She enjoys having students move around the classroom. The researcher does not use

Teaching Proficiency through Reading and Storytelling exclusively. She uses an integrated approach to teach Spanish. The TPRS community could argue that gesturing leads to learning and not acquisition.

During the time of the study, the researcher endured cancer treatment. Due to the treatment her hair fell out. This may have caused the students some discomfort, especially for one student whose mother was dying of breast cancer.

Limitations of the Study

Two classes, of 25 and 21 students, were compared. Since two different classes will be compared, this study will not show the difference between using gesturing and not using gesturing on the same group of students. The time frame is short, at one month. The results of this study will not show the affects of gesturing on long term retention, but rather learning.

CHAPTER II

REVIEW OF RELATED LITERATURE

During this literature review it is the aim of the researcher to discuss what is being written about gesturing during first language and second language acquisition. This review will also include information about methodology of teaching world languages and hypothesis such as the comprehensible input hypothesis and how affective filter influences acquisition. The steps of TPRS will also be discussed.

Need for World Language Training

Before looking at the methodology it is important to establish how and if Americans are learning foreign languages, and discuss the need for world language learning. As a nation the U.S. appears to have a case of *xenoglossophobia*, that is to say a fear of foreign languages (Cutshall, 2004). As a nation the U.S. has a history of fear of all things foreign. It was not until 1923 that the Supreme Court overturned a law that restricted the teaching of foreign languages. That law affected 22 states. In the 1940's foreign languages were removed from most high school curriculums, because they took too much time. In the late 1950's researchers could not even find enough 12th grade French students in the country to conduct a comparative study. In 1983 testimony was given to the Commission on Excellence and Education saying that world language education had not even achieved "mediocrity" (Clifford, 2004). The report, A Nation at Risk, also speaks about the "need to improve teaching and learning in fields such as English, history, geography, economics, and foreign languages" (Commission on Excellence in Education, 1983). Foreign language appears to be included as a core class in this report. Overall in 1990's there was

general apathy towards learning a world language (Clifford, 2004). Currently only 1 of 10 college students majors in foreign language. Very few students, only 9 percent, choose to study the languages that are spoken by the highest number of people worldwide. Those languages include: Arabic, Chinese, Japanese, Russian, or Indonesian (Cutshall, 2004).

What do the experts say must change in the educational programs to produce proficient language speakers? Clifford refers to the recommendations from the 1961 edition of The National Interest in Foreign Languages (2004). "First, implement eight to ten year sequences of foreign language study in public schools. Second, require demonstrated proficiency, not high school units in a foreign language, for entrance to college, and demonstrated proficiency in a second foreign language, often non-Western, for graduation (Clifford, 2004)." He continues that there should be federal funding for a foundation similar to the National Science Foundation (Clifford, 2004).

These goals although inspiring, are too big, and frankly out of the control of this researcher. Therefore the goal of this study is to find out what can be done within the constraints of a world language classroom to promote proficiency. Foreign language should be important to Americans as they travel, communicate with others, or in work situations. On average 200,000 Americans loss their jobs every year because of their inability to speak another language (Cutshall, 2004).

Gesturing in Childhood

Before looking at how gesturing can be used in the world language classroom, this review will examine how gesturing is used by hearing babies. "In the beginning

there was the Word … and an outstretched index finger (Butterworth, 1997). Butterworth creates a typical picture of a child communicating through gesture. In the book From Gesture to Language in Hearing and Deaf Children, researcher E. F. Masur states, "Finally, only when dual-directional signaling had been productively demonstrated with more than one kind of gesture did words appear for each child (Volterra et al., 1998). In the same book S. Goldin-Meadow and M. Morford describe their findings of a possible bridge between gesture and verbal communication.

> The children produced single deictic (gestures used to single out objects, people, places, and the like in surroundings) gestures to indicate objects months before they produced single words to indicate those same objects. Moreover, all three children conveyed two concatenated semantic elements first in a gesture + gesture sentence form (point at bubbles +point at table, a request to put the bubbles on the table), next in a gesture + word sentence form (point at bubbles + "table"), and only months later in a word + word sentence form ("bubble table"). Gesture thus seemed to serve as a transitional form en route to speech. (Volterra et al, 2004)

Researchers have found that pointing and gesturing has a correlation to speech acquisition. Luigi Camioni has found that, "the earlier babies begin to point, the more words they know at twenty months of age (Butterworth, 1997)."

Although researchers may have different labels for similar gestures, this literature review has found that gestures are an integral part of early speech. In Born to Talk the author gives another typical example, "Uh-uh-uh, while pointing at the

refrigerator to get food or drink (Hulit et al, 2002). The aim of this research will be to see if similar results can be observed in the case of teenagers learning a second language. The researcher will give students a chance to communicate using gestures first and later speech.

Total Physical Response and Brainswitching

TPR stands for Total Physical Response. It is a methodology founded by James Asher. Before TPR is explained it is best to understand what Asher means by brainswitching and then compare that to Krashen's comprehensible input hypothesis.

Brainswitching is a term used by Asher that describes how learning is typically done on the left side of the brain can be switched to the right side. Asher describes typical activities that give students left brain input. These include: listen and repeat, translation, and memorizing (Asher, 2001). The left brain input method looks at language learning as trying to get from A to B is the shortest distance possible. Here Asher describes the problem with that idea by relating how infants acquire language using their right brain. Asher gives this example, "The newborn hears this: 'Look at Mommy. Look at Mommy.' And the eyes of the infant move in the direction of the voice. When the child responds, the reward is excitement, followed by another direction from the father (Asher, 2001)." The hypothesis is that a map of the language is made on the right side of the brain through the child's physical responses. The child will talk, but will often make mistakes. Although the parent will not give the child grammar rules, most problems just seem to clear up on their own (Asher, 2001). When compared to Krashen's comprehensible input hypothesis, many similarities can be seen.

Krashen's comprehensible input hypothesis, also allows for students to understand language long before they speak. Krashen, "has confirmed that "competence comes from comprehension of messages, not grammar study." Although Krashen is not talking about the hemispheres of the brain, the idea of understanding something first, then producing a verbal message is consistent in both hypotheses (Krashen, 2004).

Asher's TPR can be used in the classroom to provide input that is only responded to in a physical way. For instance, students in a TPR classroom would be asked to stand up and all of the students would stand. This shows that there was comprehension of the input of the teacher's direction and then an action that Asher would say would create the language map in the right side of the brain. TPR lends itself easily to commands. But what happens when a teacher wants to go beyond commands?

Teaching Proficiency through Reading and Storytelling

That question was answered by Blaine Ray, creator of TPRS. He felt that he was unable to teach some of the languages advanced structures. TPRS originally stood for Total Physical Response Storytelling. By introducing stories and blending it with the ideas of TPR, Ray was able to teach advanced structures. A typical lesson would include at least a few minutes of gesturing the three words for the day. The guide for teaching using TPRS had seven steps. Currently TPRS stands for Teaching Proficiency through Reading and Storytelling. The name reflects changes towards comprehensible input, in whatever form it may come in. The new way to teach using TPRS has only three steps. The old steps really relied on TPR. The new steps, as

defined by Blaine Ray, suggest the use of gesture for comprehension, but not as a daily practice or step. Ray explains that the gesture phase must be explained so students are not confused (Ray et al, 2002, p. 53). A TPR technique Ray suggests is using chain commands. That is the teachers says two to three words in succession, and then students do the gestures for those words in the same order (Ray et al, 2002, p. 54). In that instance a comparison can be made between TPR, and the natural occurrence of gesture as seen above in S. Goldin-Meadow's and M. Morford's work (Volterra et al., 1998).

Multiple Intelligences

Over the years much has been written about multiple intelligences. Howard Gardner writes,

> In my view, the purpose of school should be to develop intelligences and to help people reach vocational and avocational goals that are appropriate to their particular spectrum of intelligences. People who are helped to do so, I believe, feel more engaged and competent, and therefore more inclined to serve the society in a constructive way (Gardner 1993).

Gardner's quote may show that a benefit of using this technique may simple come from engaging an intelligence, that otherwise may have been ignored. "Intelligences work together to solve problems, to yield various kinds of cultural endstates - vocation, avocation, and the like (Gardner 1993)." Gesturing then may become just another avenue for students to access memory during quizzes and tests. If this naturally occurs, will it change anything to engage the students in this activity during class time?

Affective Filter

Affective filter is a term that Krashen uses to talk about things that "prevent input from reaching those parts of the brain that do language acquisition (Krashen, 2004)." Stress is a common affective filter. Theile and Schneibner – Herzig found better language acquisition using TPR. This was noted "as well as less anxiety and higher motivation for language learning (Theile et al, 1983)." As a learner, the researcher found that having to produce language early resulted in a feeling of anxiety. The idea that gestures may make students feel less anxiety and therefore lower the affective filter, is a positive for this study. The idea of lowering anxiety is also expressed in Douglas B. Reeves article, "If I said something wrong, I was afraid." The student, whose quote became the title of the article, expressed why she would often keep silent. With the use of gesturing in the classroom the researcher hopes not to force students into silence, but rather to allow them the comfort of being silent while learning language.

Conclusion

Looking at the literature on the topic the researcher believes that the use of gestures will produce gains in language learning in a high school world language classroom. The evidence that this is a natural process of first language learning, leads to the question, Will it work in the world language classroom with high school students? Looking at the research that has been done on TPR and the idea that gesturing could lower the affective filter, the literature seems to support the hypothesis of this work. Gesturing may, therefore, increase students' language learning in a Spanish II class.

CHAPTER III

METHODS AND PROCEDURES

Overview

The following research was designed to test the validity of the removal of the gesturing phase in the current TPRS steps. Blaine Ray has written that gesturing is a great way to make language comprehensible, but as a method may be confusing. Students may at times wonder, "What does the gesture mean?" Stephen Krashen's comprehensible input hypothesis could be supported by this research. This researcher looked at both quantitative and qualitative tests to look at the hypothesis, "Does gesturing increase students' language learning in a Spanish II class?

Research Design / Measuring Devices

The researcher decided that two types of measures were needed to understand the results of this study. This study included both qualitative and quantitative measures. The qualitative measure was given in form of a questionnaire asking students to talk about there perceptions of learning vocabulary. This questionnaire was given after the end of the one month test period.

The quantitative measures were given in the form of vocabulary quizzes. The quizzes were given once a week during the first, second, and third week of the research period. The test included new vocabulary for the week as well as the vocabulary from the first three weeks, and was given the fourth week.

Validity Measures and Reliability Measures

To maintain that the results of the testing were valid, the researcher decided to give the exact same quizzes and tests to all students. All students studied the same

words. The quizzes were given at equal one week intervals and the test was given at an interval of one week later. The reliability measures that show the study could be duplicated with the same results are that the study will be conducted by the same teacher, the groups have been chosen from the same community, and students were from very similar backgrounds. Individual student situations, out of the control of the researcher, could have affected the results of testing.

Selection of Subjects

To test the hypothesis, two groups of Spanish II students were compared. One group received the gesturing phase of the lesson. Students in these Spanish classes expressed that they were taking the class to fulfill college entrance requirements. The group of students viewed themselves as college bound. Students were in the range of 15-18 years of age, and there was little diversity based on race. The two groups of students did not know that they are doing something different.

Research Procedures: Quantitative Testing

Each week students in both the control and experiential group were given the same vocabulary quiz. Students were told at least on day ahead of time about the quiz. The quizzes were ten points, and were administered as a pencil paper quizzes.

At the end of the one month experimental period both groups of students were given a chapter test. The chapter test included new vocabulary and also the vocabulary from prior weeks. The section of the test that was included in this study was worth ten points.

Research Procedures: Qualitative Testing

The researcher included a qualitative test. The students who received the treatment were given a qualitative test three months after the gesturing phase was concluded. The qualitative test was given in the following manner. Students were asked to respond on a scale of one through five. The statement on the test was, “I think gesturing helped me learn Spanish.” A score of zero will be defined as, “I totally disagree.” A score of five will be defined as, “I totally agree.” Students will respond to the statements based on their personal impressions.

CHAPTER IV

RESULTS AND DISCUSSION

Introduction

The researcher collected three quizzes and a test score for each participant. The participants were chosen by the researcher as part of her afternoon classes. One class served as the control, while the other received the treatment. The data was collected during the 2005-2006 school year. Not all of the students' results were included in the analysis of the technique. Due to specific student situations that would have changed the results of the study, the researcher decided to remove their scores from the pool. Leaving their scores in the results would show very favorably in support of gesturing.

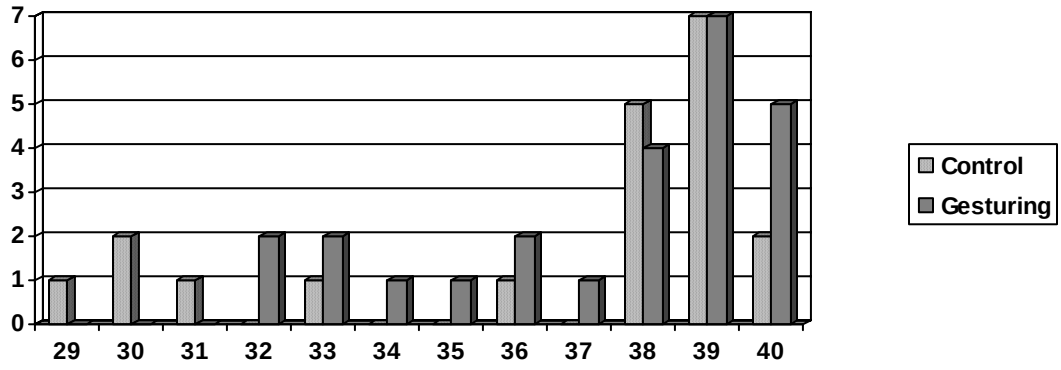
Procedures

The data was collected and entered in alphabetical order into an Excel document. This enabled the researcher to look at the numbers as a whole. The following results take a look at that data in smaller pieces.

Quantitative Results

This chart shows the difference between the two groups composite scores. Each participant was given three quizzes and one test. Each quiz and test was 10 points. All of the scores were added together to give the participant a composite score. The highest possible score was 40. The lowest score was a 29 and the highest was a 40.

Figure 4-1



Observing the table, one notices the absence of scores for the gesturing group on the low end. This shows a weak trend towards the fact that gesturing can aid learning. This will be further explored looking at the mean, median, mode, and minimum of the composite scores.

Analyzing the mean, median, mode, and minimum creates a similar view of the results, and the evidence that the two groups were not significantly different.

Figure 4-2

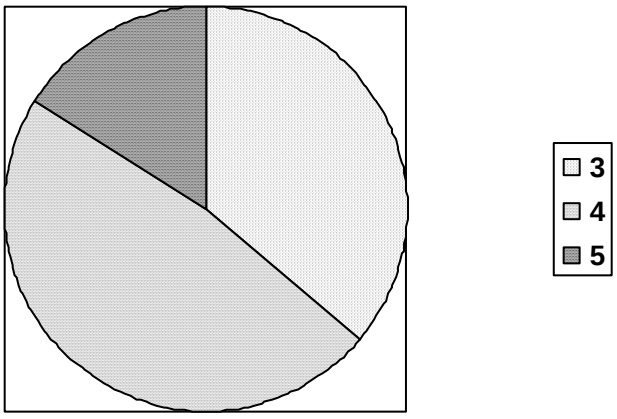
	Control group	Gesturing group
Mean	36.71	37.32
Median	38	38
Mode	39	39
Minimum	29	32

This chart shows that there is very little difference between the two groups. An interesting difference can be seen in the minimum.

Qualitative Results

The qualitative results were collected three months after the one month test period. The researcher gave the students one statement to which they needed to respond. The statement was, "Gesturing helps me learn Spanish." Students were instructed to circle a number zero through five. A zero represented, "I totally disagree." A five represented, "I totally agree." Nine students responded with a 3, 12 students responded with a 4, and 4 students responded with a 4. Overall students responded favorably to the treatment.

Figure 4-3



Hypothesis Testing – *t*-Test

The quantitative data produces a *t*-value of .647; this indicates a .521 probability that the difference in the means is significant. The results show that gesturing did not have a significant effect on the students' learning.

CHAPTER V

SUMMARY OF RESEARCH RESULTS

Although the results did not support the hypothesis, the research shows that the use of gesturing is equally as effective as the traditional methods the researcher was employing. Blaine Ray brings up a good point that gesturing is a great way to make words comprehensible, but can be confusing to some students. As the researcher looks back through quizzes, students who received the treatment made errors that seemed to point to a misunderstanding or misinterpretation of the gesture. The students who did not receive the treatment made mistakes on the quizzes that seemed very random. This point would lead the researcher to further explore gesturing and its placement within the curriculum.

Looking at the overall scores for the students, there was not one student from the group that did the gesturing that did not get at least 80% correct as a composite score. From the group that did not receive the treatment, four students had a composite score of under 80%. Even though the overall scores did not show an improvement, looking at the lows within the scores, it can be suggested that this technique may work, supporting Howard Gardner's theories of multiple intelligences.

Recommendations for Further Studies

Examining the idea that the gestures may have been misinterpreted, the researcher wonders if the study would have been better suited for a beginning language class. The basic vocabulary commonly taught in an introductory level course may have lent itself better to the use of gesturing. The gestures may not have been misinterpreted and for that reason shown better results on quizzes and tests.

The researcher would suggest having pop quizzes and tests to truly look at how much the classroom activities had to do with learning and acquisition. The students in both groups had the option and opportunity to study. For both groups this may have inflated the scores. In a situation where the students are not worried about grades, the research techniques could truly be tested.

The time period of the study may have been improved by taking into consideration the health of the researcher. During the study she was undergoing treatment for cancer including missing class for bi-weekly chemotherapy treatments. This meant that the students saw a substitute teacher twice during the treatment. The results probable were not changed by that, but it has to be taken into consideration. The classroom environment may have been affected by the fact that the researcher lost her hair during the study, and she did not have as much energy and endurance as normal. This in turn may have affected student learning.

The length of the study was short with a small student sample. A lengthier study and a larger sample size, could lead to different results. Since the researcher's current situation does not offer much in terms of diversity, a more diverse sample may lead to different results.

The study focused in on gesturing as a form of comprehensible input. This did not take in to account that the students were given comprehensible input in various forms. This may explain why there was not a big difference between the two groups. If both groups received comprehensible input, although varied, why would the results be different if Krashen's hypothesis is correct?

Conclusion

In conclusion, the researcher was at first very surprised to see that the results were not more favorable towards gesturing. It was felt that offering various forms of comprehensible input and using different intelligences would lead to language learning.

Looking at some of the recommendations could lead to a better study or application of the technique. The researcher will continue to use gesturing on a regular basis, as it can be used to make words comprehensible. Continued research into Stephen Krashen's comprehensible input hypothesis could give helpful information about how to make all class activities comprehensible in Spanish. Examining the results, comprehensible input seems to be the most important factor. Using gesturing may help support the different intelligences, offer comprehensible input, and aid students in language learning.

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Does having students formally write down notes, using the classic projector, transparency, and screen method, aid middle level students in the learning of basic historical ideas and facts?

by

Michael Peter Matiash

B.S., University of Wisconsin La Crosse, 2001

A capstone submitted to the

Faculty of the Graduate School of Winona State University

in partial fulfillment of the requirement for the degree of

Master of Science

Department of Education

April 2006

This action research project entitled:

Does having students formally write down notes, using the classic projector, transparency, and screen method, aid middle level students in the learning of basic historical ideas and facts?

Written by Mike Matiash

Has been approved for the Department of Education

_____	_____
John Rud	Dr. Tom Sherman
_____	_____
Erika Youlden	Angela Matiash

_____

Date

The signatories have examined this project, and we find that both the content and the form meet acceptable presentation standards of scholarly work in the above-mentioned discipline.

Matiash, Mike (BS, Broad Field Social Studies)

Does having students formally write down notes, using the classic projector, transparency, and screen method, aid middle level students in the learning of basic historical ideas and facts?

Research project under the direction of Dr. Thomas Sherman

ABSTRACT

Go into any middle level classroom across the country where history is being taught and chances are you will see a teacher standing at the front of the room lecturing using notes on an overhead projector as he/she has the students copy the notes into their own notebooks. It is assumed by many that this time tested method of teaching history is effective for delivering large amounts of facts to students in a relatively short period of time. The usefulness of having students copy notes appears effective at first glance, but its usefulness should not be accepted by faith alone. Every good teacher questions his or her own teaching practices; therefore, this method should be closely examined by anyone who relies on it as a teaching methodology. An inquisitive mind must wonder whether there is a better way to teach students history than having the students copy notes. One must also wonder if students are really learning more by copying notes than they would otherwise. This action research project seeks to examine these issues and explore the importance and value of the classic method of teaching middle level history students through the practice of having them copy notes.

This study's intent was to discover if students performed better on unit tests if they were taught when the instructor required them to copy notes or when he/she did not

allow them to copy notes. The test was administered to four eighth grade world history classes over the course of four consecutive units. During each unit, two classes were taught by having students copy notes and two of the classes were taught without having students copy notes. The methods used were switched randomly at the conclusion of each unit. After all units were completed, all test scores were collected and sorted according to the teaching methods. A class mean was then calculated for each class. A head to head comparison was then conducted to determine which method yielded the highest percentage, therefore making it the preferred method for improving students' ability to learn historical facts and information.

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CONTENTS

CHAPTER I: INTRODUCTION

For three and a half years I have taught at a seventh through twelfth grade high school in a small town in Minnesota. Every year I have taught four classes of world history to eighth grade students and one class of sociology to junior and senior students. This is the only teaching job I have ever had. As each year has passed, I have continually looked for ways to improve my teaching. I have worked on sharpening that which has worked and correcting that which needed fixing. During my first two years of teaching I tried to perfect my teaching through improving that which I used in my classroom. I was always searching for new and better material, recourses, and ideas. This search improved the quality of education in my classroom, but then I started to look for other ways to improve. Soon, I reached the conclusion that I needed to improve the methods I used to teach. To improve the methods I used to teach, I decided that I needed to return to a university setting. This brought me to working on my master's degree at Winona State University through a "learning community" with other teaching professionals.

As part of my master's degree, I was given the opportunity to research my own teaching methods in a scientific manner and to reach an outcome that could have far reaching effects on my teaching style for many years. I decided that I wished to test the usefulness of the age-old method of teaching students history through having them copy notes. Within my department at my school, I am in a minority as far as not believing in the value of note taking. I only occasionally will dust off my overhead to have the students take notes, and I only do this because I feel like it is something that is required of a history teacher.

Through this action research paper I aim to scientifically prove whether my students perform better (get better test scores) when they are taught by taking notes or not taking notes. The result of this research project will help me to alter my teaching methods to better teach my students.

Need for study:

Go into any middle level classroom across the country where history is being taught and chances are you will see this; a teacher standing at the front of the room lecturing using notes off of an overhead projector as he/she has the students copy the notes into their own notebooks. I have often questioned the point and usefulness of having middle level students copy notes from an overhead to their personal notebooks. Do they learn more by writing information down? Are these written notes useful for studying? Do the students ever even look back at them? If they are only a study aid, then why not just give the students a copy of the notes? Are ideas and information lost in the transition of writing them down? Through my capstone project I seek to answer these questions and explore the importance and value of the classic method of taking notes.

Statement of Problem:

The majority of high school students learn history through the act of copying notes from an overhead projector as a teacher reads the notes to them. This method of teaching history has been time tested and is effective, but the question can be asked; is there a better method out there? Does having students formally copy down notes, using

the classic projector, transparency, and screen method, aid middle level students in the learning of basic historical ideas and facts?

Purpose of Study:

The purpose of this study is to compare students' test scores who were taught through the use of copying notes with the scores of students who did not take any notes. Comparing these scores will show the instructor, which method will aid their students more in the learning of historical information and facts.

Tentative Hypothesis:

Having students formally write down notes, using the classic projector, transparency, and screen method, does not aid middle level students in the learning of basic historical ideas and facts.

Definition of Terms:

Taking Notes/Copying Notes: For the purposes of this study, these terms will refer to students copying the notes given to them in the form of an overhead projection into their own personal notebooks.

High School: The school within the study includes students in grades seven through twelve.

IEP Plans: Individual Education Plans of students who officially qualify for special education. Many of these students receive special accommodations including modifications on tests.

504 Plans: Educational accommodation plans for students who do not qualify for traditional "IEPs," but who are assessed by the school to be at risk of failing. Such students can receive modifications on their tests.

Variables:

Independent Variables-

The independent variable for this study will be the teaching method used to teach the students the historical information and facts for each chapter. Half of the world history classes will be taught through having the students copy notes using an overhead projector, transparency of notes, and a projector screen. The other half of the world history classes will be taught having them copy any notes.

Dependent Variables-

The dependent variable for this study will be the chapter test score class averages. Chapter tests of fifty-four to sixty-four questions will be given at the conclusion of each chapter to assess student learning. There will be four chapter tests given in all.

Control Variables-

In an effort to ensure reliability, there will be many control variables for this study. The biggest control variable is that the same teacher will be conducting all teaching, testing, and assessing of the students. All students (regardless of the independent variable group) will be taught the same material each chapter, over the same amount of time, and will take the same test. All students within the study will be eighth graders from the same school and community. All teaching and testing will be conducted within the same classroom setting. All students have been in the teacher's class for over a semester and are accustomed to the teacher's expectations.

Moderator Variables-

Difficulty in repeating this exact study will come from the moderator variable of the teacher's personal teaching style and abilities. Although the independent variables of having the students copy notes or not copy notes is very clear, a different teacher may have a different style or method within the fundamental methods of teaching. More simply put; not all teachers will have students copy notes in the exact same way. This moderator variable will only be important for others wishing to use this study or repeat this study. It will not be important for the conductor of this study whose intention is to learn about his own personal classroom.

Limitations of Study:

A big limitation of this study is that the moderator cannot control the amount students may or may not study for the chapter test outside of the classroom. It can be

assumed that students will do varied amounts of studying at home and in study halls ranging from none at all to a couple hours over a week. Students who copied notes may study using their notes and students who did not copy notes could study using their textbooks. The amount of studying outside of class will have some effect on individual student's chapter test scores regardless of which independent variable group they are in. Ethically the moderator cannot control this because these chapter test scores will count for each student's grade and ultimately their high school grade point averages.

Another limitation of the study that cannot be controlled is each individual student's prior knowledge of the subject area for each chapter. The four chapters of history are on the Eastern Roman Empire, The Rise of Islam, The Dark Ages, and The Renaissance. All four of these chapters should be new information to the average eighth grader, but a few students may bring prior knowledge from outside of school experiences. Any prior knowledge of the chapter students bring with them will undoubtedly affect their test score.

A final limitation of the study is that it will involve all students including special education students with "IEPs" and students with 504 plans. Many of these students will be required to take modified chapter tests. The tests will cover the same material and be the same length. The modifications many consist of limiting choices for multiple-choice questions and providing word banks of possible answers for short answer questions. This modified testing will also limit the results of the study.

It is of note that all of the limitations mentioned above will be somewhat limited because of the randomness and repetition of the study. For every chapter test half of the classes will have randomly taken notes and half of the classes will not have taken any

notes. The study also will be repeated this way for four consecutive chapters. Each student will take four chapter tests: two with copying notes and two without copying notes, thus ensuring that an individual student's testing ability will be equally reflected in each of the teaching methods.

II. REVIEW OF LITERATURE

There are numerous researchers who have studied the effectiveness of having students copy or take notes. The findings of the research are somewhat varied. Two researchers, Beecher (1988) and Lonka (2003) have said that the research results on this topic are mixed, lacking, and have little to offer others. One must wonder why there is such little evidence pointing one way or another since the teaching method of having students take notes is such a common practice in the American educational system. But before looking into the research on the effectiveness of note taking, one must also consider the reasons for taking notes and understand what note taking is.

Note taking is "a complex activity that requires comprehension and the correct selection of important information in conjunction with a written production process;" or more simply it can be defined as a "short condensation of a source material that is generated by writing information down while simultaneously listening, studying, or observing (Lonka, 2003). This process is meant to aid learning.

There are two commonly recognized reasons for how note taking aids learning. The first reason is that the process of taking notes itself serves as a reflection or teaching aid. The second is reason is that the product of note taking leaves the student with a written record from which to review or study (Boch, 2004). This study and research will mostly concern itself with the process of how note taking itself aids the student in the learning of material.

A few studies do exist that show the positive effects of copying notes on students' retention of knowledge. During the 1920's a man named C. C. Crawford conducted studies to verify a positive correlation between college students who copied their lecture

notes and their scores on the related quizzes. Crawford concluded that "taking notes was better than not taking notes" and he went on to suggest that "reviewing notes was key" to retention (Beecher, 1988). In 1970, Michael Howe did a similar study and found that students were about seven times more accurate in recalling information if they had copied it in their notes. Howe concluded "the act of note writing per se makes a contribution to later retention" (Howe, 1970). John H. Carter and Nicholas Van Matre completed another similar study with similar findings. This study, also performed on college students, yielded results that support the correlation between copying notes and learning. The researchers concluded that "taking and reviewing notes yielded maximum retention, while listening only resulted in the poorest performance (Carter, 1975). These studies, however, did not show much evidence to prove that the actual copying of the notes improved the students' retention of knowledge and that the knowledge was not gained from studying the notes.

Some researchers agree that the actual act of note taking increases learning because it focuses attention and concentration. "Taking notes requires attention to be more precisely focused on the accessing, sorting, and coding of the information than would be needed to simply listen to a speaker or read" (Boch, 2004). The basic taking of notes requires individuals to reprocess information instead of just processing information.

One of the most convincing studies, which shows the capabilities of note taking was done by Kerwin and Benton in 1988. In this study researchers compared note taking to overall academic achievement. More exactly, they compared quantity of notes copied to student grade point average. What they found was the "amount of note-taking is related to academic achievement" and "the ability to hold and manipulate prepositional

knowledge in working memory is related to the number of words and main ideas recorded in notes" (Kiewra, 1988). This study seamed to show a positive correlation between note taking and learning. Still, it does not prove whether note taking makes for smarter students or if smarter students take more notes.

Other studies show evidence that the act of note taking does not aid in retention. During a study conducted in 1985, by Henk and Stahl, the researchers concluded "the process of note taking itself does little to enhance recall" (Henk, 1985). Still other studies criticize note taking as causing students to lose interest and not pay attention. Professor Jeffrey S. Nevid of St. Johns University says students who are exposed to lengthy lecture notes "are unlikely to encode and retain key points from lecture materials if they are not paying attention" (Nevid, 2006). Still another study by Bretzing shows that repetitious note copying can cause "unlearning." Bretzing found that "subjects who took verbatim notes scored lower than subjects who processed information at a higher level" (Bretzing, 1979).

Finally of note is a study by Fisher and Harris, who found that students "perform better when they are allowed to encode information in the way that they prefer" whether that is copying notes or just listening (Fisher, 1974). This study points to mixed effects of note taking.

Other studies offer advice to instructors about how to give better notes that help students with retention. One such study offers the following advice. Start each note taking session with a brief overview so that students will be primed for what they are to learn. Next, break note-taking sessions into segments of no longer than fifteen minutes followed by short breaks. Also during lecture, the instructor should change the pace of

delivery and move gradually about the room (Nevid, 2006). Another study offers this advice to students, "it is better to highlight notes than to simply read them, and better again to summarize them (re-write them) than to highlight" (Boch, 2004).

There is a lot of sound advice on note taking, but still little that explains how it directly helps students learn. Regardless of the claims of the capability of note taking to help students to improve retention, one important by product of note taking mentioned in many of these studies related to the fact that it teaches students handwriting skills. It is also of note that many of these studies mentioned the fact that teachers teach students how to write and have them take notes, but usually teachers never really teach sound noting skills. Because of conflicting studies and mixed results within studies, the question still remains as to whether the act of taking notes itself actually improves student learning. The answer to this question is of great importance when one examines the relatively large number of teachers who instruct solely through lecture and notes.

III. METHODS AND PROCEEDURES

Overview:

Four different world history classes will be tested during this study. The classes are 1st, 3rd, 6th, and 7th periods in a seven period day. For the purposes of this study they will be referred to as class A, B, C, and D respectively. This can be seen in figure 3.1. The tests will cover four consecutive chapters, each of about two weeks. The topics of each chapter can be seen in figure 3.2. During each chapter two of the four classes will be taught using a teaching style that requires the students to write down all information in basic note format. The other two classes will be taught in a teaching method that will not allow the students to copy any notes. The teaching style will be switched randomly between classes at the start of every new chapter. This can be seen in figure 3.3. Mean class test scores will be compared between independent variables to determine which teaching method yields the best average results.

Figure 3.1

Period of Day	Letter	Number of Students
1st	A	23
3rd	B	28
6th	C	30
7th	D	19

Figure 3.2

Chapter Test Key:
- Test 1: The Eastern Roman Empire (56 questions)
- Test 2: The Rise of Islam (54 questions)
- Test 3: The Middle/Dark Ages (63 questions)
- Test 4: The Renaissance/Ages of Discovery (64 questions)

Figure 3.3

	Test 1	Test 2	Test 3	Test 4
Class A	**Notes**	No notes	No notes	**Notes**
Class B	No notes	**Notes**	No notes	**Notes**
Class C	No notes	**Notes**	**Notes**	No notes
Class D	**Notes**	No notes	**Notes**	No notes

Bold is class with notes

Research Design:

The variable in this study will be the teaching method used. The "Note" teaching method will use the classic overhead projector and screen in which the teacher will show notes written on a transparence. Students will be required to write down all notes as given on the projection screen. Students' notebooks will be checked to insure that they are following directions and taking notes correctly. The teacher will read and discuss the notes as the students write them. Any absent students will be given a copy of the notes the next day. The students have practiced this method in the past and are accustomed to learning in this manner. All students will be required to take notes during this method. Students with IEP's or 504 plans that do not require the students to copy their own notes, will still be asked to take their own notes and then will be given a teacher copy of the notes at the end of the note taking session in exchange for their notes. This has been the common practice all year.

The other method used will be teaching without allowing the students to copy any notes down. This teaching method will still show the students the same notes using an overhead projector and the same transparencies, but the students will not be allowed to write any notes down. In place of having the students copy notes, the instructor will

devote the extra time to discussing the notes with students and orally reviewing the content of the notes with the class.

The exact same material will be covered by both methods and the same overhead transparencies will be shown to all test groups. All test groups will receive the same amount of instructional time per class period and per chapter. All test groups will also take the same chapter test for assessment at the end of each chapter.

Selection of Test Subjects:

The test subjects for this study will be four different world history classes. All classes will be taught by the same instructor at the same school. All classes contain only eighth grade students ranging in age from twelve to fourteen. Each class contains about an equal mix of both genders. The classes are hours 1st, 3rd, 6th, and 7th in a seven period day. For the purposes of this study they will be referred to as class A, B, C, and D respectively. There are twenty-three, twenty-eight, thirty and nineteen students in these classes respectively. This can be viewed in figure 3.1. Each class has students of mixed ability levels and each class is inclusive of students with IEP's and 504 plans. Although the amount and ability level of students varies from period to period, it remains constant within the period during the entirety of the testing. No students switched classes, withdrew from school, or missed more than two consecutive days during the testing period.

Measuring Devices:

For the purposes of this study, the test subjects/test groups will be treated as an entire class as a whole. Their assessment will be measured as a mean class test score at the end of every chapter. All scores within a class will be counted toward the class mean. Each test group/class with be tested using each method twice by random selection. This can be seen in figure 3.3. Because each chapter test contains a different amount of questions ranging from fifty-four to sixty-four, test scores will be converted into percentages correct out of one hundred. This can be seen in figure 3.2. All tests and data will be collected, corrected, converted, and entered by the instructor.

Validity Measures:

Validity refers to a study's ability to accurately assess or reflect the concept the research was intending to measure. To examine the validity of this study, it is necessary to consider both the internal and external validity. Both measures of validity may have two very different outcomes.

External validity is the extent to which the results can be generalized or used by others. Good external validity means that another person could complete this exact study and get the same results or that another person could use these results to make valid connections in their own research. Using either of these definitions, the external validity of this study is poor. The external validity is poor because of a few different threats to the validity, the moderator variable and test subject selection. The moderator variable is a large threat to the external validity of this test because the independent variables involve the instructor's personal teaching style. This would be hard if not impossible to duplicate if trying to repeat this study with a different instructor. The second threat to

external validity, test subject selection, is not as large of a threat but is still worth mentioning. The test subjects used in this study, like all classes of students, were unique in many ways. If repeating this study again, it would be very hard to get a similar group of test subjects who had the same relationship and rapport with the instructor. Although the external validity of the test is poor, it is not a problem because the test was designed and conducted for the use of the instructor as a way to improve his teaching abilities. The test was not designed to be replicated by others or to tell other instructors how to teach their own students.

Although the external validity for the test was poor, the internal validity is quite sound. Internal validity deals with the rigor in which the study was conducted to make sure that it is measuring what it set out to measure. In this study great lengths were taken to hold all control variables constant. The test used the same groups of students, in the same school, over the same amount of time, and was conducted by the same instructor in the same classroom, students learned the same material, and all students were given the same assessment. No subjects were lost or added, as is normal over extended periods in a high school. Also, the testing itself did not affect the outcome because the results were part of the test subjects' grades: therefore, students would always try to do their best for personal gain. For these reasons the internal validity of the test is quite good.

Reliability Measures:

Reliability is the extent to which a study would produce the same results when conducted again. To conduct a standard "t-test," the mean class test score for each unit and each variable were compared. The result was a probability of 0.876. This is saying

that the results would be reliable approximately 88% of the time. The results of 88% accuracy is not within the recommended 95% accuracy, so therefore the reliability of this test is not reliable within the expected amount. Still, the test does show strong signs of reliability.

Field Procedures:

The testing began with a unit on “The Eastern Roman Empire.” Classes “A” and “D” were taught requiring them to write down all notes given during this unit. Classes “B” and “C” were taught the same material but were not allowed to write down any notes. At the end of the unit all classes took the same test to assess what they learned during the unit. This process was repeated three more times for the next three units. Each time two different class were required to either copy all notes or copy no notes. This can be seen in figure 3.3.

After all units were completed, all test scores were collected and converted to percentages. A class mean was then calculated for each class and for each unit. A unit test mean was also calculated using all four classes per test. A head to head comparison was then conducted to determine which method yielded the highest percentage above the average and therefore would be the preferred method for improving students' ability to learn historical facts and information.

Conclusion:

This study measured students' ability to recall and use historical facts and information that was taught to them using two different teaching methods. Students were either taught using a method that required them to copy all notes given to them using a transparency, overhead projector, and screen; or the students were taught the same material but without being allowed to write down any notes. The study allowed a head to head comparison of both methods through comparing the mean score comparisons of both variables.

CHAPTER IV: RESULTS AND DISCUSSION

To fully examine the results of this study, two different approaches could be used. One approach would involve comparing the mean of all test scores of students who copied notes to the mean of all test scores of all students who did not copy notes. This approach would give you a very straightforward look at which teaching method allowed students to earn higher scores, but this method would not take into account the difficulty level of the different tests taken with each chapter. To account for this, a second approach to looking at the results can be used. This approach involves first comparing each class's mean test score to the all class's mean score for that particular test and then comparing the two teaching methods used. Both approaches give similar results.

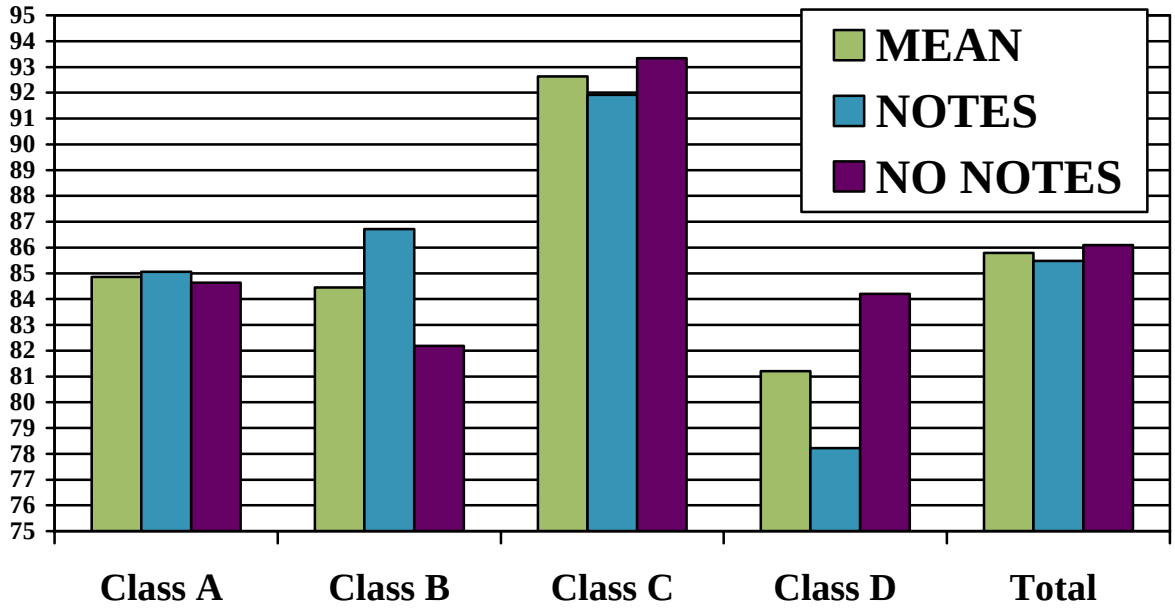
The first approach involves a basic comparison of the mean of all test scores of students who copied notes versus a mean score of all students who did not copy notes. Figures 4.1 and 4.2 show this comparison in three different ways; by class and test, by class and method, and by all classes and method. The results show that classes "A" and "B" did .42% and 4.54% better with notes respectively. The results also show that classes "D" and "C" did 1.42% and 5.98% better without copying any notes. When combining all students to get an all class mean, the results show that the students averaged 85.48% when they copied the notes and 86.09% when they did not copy the notes. In a straight head-to-head comparison not copying the notes out performed copying the notes by .61%.

Figure 4.1

	Class A (1st)	Class B (3rd)	Class C (6th)	Class D (7th)	*Test Mean*	***Note Mean***	*No Note Mean*
Number of Students	23	28	30	19			
Test 1 Mean	**84.86%**	83.47%	92.92%	**78.57%**	*84.96%*	***81.72%***	*88.20%*
Test 2 Mean	87.28%	**90.34%**	**94.26%**	86.16%	*89.51%*	***92.30%***	*86.72%*
Test 3 Mean	81.99%	80.89%	**89.58%**	**77.86%**	*82.58%*	***83.72%***	*81.44%*
Test 4 Mean	**85.26%**	**83.09%**	93.75%	82.24%	*86.09%*	***84.18%***	*88.00%*
Class Mean	*84.85%*	*84.45%*	*92.63%*	*81.21%*	*85.79%*	***85.48%***	*86.09%*
Notes	***85.06%***	***86.72%***	***91.92%***	***78.22%***	***85.48%***		
No Notes	*84.64%*	*82.18%*	*93.34%*	*84.20%*	*86.09%*		

Bold is class with notes

Figure 4.2



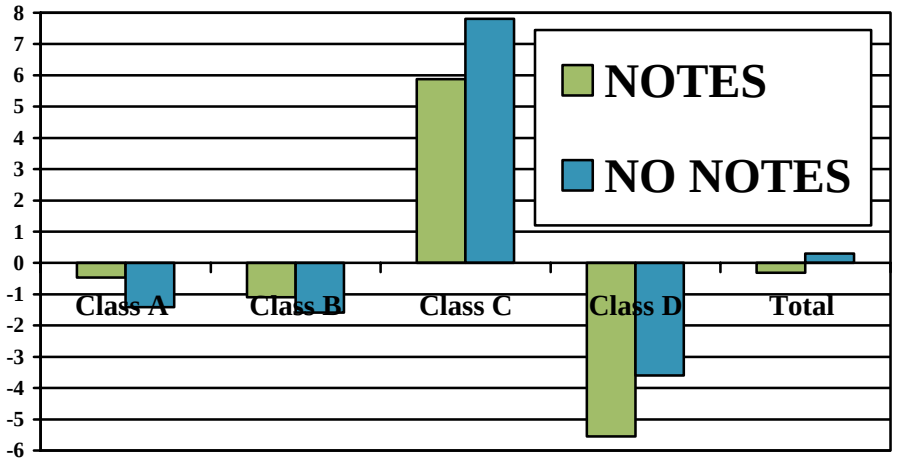
The second approach, which takes into consideration the difficulty of each individual test, can be seen in figures 4.3 and 4.4. This approach first measures the difference of each class's test score verses the all classes average and then does a head to head comparison of both teaching methods. These results show the test scores without showing the relative difficulty of each individual test, yet they give the same results as mentioned above. Classes "A" and "B" still performed better with copying the notes and classes "D" and "C" still did better without copying the notes. This approach also clearly shows that class "C" had the highest test scores across the board, while class "D" performed the worst on every test. Classes "A" and "B" were still below the mean average, but were much closer and more constant than class "D." In a strait head-to-head comparison, using the second approach, not copying the notes preformed .3% above the all class average and copying the notes preformed .31% below the average. There was a .61% difference of no notes out performing notes just as in approach one.

Figure 4.3

	Test Mean	Class A (1st)	Class B (3rd)	Class C (6th)	Class D (7th)	
Test 1 Mean	*84.96%*	**-.10**	-1.49	+7.96	**-6.39**	
Test 2 Mean	*89.51%*	-2.23	**+.83**	**+4.75**	-3.35	
Test 3 Mean	*82.58%*	-.59	-1.69	**+7.0**	**-4.72**	
Test 4 Mean	*86.09%*	**-.83**	**-3.0**	+7.66	-3.85	
Class Mean	*85.79%*	*-.94*	*-1.34*	*+6.84*	*-4.85*	*-.08*
Notes	***85.48%***	***-.47***	***-1.09***	***+5.88***	***-5.55***	***-.31***
No Notes	*86.09%*	*-1.41*	*-1.59*	*+7.81*	*-3.60*	*+.30*

Bold is class with notes

Figure 4.4


8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
NOTES
NO NOTES
Class A
Class B
Class C
Class D
Total

CHAPTER V. SUMMARY AND CONCLUSIONS

Summary:

A very common approach to teaching history to middle level students is having them copy notes off an overhead projector. This study's intent was to discover if students performed better on unit tests if they were taught when the instructor requires them to copy notes or did not allow them to copy notes. The test was administered to four eighth grade world history classes over the course of four consecutive units. During each unit, two classes were taught by having them copy the notes and two of the classes were taught without copying the notes. The methods used were switched randomly at the end of each unit. This can be viewed in figure 3.3. The results of the study are written below.

Conclusions:

This study gave some evidence supporting the hypothesis that "Having students formally write down notes, using the classic projector, transparency, and screen method, does not aid middle level students in the learning of basic historical ideas and facts." The results for this study show that in a straight head-to-head comparison not copying the notes out performed copying the notes by .61%. This brings up the question of how big of a difference is .61%? A standard t-test says that the probability of repeating these results was approximately 88%. This percentage is close to but below the recommended 95% for accuracy. Also given the fact that this study was only repeated four times, this somewhat limits the reliability of the study.

The conclusion is that having students not copy notes only slightly out performs having students copy notes. This difference is not significant enough to recommend one teaching method over the other. Both methods performed almost equally. It can be noted that half of the classes performed better on their tests with copying notes and half of the classes without copying notes.

Recommendations:

After examining the results of this study, I would recommend that the instructor continue to implement both methods. Students seem to learn equally well with both methods. I could also say that the instructor should be free to use whichever method he/she prefers or the students prefer. Thus the instructor should not be locked into only following the typical protocol of teaching students history through having them copy notes.

I would also recommend that the instructor, look at the effects of this study on the individual classes. Class "A" and class "B" performed only slightly below the all class mean score by -.94 and –1.34 percent respectively. These classes could be viewed as average classes. These classes both performed better with copying the notes. Class "C" on the other hand, performed far above the all class mean score by +6.84 percent. This class consistently got much higher test scores. They performed better without copying the notes. Finally, class "D" performed far below the all class average by –4.85 percent.

Class "D" consistently had the weakest test scores, but they performed better without copying the notes. This can be seen in Figures 4.3 and 4.4.

This was not scientifically measured during this study, but from this information one could assume that average classes will do better on a test when they copy notes, while higher level classes and lower level classes will do better when they do not copy notes. Keep in mind that this is only an assumption and more research would be needed. My guess for this occurrence is that average students get good grades through hard work like copying and studying notes. Exceptional students will get good grades no matter what methods is used, but will take more of an interest in the subject if they do not need to do the "boring" task of coping. Copying notes on the other hand may not work for low achieving students for many reasons. First it may be such a time and effort-consuming task that these types of students focus more on copying than on learning. Second these students often have such poor organizational skills that they never keep the notes long enough to study them. My recommendation is that these students should be given a copy of the notes and free their time and effort to listen to the lecture.

If I were to do this study again, I would change many things. First, I would have increased the length and repetition of the study. Originally it was conducted for about one quarter of a school year. I would increase the length to about a full semester. This would increase the number of unit tests from four to eight. This of course would then double my sample size from about 400 tests scores to about 800 test scores. All of this would increase the validity and reliability of the test.

I also wished I would have done a student survey to find out what the students thought. It would be interesting to know which method the students thought they learned best from and which method they preferred. It also would have helped to know how much students actually studied their notes and what they did with them after class.

Finally, I wish I could have somehow done a breakdown of students' test scores by method according to their "grade point average." This would have truly shown me which method best helps what type of class or student. Even though I do not have conclusive evidence, I have learned from this study that I should start giving lower level students copies of the notes ahead of time, and that I should mix my methods up. The average class has students of all levels.

CHAPTER VI: REFERENCES

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WILL JOURNALING WHILE GOING THROUGH THE EXECUTIVE PROCESSES IMPROVE STUDENTS' PERFORMANCE IN MATHEMATICAL PROBLEM SOLVING?

by

Brian D. Menk

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Written by Brian D. Menk

Has been approved for the Department of Education

_____	_____
Dr. Thomas Sherman (Faculty Advisor)	Mike Kesler
_____	_____
Jane Erickson	Dawn Lueck (Outside Resource Advisor)

The final copy of this capstone has been examined by the signatories,
and we find that both the content and the form
meet acceptable presentation standards of scholarly work
in the above mentioned discipline.

Menk, Brian D. (M.S., Education, Department of Education)

Will Journaling While Going Through the Executive Processes Improve Students' Performance in Problem Solving?

Capstone paper directed by Dr. Thomas Sherman

Abstract

The ability to effectively solve problems has been a constant focus of mathematics education throughout history. The approach of teaching the executive processes through journaling involves, first, the teaching and modeling of the four step problem solving method, and second, using reflective journaling within the process. Students that employ the four steps alone, incorporate little reflective thinking, or self-regulation. Finding a solution without reflective thinking will often produce an inaccurate or incomplete solution, with little retention. The students who use this journaling process are asked to write down, as they work through the four steps, any thoughts that come up while examining the problem. This will more often produce a solution, which is not only correct, but also complete. The effectiveness of this approach was measured by doing a study on two groups of students, one using the four steps, and the other adding journaling. Data was taken from both groups, analyzed, and tested to see significant difference.

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CHAPTER I: INTRODUCTION

Need for the study:

"For the things of this world cannot be made known without a knowledge of mathematics." (Bacon, 1266) Mathematics has provided essential building blocks that have created much of the world, as we know it. Throughout history, mathematics has grown into a language that is universal. After its initial development over hundreds of years, little has been added or taken away from this great subject. While the content has not seen any recent change, the way it is taught has seen tremendous manipulation. Mathematics curriculum across the nation has gone from traditional "drill and kill" techniques, to application based learning, to investigation and discovery learning, and back to "drill and kill". This changing has gone on for many years, but one problem has remained constant, how to teach problem solving.

Problem solving is generally recognized as one of the most important components of mathematics. In *Principles and Standards for School Mathematics,* the National Council for Teachers of Mathematics emphasized that instructional programs should enable students in all grades to "build new mathematical knowledge through problem solving, solve problems that arise in mathematics and other contexts, apply and adapt a variety of appropriate strategies to solve problems, and monitor and reflect on the process of mathematical problem solving" (NCTM 2000, p. 52). How do students become competent and confident problem solvers? The technique that has been used and remained relatively unchanged is the four executive processes outlined by George Pólya (1973). His four steps are (1) understand the problem; (2) devise a plan; (3) carry out the plan; and (4) look back at the problem. This process is the unofficially adopted universal method of problem solving.

Understanding the problem involves determining what the problem is asking for and what information or details are provided. Devising a plan involves breaking down the given data and creating a strategy or plan of attack that may help solve the given problem. During this step, the student may need to create lists, tables, diagrams, algorithms, and relationships between the given data and the proposed question or unknown quantity. “Carrying out the plan” is where the plan is carried out and checked for flaws. Looking back involves ensuring that the solution(s) are reasonable for the given problem. (Pólya, 1973)

Statement of the Problem:

Even when teachers model these executive processes, teaching students to be great problem solvers is difficult. Problem solving is a technique that takes time to learn and develop. What can teachers do to improve upon this process and help students learn it? Mathematicians and mathematics educators agree that modeling and using the executive processes will improve students’ performance and understanding of problem solving. Also, “writing is a valuable way for students to reflect on mathematical concepts and solidify their understanding of them” (NCTM 2000). Thus, writing or journaling about the executive processes while going through them may aid in the understanding and performance in problem solving. Students will better be able to organize their thoughts while attempting to solve a particular problem.

Purpose of the Study:

The purpose of this study is to determine whether or not journaling while processing the formal executive processes will improve students' performance in problem solving.

Statement of the Hypothesis:

Journaling while going through the executive processes will improve students' performance in problem solving more than going through the processes without journaling.

Definition of Terms:

DRILL AND KILL- A method of teaching a particular skill in mathematics by modeling the skill through an example problem then assigning multiple problems similar to the one modeled.

UNKNOWN QUANTITY- The desired solution to a particular problem that is not given.

ALGORITHM- A step-by-step procedure to accomplish something.

MEAN- The calculated average of a set of data.

Variables:

Independent Variables: The means of the assigned grades for a pre-test for both the control group and treatment group.

Dependent Variables: The means of the assigned grades for a post-test for both the control group and treatment group.

Control Variables: Both groups, control and treatment, were geometry students. Both classes were taught in the same semester of the same year. The students were not led to believe that they were involved in a study during the time of the testing. Both groups were given the same instruction on the executive processes to problem solving.

Moderator Variables: The two groups were taught at very different times of the day. One was taught in the first class of the day and the other the last, which can impact the teaching as well as the learning.

Delimitations:

Both groups were homogeneous in some aspects. All students were enrolled in a required class (Geometry) at a rural high school in southeastern Minnesota. All students have had Algebra I in the past two years, so they have a background in problem solving and its processes. Both groups were subject to the same teacher, rules, assignments, and expectations.

Limitations:

A few factors exist, which could skew the data. Not all the students were 10th graders coming from Algebra I. One student was a junior that took Algebra II as a sophomore, so his problem solving skills may be stronger to begin with. In addition to that, his higher maturity level may play a role in his advanced skills. Another

student was a senior who had failed the class previously, so he may be under extra stressors. There were also six students who did not come up through the Lewiston-Altura school system, so their backgrounds in mathematics and problem solving may be different than the others. Also, our school is on the block schedule, so there are some students that had Algebra I the first semester of their freshman year, and some had it second semester of their freshman year. This means that there is a larger gap between math classes for some than others. Finally, the class sizes were substantially different. The control group consisted of 26 students, and the treatment group had 19. The atmosphere and attitudes of the students as well as the instructor can vary largely with a difference this big.

CHAPTER II: LITERATURE REVIEW

Complexity

Problem solving is “any goal-directed sequence of cognitive operations” (Anderson, 1980, p. 257). It can range from simply thinking about the process of tying your shoe, to the most sophisticated of situations. There is little dispute among mathematicians that the biggest issue that plagues mathematics students is problem solving. The first reason is that of the complexity of the problems. “Problem complexity is defined by the number of issues, functions, or variables involved with the problem; the degree of connectivity among those properties; the type of functional relationships among those properties; and the stability of the problem over time” (Funke, 1991). Complexity is then a direct path to difficulty; therefore, students have trouble with complex problems. “Problem difficulty is a function of problem complexity. For example, problem difficulty has been found to be a function of relational complexity” (English, 1998). “Problem complexity necessarily affects learners’ abilities to solve problems. For example, problem complexity has significant effects on search problems” (Halgren & Cooke, 1993).

Why do we assume that complex problems are more difficult to solve than simple problems? The primary reason is that complex problems involve more cognitive operations than simpler ones (Kluwe, 1995). Therefore, working memory requirements increase at least proportionally. Accommodating multiple factors during problem structuring and solution generation places a heavy burden on working memory. The more complex a problem, the more difficult it will be for the problem solver to actively process the components of the problem. Writing down

thoughts and ideas while solving complex problems will take much of that burden off the working memory by possibly breaking the complex problem up into smaller, simpler ones.

Context

Students' past experiences in mathematics consist mostly of generating "the answer" to problems by applying procedures for manipulating numerical and symbolic expressions. They have learned to view the teacher (and/or the textbook) as the sole authorities in the classroom, and defer thought to them on most issues. They have developed the ability to "master facts and procedures for exams, which are the accepted evidence of their mathematical competence" (Anderson, 1976). However, given problems out of context they may well not know when to apply those facts and procedures. Unfortunately, "mastering each component skill is not enough to promote non-routine problem solving" (Mayer, 1998, p. 50). Moreover, as Schoenfeld (1985, p. 43) notes, "For most of them, doing mathematics has meant studying material and working tasks set by others, with little or no opportunity for invention or sustained investigations." Problem solving often requires the generating and use of skills and theories that are out of the current context of the class. This requires the students to refer to many aspects of what they have learned. Keeping a written log of their work should help to make this process much easier.

Mathematical Thinking

Learning mathematics is by and large a reflective activity (Thompson, 1985, p. 2). Reflection back on what you have learned is essential to problem solving, and journaling is perhaps the most convenient way to do that. "To learn mathematics is to

learn mathematical problem solving" (Thompson, 1985, p. 2). This thought contrasts the view that "one learns a set of mathematical skills and then learns to apply them to solve problems" (Gagné, 1983). However, the essential feature of constructing mathematical knowledge is the creation of relationships, and creating relationships is the hallmark of mathematical problem solving. All too often, students fail to see the relationships between various mathematical concepts, even after using them together to solve a complex problem.

Operative Thinking

Operative thinking is a skill needed to be a successful problem solver. This is the idea that one can think in terms of transformations and changing information. Piaget (1970) clearly distinguishes between two modes of thought. The distinction is between figurative and operative thought comes in the following quote:

> I shall begin by making a distinction between two aspects of thinking that are different, although complementary. One is the figurative aspect, and the other I call the operative aspect. The figurative aspect is an imitation of states taken as momentary and static. In the cognitive area the figurative functions are, above all, perception, imitation, and mental imagery, which are in fact intereorized imitation. The operative aspect of thought deals not with states but transformations from one state to another. For instance, it includes actions themselves, which transform objects or states, and it also includes the intellectual operations, which are essentially systems of transformation. They are actions that are comparable to other actions but are reversible, that is they can be carried out in both directions, and are capable of being intereorized: they can be carried out through representation and not through actually being acted out. (p. 14)

"A modern translation of what Piaget was saying is that thought in a particular domain allows students to make propitious decisions about what may be next, and allows them to see what they might do next in relation to what has already taken place"(Lawler, 1981). Problem solving, in many cases, is prediction based on known information, and that is precisely what operative thinking entails. With all of the prediction, internalizing, and transforming that must take place in many areas of problem solving, writing down thoughts and ideas would do nothing but help the student keep all of the information organized and available.

Confidence

A large part of all mathematics curriculums is building self-confidence in students. "Social cognitive theorists maintain that the academic performance of students in large measure is determined by the confidence with which they approach academic tasks" (Schunk, 1991). This is precisely the reason that mathematics curriculums start with simple problems and lead up to the more complex. This may be the biggest point, which suggests the use of journaling. "Using the idea of journaling while working out a complex problem, an experienced student should go through a thought process, which goes through simpler, related situations as they approach the solution. A student who goes through the same thought process, but does not write it down, may be less likely to see the connection, or make use of it" (Borasi & Rose, 1989).

Structure

Studies of problem solving using expert/novice comparisons have given much data on the idea of structure in problem solving. Larkin (1980) found that "the

better problem solvers in her physics study tended to operate at both highly structured/low detailed and highly structured/highly detailed levels of thinking. The thinking of poorer problem solvers tended to have little structure and tended to be bound to highly detailed levels."

Several studies in cognitive psychology and mathematics education have also shown the importance of structure in one's thinking in mathematical problem solving. Kruteskii (1976) found in over 12 years of research that students who were able to grasp the structure of a problem showed the greatest flexibility in problem solving. Resnick (1983) and Thompson (1982) both found that children whose thinking attained a structural character in regards to whole number numeration showed the best understanding of the subject, as manifested in their flexibility of their problem solving.

Perhaps the easiest way to both identify and understand the structure of a problem is to write down and keep track of the thoughts about it as you go through it.

Self-Regulation

Self-Regulated Learning (SRL) refers to research and theory that has emerged since the mid 1980's concerned with how students, "… become masters of their own learning processes" (Zimmerman, 1998, p.1). "A self-regulated learner is someone who is actively involved in maximizing, his or her opportunity and ability to learn. This involves not only exerting control over cognitive activity (metacogniton), but also developing metavolitional skills that enable the regulation of attitudes, environments and behaviors to promote positive learning outcomes" (Zimmerman, 2001, p.1). The

goal is to get students to think about what they are thinking, and this may be more easily accomplished by journaling.

> "... writing can engage all students actively in the deliberate structuring of meaning: it allows learners to go at their own pace; and it provides unique feedback, since writers can immediately read the product of their own thinking on paper" (Emig, paraphrased in Borasi and Rose, 1989, p.384).

Conclusion

Much literature and many studies have been done showing the existence and importance of complexity, context, mathematical thinking, operative thinking, confidence, and structure in the vast concept that is problem solving. Those studies have also shown a link to the benefits of writing/journaling and problem solving. The memory of human beings is an amazing thing, but it does have its limitations, and journaling can help alleviate those shortcomings.

CHAPTER III: METHODS AND PROCEDURES

Overview

Two groups, both geometry classes, were chosen to take part in this study. The classes took place in second semester of the 2004-2005 school year. Both groups were taught the same geometry curriculum, along with the same instruction on the executive processes of problem solving, and given the same pretest, practice problems, and posttest. The only difference in the curriculum and instruction was that the treatment group was given additional instruction on how to journal as they made their way through the executive processes. Those students were given the expectation that along with the solution or solutions to the problems, they must provide their thoughts, notes, diagrams, etc., in the form of a journal. A statistical t-test of the data was conducted on the pretest and posttest scores to test my hypothesis, which states that journaling while going through the executive processes will improve students' performance in problem solving more than going through the processes without journaling.

Design

A pretest, which consisted of six mathematical problems of varying complexity, was given to both groups at the beginning of the semester. This acted as a gauge of preexisting knowledge and skill in the area of problem solving. Following the pretest, both groups were given identical instruction and modeling of the executive processes being put to use in several mathematical problems in addition to the problems from the pretest.

The difference in the instruction was only that the treatment group observed and practiced journaling as they worked through the processes. The journaling consisted of writing down any thoughts that pertained to the problem as they worked toward the solution. They could be in the form of statements, questions, diagrams, charts, graphs, or anything that the person thought about as they worked through the problem. The students in this group were expected to do this for every problem they worked through.

Both groups were given a set of four problems each week that they had to work through, write up, and have graded at the end of the week. At the start of each week, both groups had their graded problem sets returned to them with comments about the processes and solutions. Upon the return of the sets, a block of time was set aside to go over the problems and ask any questions that the students had. There was a predetermined set of important points of discussion. This was there so that both groups got feedback one the major points of emphasis or concern for the problem sets. Once the questions were answered, the next week's set of problems was handed out, and the cycle started again. This went on for nine weeks, so each group observed and worked on 36 problems over the span.

The final part of the data-gathering portion of the study was a posttest of six problems given to both groups at the end of the nine weeks. The tests were identical for both groups, as well as the expectations for the write-up of the solutions. The treatment was given the choice to include any journaling along with their solutions. The journaling was not part of how the test was graded; only the solutions were looked at and graded.

Once the scores were collected from both the pretest and posttest, the data was tested using a statistical t-test of the means. This test shows if there is a significant difference in the means of the data sets.

Selection of the Test Subjects

The study compared test results of students in two geometry classes. Both classes were taught on the same days in the same semester, which eliminated some variables. The classes were second and fourth block of the second semester of the 2004-2005 school year. Both groups were predominantly 10^{th} graders with one year of algebra.

Measuring Devices

The measuring devices were a pretest and posttest consisting of problems ranging in complexity from mid-level algebra I to low-level algebra II.

Validity Measures

An instrument is said to be valid if it measures what it is supposed to measure. This study is valid in that the data used are the mean scores from the pretest and posttest. The tests measured skill development in the area of problem solving based on the same material and teaching style for both classes. The fact that there are actual numbers to evaluate and compare makes this a valid study. The possible threats to validity can be either external or internal. Such things as selection bias and reactive effects of pretest sensitization can jeopardize external validity. No selection

bias existed with the groups not being chosen. The groups were determined by schedule. The idea of pretest sensitization can be disregarded because both groups took the pretest, and then the results were compared to see if there was a significant difference. It is possible that one group may have disregarded the importance of the pretest, thus making their data invalid. Making the pretest graded should have taken care of this.

Reliability Measures

Reliability is attained when the results of a test or study are consistent with the results when the test or study is repeated. Using the mean class scores for the pretest from both groups allowed for comparison of preexisting knowledge. This alone allows one to conduct a reliable study, even if there is a significant difference in the two means. For this study though, the t-test showed no significant difference in the mean scores of the two classes. This, in turn, creates a much neater comparison of the posttest means. In addition, the two groups were given no information leading them to believe that they were part of a study.

Field Procedures

The independent variables were the mean of the control group and mean of the treatment group for the pretest. These means come from averaging the class scores to come up with one number to measure and compare for each group. These will be represented by X_1 for the treatment mean, and X_2 for the control mean. The dependent variables were the mean of the control group and mean of the treatment

group for the posttest. These means will be represented by X_1 for the treatment group, and X_2 for the control group.

Once the means are calculated, the standard deviation for each set of scores must be calculated. The standard deviation measures the spread of the data about the mean. This is an essential piece of data in conducting a test of a hypothesis using the t-test. These will be represented as SD_1 for the treatment group and SD_2 for the control group. These will be noted as the same symbols in the standard deviations for both the pretest data and the posttest data.

Table 1

	Treatment Group		Control Group	
	Pre	Post	Pre	Post
Mean class score	6.895	14.316	6.615	12.3
Standard Deviation	2.052	2.193	3.021	3.03
Class size	19	19	26	26

The final data used in the test is the class size, which will be represented as n_1 for the treatment group, and n_2 for the control group. The data above shows the means and standard deviations for each group for each test (pretest and posttest).

With these pieces of data, the statistic t can be calculated using the following formula:

$$t = \frac{x_1 - x_2}{\sqrt{\left(\frac{(SD_1)^2}{n_1} + \frac{(SD_2)^2}{n}\right)}}$$

Conclusion

The t-test calculates whether or not there is a significant difference between the means of two sets of data. With a total of 45 data, that would fall into the 60 degrees of freedom, and if the value of t is greater than 2.00 there is a significant difference. Anything under 2.00 shows no significant difference. Many other factors are involved in student performance, such as class size, time of day, individual schedules, effort outside the classroom, and countless other factors which affect individuals. Keeping in mind the variables that were controlled and the ones that could not be, a t-value above the desired number would suggest support for the hypothesis that journaling while going through the executive processes will improve students' performance in problem solving more than going through the processes without journaling.

CHAPTER IV: RESULTS AND DISCUSSION

The data that was used in this study was derived on two occasions for two separate groups. The first sets of data were the pretest scores for the control group and the pretest scores from the treatment group. This was done to determine if there was a significant difference in the two groups prior to the study.

Results

Once both tests were taken, the data was recorded and used to make various calculations. The first calculations to look at were the means. Four different means were needed for the study. A mean class score for the pretest was needed for each of the two groups, in addition to the mean class score for the posttest for each group. Just looking at the means as numbers compared to one another was revealing. The mean score for the control group on the pretest is 6.615, and the treatment group has a mean score of 6.895. With the numbers being relatively close, this leads to the assumption that the two groups are not significantly different.

Figure1

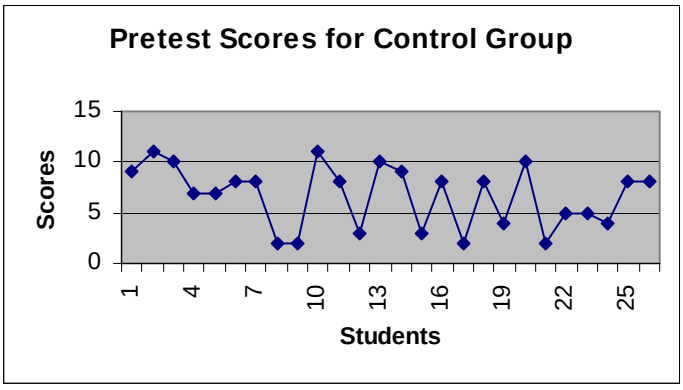
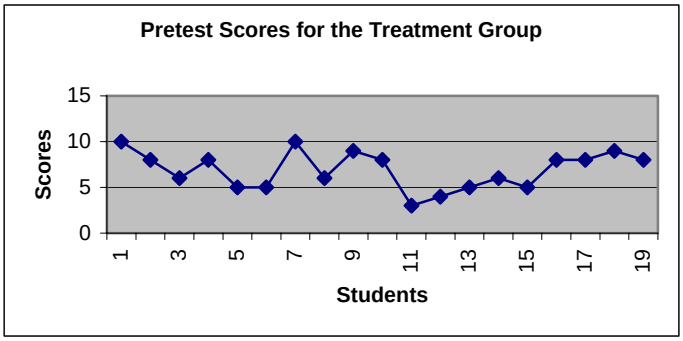


Figure 1 shows the distribution of scores for the control group on the pretest. This group had a mean score of 6.615.

Figure 2 shows the distribution of scores on the pretest by the treatment group. This group had a mean score of 6.895.

Figure 2



Looking at the graphs and means for the two groups didn't suggest a significant difference. This was backed up by the statistical t-test of the means. The number of concern was 2.00. This is the gauging number for the t-value with 45 degrees of freedom. The t-value was calculated as 0.37, which is less than 2.00. This shows no significant difference in the two groups prior to any instruction within the study.

Figure 3 shows the distribution of scores on the posttest by the control group. The mean score for the group is 12.3.

Figure 3

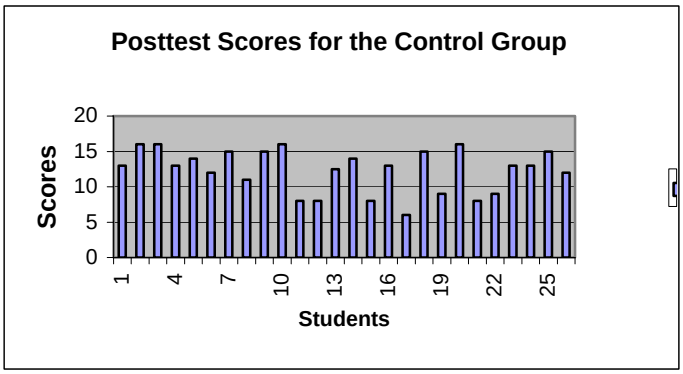
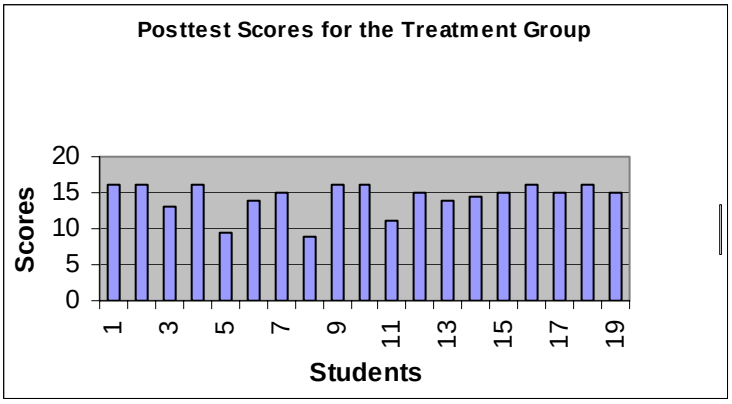


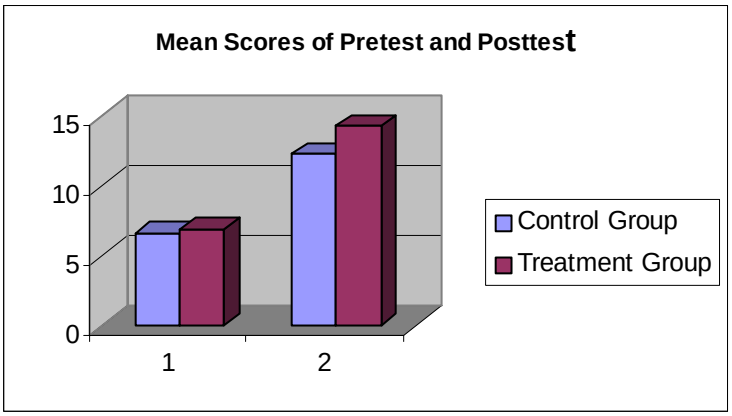
Figure 4 shows the distribution of scores on the posttest for the treatment group. The mean score for the group is 14.316.

Figure 4



A closer look at the means scores, of both groups for both tests in figure 5, reveals two things. First, a sizeable increase occurred in the mean scores for both groups from the pretest to the posttest. This is to be expected. With nine weeks of instruction and practice with the problem solving method, the students should improve. The more pertinent observation is that the difference between the two groups is greater for the posttest than the pretest.

Figure 5



Discussion

The results of the study matched the expectations. When a group receives instruction on a specific topic or skill, the thought is that their level of comprehension or proficiency will increase. This is verified by both the data and graphs. Both groups had higher achievement scores on the posttest than the pretest.

To increase the validity of the research, it really should be conducted within the context of an algebra class, where there is a direct focus on problem solving. With the timeframe of the study, a limit was put in place that constricted the choice of classes to involve in the study. The geometry students were engaged in the study as an extra part of their normal geometry curriculum. This may have caused some of the students to give less focus to the problem solving, in an attempt to focus more on the geometry content. Conducting the study in an algebra class, where the students are immersed in problem solving, may have made the study more valid.

The reliability of the study could also be higher, if there was not such a sizeable discrepancy in the size of the groups. In a small school district, this is not always possible, however.

CHAPTER V: CONCLUSION

Upon conducting a t-test of the two means, proof was provided to back the assumption. The t-value, of 0.37 leads to the conclusion that no significant difference exists in the pretest scores of the two groups. This allows the t-test of the posttest means to be used. If the t-value of the pretest were above 2.00, that would show a significant difference in the two groups before the study. The study would still be possible, but the only way to test the hypothesis would be to conduct a t-test of the mean increase from pretest to posttest for each group.

When the test was done on the posttest data, the value of t was approximately 2.65, which leads to the conclusion that a significant difference does exist in the posttest scores of the two groups. Therefore, the increase in the posttest scores was significant. This does not however, prove the hypothesis true. It does prove our hypothesis true for this study on these particular groups. Only upon achieving similar results in several studies, could the conclusion be drawn that the hypothesis is true.

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Footnotes

1 The phrase “NCTM Standards” will be used for the National Council of Teachers of Mathematics recommendations for K–12 curriculum, teaching, and assessment contained in the initial three-volume set (*Curriculum and Evaluation Standards for School Mathematics* [1989], *Professional Standards for Teaching Mathematics* [1991], and *Assessment Standards for School Mathematics* [1995]) and in the revised volume *Principles and Standards for School Mathematics* (draft, 1998), all published in Reston, VA, by the NCTM.

WILL THE *READ NATURALLY* PROGRAM PRODUCE BETTER RESULTS AMONG ELEMENTARY-AGED STUDENTS WHEN COMPARING WORD PER MINUTE FLUENCY PROBES THAN A MULTI-SENSORY, PHONETIC APPROACH TO READING?

By Carrie Miller

B.A. Luther College, 2000

A capstone submitted to the Faculty of the Graduate School of Winona State University in partial fulfillment of the requirement for the degree of

Master of Science

Department of Education

Spring 2006

This capstone entitled:

The *Read Naturally* program produces better results when comparing word per minute fluency probes than a multi-sensory, phonetic approach to reading.

Written by Carrie Miller

Has been approved for the Winona State University Department of Education by

_____	_____
John Pittenger	Chris Fernholz
_____	_____
Dr. Tom Sherman, Faculty Advisor	Heather Klees
_____	
Julie Yost	

Date:_____

The signatures have examined the final copy of the capstone, and we find that both the content and the form meet acceptable presentation standards of scholarly work in the above mentioned discipline.

Miller, Carrie, (B.A. Education)

The *Read Naturally* program produces better results when comparing word per minute fluency probes than a multi-sensory, phonetic approach to reading.

Abstract

Reading is a complex interaction of language, sensory perception, memory, and motivation which makes reading difficult for many young students, especially for students with a learning disability. Many students with a learning disability lack the skills to become a fluent reader.

The results of this study did demonstrate the effectiveness of the *Read Naturally* program when compared to a multi-sensory, phonetic approach to reading.

Recommendations include further study to compare the percentage of words read correct and incorrect as well as to measure the comprehension of material read.

CONTENTS

CHAPTER

INTRODUCTION

In today's schools, too many children struggle with learning to read. It is common for students with a learning disability to be reading one to three years below grade level expectations. The need is to increase students reading fluency skills to grade level at the quickest rate possible. All teachers and parents are searching for quick, easy solutions to optimize reading achievement for all students.

Reading has received so much attention in recent years that the National Reading Panel (NRP) issued a report in 2000 responding to a Congressional mandate to help parents, teachers, and policymakers identify key skills and methods central to reading achievement. Following a review of more than ten-thousand studies, the National Reading Panel provided five key areas of reading instruction: phonemic awareness, phonics, fluency, vocabulary, and text comprehension.

The students in many special education classrooms struggle with reading due primarily to a learning disability. A common core problem is the ability to read sight words, decode words, and read phrases and sentences automatically and rapidly. Thus, students with a reading or learning disability are most at risk for presenting difficulties in fluency (1999). Fluency is a critical but often neglected element of reading programs (Allington, 1983). A recent large-scale study by the National Assessment of Educational Progress (NAEP) found that 44% of a representative sample of the nation's fourth graders were low in fluency. The

study also found a close relationship between fluency and reading comprehension. Students who scored lower on measures of fluency also scored lower on measures of comprehension, suggesting that fluency is a critical area in need of greater attention in both research and practice.

Statement of the Problem

When using the *Read Naturally* approach to reading will the students with a learning disability increase their reading fluency at a more rapid pace than using a multi-sensory, phonetic approach to reading?

Statement of the Hypothesis

Students with a learning disability read at a slow, laborious, and word-by-word pace. The *Read Naturally* approach to reading will allow students to spend most of their instructional time engaged in reading. Through teacher modeling, repeated reading, and progress monitoring, students will increase their reading fluency. Consequently, students using the *Read Naturally* program will produce better results when comparing word per minute fluency probes than a multi-sensory, phonetic approach to reading.

Definition of Terms

Fluency: Refers to the ability to read a text accurately and quickly.

Fluent Readers: Focus their attention on making connections among the ideas in a text and between these ideas and their background knowledge. Therefore, they are able to focus on comprehension.

Automaticity: The fast, effortless word recognition that comes with a great deal of reading practice. Automaticity refers only to accurate, speedy word recognition, not to reading with expression.

Fluency intervention: Refers to any instructional intervention designed specifically to increase students' reading fluency in connected text.

Reading Fluency: Refers to efficient, effective word-recognition skills that permit a reader to construct the meaning of a text. Fluency is manifested in accurate, rapid, expressive oral reading and is applied during, and makes possible, silent reading comprehension.

Learning Disability: Students assessed on intellectual and academic achievement scores and had attained standard score units of fifteen or more points below their academic/cognitive functioning. The learning disability must also not be the primary result of other handicapping conditions, and / or environmental, cultural, and/or economic influences.

Repeated oral reading: Rereading a text out loud.

Tape-assisted reading: Reading aloud simultaneously or as an echo with an audio taped model.

One-minute reading: Number determined by subtracting errors from total words read to arrive at words correct per minute

Phonemic awareness: The ability to hear, identify, and manipulate the individual sounds—phonemes—in spoken words

Phonemes: The smallest part of spoken language that makes a difference in the meaning of words.

Independent variables:

My students' reading instruction was divided into two different groups. One group did receive a multi-sensory approach to reading through phonemic awareness activities, direct teaching of decoding and encoding skills, and developing word fluency. My second group of students received reading fluency instruction through the program *Read Naturally*.

Dependent variable:

The word per minute reading rate of my student's fluency was the dependent variable.

Control variables:

The control variables include: same school, same students, same teacher, and same instructional time.

Moderator variables:

The moderator variables that impacted this study were my personality, gender, and a school diversity rate of 34%.

Limitations of the study:

This research was completed during two quarters. Time of instruction was a limitation as well as student attendance. Several of my students struggled with attending school every day. The time my students spent reading outside of class is also a limitation. The study was completed with a small number of students.

Baseline Timeline:

During our second quarter, half of my students received instruction through *Read Naturally* and the other half received a multi-sensory approach to

reading. Then the following quarter instruction for the groups was switched. Word per minute probes were taken at the beginning and end of the second and third quarters.

REVIEW OF LITERATURE

The National Assessment of Educational Progress (NAEP) conducted a recent large-scale study that found 44% of a representative sample of the nation's fourth graders low in fluency. Research shows that children who read well in the early grades are far more successful in later years and those who fall behind often stay behind when it comes to academic achievement. Struggling readers are much more likely to drop out of school and be limited to low-paying jobs. Students with learning disabilities would fall in this category.

According to the National Reading Panel (NRP) in 2000, there are key skills and methods central to reading achievement. The Panel provided analysis and discussion in five areas of reading instruction: phonemic awareness, phonics, fluency, vocabulary, and text comprehension. All critical reading components sited by the National Reading Panel are embedded within the *Read Naturally* reading intervention program.

Specifically, phonemic awareness and phonics instruction may be found in levels .8 to 1.8 of the *Read Naturally* program where a specific vowel sound is the focus of each lesson. The students receive extra practice in letter sound recognition, blending, and segmenting through decoding words in isolation. The repeated readings provide the student with multiple opportunities to practice the specific vowel sound in context.

In addition, there is a word list that consists of three columns of words with each column focusing a particular word family. Students practice these words lists and are timed for one minute while they read as many words correct as

possible. The ultimate goal of this program is to develop students' reading fluency. The repeated readings strategy increases student's reading speed and accuracy. Oral repeated readings of the same text appear in two contexts: listening and whisper reading with the audio-taped reading of the story, and independent repeated reading. This reading occurs at the appropriate reading level of the students.

Vocabulary instruction is woven into the reading program. During the prediction of the story, students review the key words, and then write what they think the story will be about. Questions following the story are based on the main idea, vocabulary words, and literal questions to indicate whether the student has grasped the meaning of the story. Another way to increase students' reading comprehension is to have the students read the questions first before they read with the tape or independently. Then students have a set purpose for reading. These five critical components of reading instruction according to the National Reading Panel (NRP) in 2000 are embedded within the *Read Naturally* program.

The *Read Naturally* reading fluency program provides struggling readers a safe, structured, and motivated opportunity to engage students in reading on a daily basis. Lesley Mandel Morrow (2003) states, "When looking over those articles, chapters, and books that have dealt with fluency development over the past two decades, it becomes clear that their authors consider fluency reading to be a critical component of reading. Fluency reading not only incorporates automatic and accurate word recognition and expressive rendering of the text, but it is also likely to be a contributing factor to a reader's ability to construct

meaning from what is being read. Fluency development often has been overlooked as an instructional component of reading, both in school's literacy curricula and in the pre- and in-service courses for teacher development" (P. 128). According to the large-scale study done by the National Assessment of Educational Progress (NAEP) students who scored lower on measures of fluency also scored lower on measures of comprehension, suggesting that fluency is a neglected reading skill in many American classrooms, negatively affecting many students' reading comprehension.

Morrow gives the major roles of fluent reading. The components of fluency reading are accurately decoding; automatic word recognition; and the appropriate stress, pitch, and suitable phrasing, or the prosodic elements of language. According to Morrow (2003) by incorporating such prosodic elements into their oral reading, readers are provided clues to an otherwise invisible process, that of comprehension. It is through their grouping of print into meaningful phrases that fluent readers make written text sound like oral language. Expression can be seen as an indicator of their understanding of what is being read because they can only begin to apply appropriate phrasing and expression to a text if they are able to make sense of it (P. 131).

This situation is familiar in my classroom of students with learning disabilities. Often students have reached the last page of their reading book and have maintained a high level of word recognition throughout the book. They read the connected text in a slow, halting level and without expression. Although teachers of students with learning disabilities devote the greatest portion of

instructional time to reading (Houck & Given, 1981), development of fluency is often overlooked (Shinn & Marston, 1985). Moreover, without adequate fluency, comprehension is impaired (Potter & Warme, 1990). The technique of repeated reading, which requires a student to reread a selected passage until an established criterion is met, offers one promising solution to this instructional problem (Weinstein & Cooke, 1992). Recent research supports the use of repeated reading to develop fluency and improve comprehension; some authors have reported motivational benefits as well (Dowhower, 1987). The ultimate test of the repeated reading technique is the extent to which achieved gains generalize or transfer to unpracticed passages. Evidence of generalization has been found in the need for fewer rereading to reach criterion as well as in carryover of fluency and accuracy gains to new passages (Dowhower, 1987).

According to the author's original research of the program *Read Naturally* from 1989-90 special education students gained 2.3 words correct per minute within seven weeks using this program. Title One students gained 1.23 words correct per minute in seven weeks and within thirteen weeks gained 2.13 words correct per minute. Additional observational benefits of this program noted were the students' increase in their confidence and self-esteem, confidence in academic abilities and hope for their future, and immediate and frequent teacher feedback.

The multi-sensory phonetic approach to reading develops the phonemic awareness, word fluency necessary to reading which according to the Report of the National Reading Panel (NICHD, 2000) is definitely a necessary component

to reading. Reading successfully is a complex interaction of language, sensory perception, memory, and motivation (Samuels, 1997). To illustrate the role of fluency, it helps to characterize this multifaceted process as including at least two activities: (1) word identification or decoding and (2) comprehension, or the construction of the meaning of text. In order for reading to proceed effectively, the reader cannot focus attention on both processes (Samuels, 1997). Constructing meaning involves making inferences, responding critically, and other complex interactions. The nonfluent reader can alternate attention between the two processes; however, this makes reading laborious, often punishing process. If attention is drained by decoding words, little or no capacity is available for the attention- demanding process of comprehension. According to Pikulski and Chard (2005), automaticity of decoding—a critical component of fluency—is essential for high levels of reading achievement" (P. 511).

According to Ehri's stages of reading development and fluency (1995, 1998), Ehri distinguished four stages of reading development. The Pre-Alphabetic State, where children attempt to translate the unfamiliar visual forms of print into familiar oral language through visual clues in the print. At the Partial Alphabetic Stage, readers have learned that letters and sounds are related, and they begin to use that insight. As the children become more familiar with letters and sounds they move into the Fully Alphabetic Stage. Readers who recognize whole words instantly have reached the Consolidated Alphabetic Stage. According to Pikulski & Chard (2005), repeated encounters with words allow them to store letter patterns across different words. Ehri (1998) described skilled

reading in the following way: "Most of the words are known by sight. Sight reading is a fast-acting process. The term sight indicates that sight of the words activates the words in memory, including information about its spelling, pronunciation, typical role in sentences, and meaning. This instant, accurate, and automatic access to all these dimensions of a printed word is the needed fluency that will allow readers to focus their attention on comprehension rather than on decoding." (P. 11-12).

According to Pikulski and Chard (2005), there is a nine-step developmental program for improving fluency.

1. Building the graphophonic foundations for fluency, including phonological awareness, letter familiarity, and phonics.

2. Building and extending vocabulary and oral language skills

3. Providing expert instruction and practice in the recognition of high-frequency vocabulary

4. Teaching common word parts and spelling patterns.

5. Teaching, modeling, and providing practice in the application of a decoding strategy.

6. Using appropriate texts to coach strategic behaviors and to build reading speed.

7. Using repeated reading procedures as an intervention approach for struggling readers.

8. Extending growing fluency through wide independent reading.

9. Monitoring fluency development through appropriate assessment procedures.

These nine steps are all components of the *Read Naturally* fluency program. As noted earlier in this research paper, the *Report of the National Reading Panel* (NICHD, 2000) was unequivocal in its support of repeated reading procedures. According to Pikulski and Chard (2005), a very strong research and theoretical base indicates that while fluency in and of itself is not sufficient to ensure high levels of reading achievement, fluency is absolutely necessary for that achievement because it depends upon and typically reflects comprehension. If a reader has not developed fluency, the process of decoding words drains attention, and insufficient attention is available for constructing the meaning of texts. Fluency builds on a foundation of oral language skills, phonetic awareness, familiarity with letter forms, and efficient decoding skills. Research shows that a variety of procedures based on repeated readings can help readers to improve their fluency (P. 517).

The multi-sensory phonetic program is based on the foundation that, "Children, who exhibit problems in learning to read and/or spell, as well as those who more easily gain these skills, greatly benefit from attaining knowledge of word composition. Children who develop good reading/spelling skills often intuitively gain an understanding of how words in the English language are structured. Most children who experience difficulties in learning these skills, however, lack linguistic awareness at the word level" (Strei, 2005, P.vii). It is

Strei's belief that this phonemic awareness at the word level will develop students decoding, reading fluency, and/or spelling difficulties.

METHODS AND PROCEDURES

Overview

This study examined the effects of two reading programs on student's fluency rates. The *Read Naturally* reading program and a multi-sensory, phonetic program were used to develop elementary-aged students' with learning disabilities reading fluency rates. All of the twelve students in this class received supplemental reading instruction using two different approaches to reading. The components of the *Read Naturally* program include:

1. Teacher modeling: Listening to the tape of a high interest story.
2. Repeated reading: Improves reading fluency. Students practice until they can read at their predetermined reading rate.
3. Progress Monitoring: Motivation, involves students in the learning process.

The multi-sensory-phonetic approach includes the following components: Phonemic awareness activities, direct teaching of a decoding, encoding skills, comprehension skills that focus on explaining why words in our language say what they say, reading decoding fluency at the words level, memory devices that assist visual memory of the word structure, and repetition.

Each reading program was used for one quarter, and instruction was switched to determine each program's effectiveness with students with learning disabilities. Fluency assessments were given at the beginning and end of each quarter to measure how many words students read correctly per minute.

Research Design

This study was a simple experiment that examined the effects of the independent variables, the *Read Naturally* fluency program and a multi-sensory-phonetic approach to reading. Students' reading fluency scores were measured to determine the programs effectiveness in improving the number of words students could read correctly per minute.

Subjects

The participants of this study included twelve students with learning disabilities in third through fifth grades. There were four 5th graders, two 4th graders, and six 3rd graders. The urban city in which this school is located is made up of a wide variety of ethnic groups. There were three students with Hispanic backgrounds, three-African American students, one Laotian student, and five Caucasian students. Three students qualified for English as Second Language assistance. Nine of the students qualified for free and reduced lunch.

Instruments/Measuring Devices

The validity of this study was not strong enough. Small sample size, individual student differences in reading ability, intellectual ability, and the amount of reading help that each student received at home were not able to be standardized. The students were from the same classroom and taught by the same teacher. Comparing the results of this group of students with learning disabilities to other students in other classes and other schools may not be applicable. The study needs to be replicated with other students and classes in order to ascertain

validity. The reliability measures used include having the same person conduct all of the fluency assessments.

Procedures

The procedures for each reading program varied greatly. Each reading program was administered for a quarter, following which the type of reading instruction switched. Students reading fluency was measured using word per minute probes at the beginning and ending of each quarter. The *Read Naturally* procedure included the following:

1. Pick a story.
2. Read along to learn the key words.
3. Write a prediction.
4. Time yourself reading.
5. Mark your words correct per minute graph in blue.
6. Read along with the tape to learn the story.
7. Practice reading the story on your own.
8. Answer the comprehension questions.
9. Have your teacher time you reading the story aloud.
10. Mark the number of words correct per minute graph in red.
11. Write a retell or practice word lists.

The multi sensory-phonetic program is scripted for the teacher to follow closely. Part One A utilizes reading phonetically regular words. Part Two is reading word fluency. This is to be used with students to improve efficient recognition of letters and sounds in isolated high frequency usage. Once Part Three is added, students are to spend half of their class time with phonetically irregular words.

Conclusion

Using the *Read Naturally* fluency program proved to be more successful than a multi-sensory, phonetic reading program in teaching reading to students with a learning disability. During the quarter when the students used the *Read*

Naturally fluency program the students reading fluency rate improved two times the rate of students using the multi-sensory, phonetic reading program. The key is in order to begin using the *Read Naturally* fluency program students must have a working knowledge of beginning sounds and can recognize at least fifty words. There is no pre-requisite knowledge required for students when using the multi-sensory, phonetic reading program. After implementing both separately, it seems logical to begin using the multi-sensory program for beginning readers to develop their phonemic awareness. Once the students' reading foundation of beginning sounds and fifty sight words is present, the recent data collected suggests using the *Read Naturally* fluency program to quickly improve students with learning disabilities ability to read fluently based on their words read correctly per minute.

RESULTS AND DISCUSSION

A. Analysis

The conclusions of this study have been drawn based on data collected from two sets of reading programs during two quarters of reading instruction. The blue bar represents the students' word per minute fluency based on a grade level reading passage before using the *Read Naturally* approach. The red bar represents the students' word per minute fluency based on a grade level reading passage after using the *Read Naturally* approach for one quarter of instruction. This graph gives a clear picture of the effectiveness of this reading approach. Each student made significant word per minute fluency gains in just one quarter of instruction. Student number nine increased his reading fluency by thirty nine words using this method. The student with the least improvement made was student number nine. This student improved by just thirteen words per minute.

Figure 1 *Read Naturally*

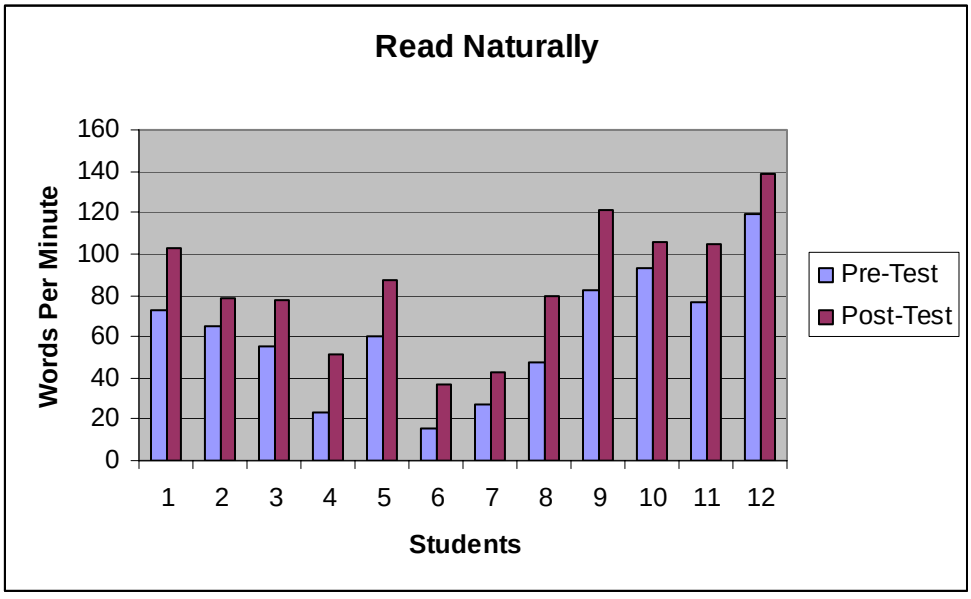


Figure 2 represents the progress of using a multi-sensory approach to reading instruction for students with learning disabilities. The blue bar represents the students' word per minute fluency based on a grade level reading passage before using a multi-sensory approach. The red bar represents the students' word per minute fluency based on a grade level reading passage after using a multi-sensory approach for one quarter of instruction. Ten of the twelve students made word per minute fluency gains in just one quarter using this phonetic-multi-sensory approach. Student number seven made the most progress during this quarter of instruction with an increase of thirty-four words correct per minute. Two students, student one and three, did not make significant reading gains. Both students word per minute fluency probes decreased during the quarter of reading instruction. This could be due to the fact that these two students had been identified with Attention Deficit Disorder but were not medicated at the time.

Figure 2 Phonetic Multi-sensory Approach

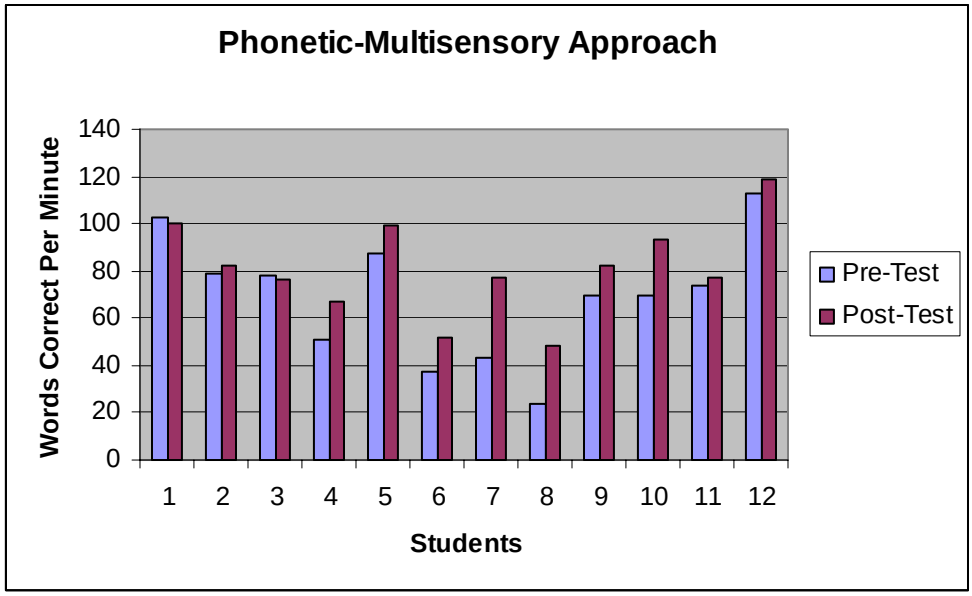
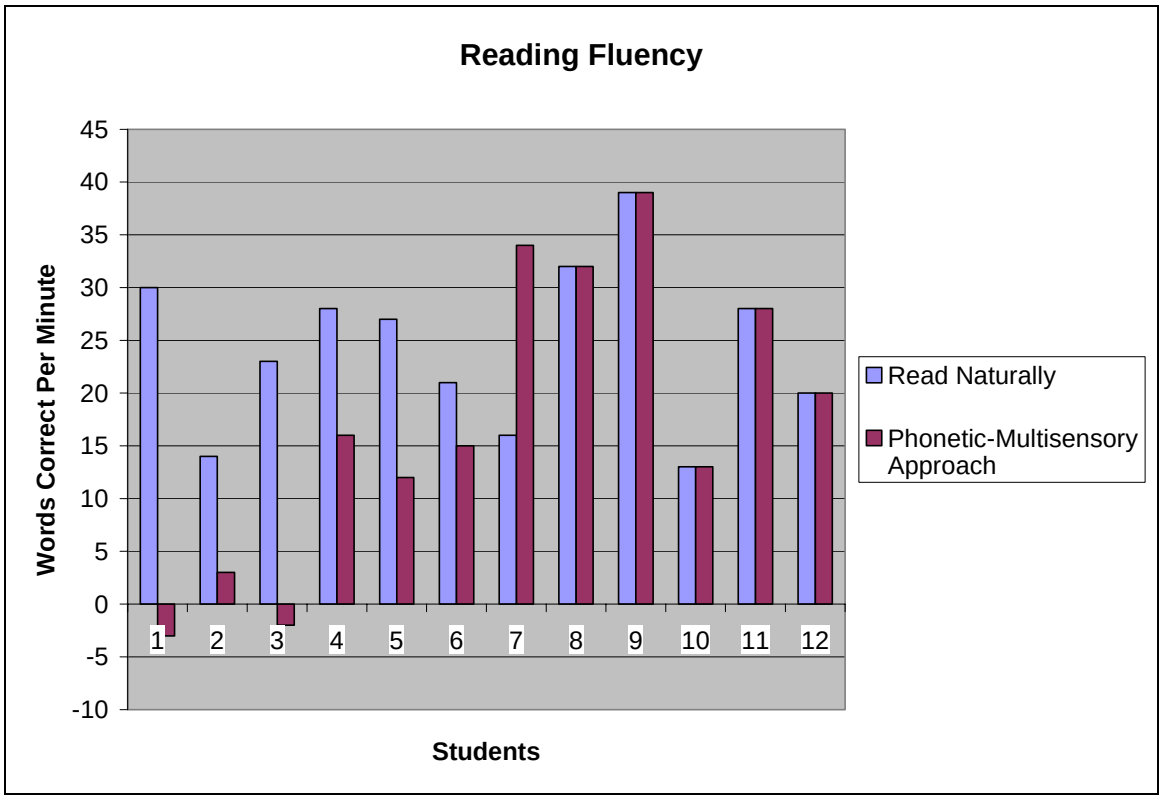


Figure 3 compares the improvement of students' reading fluency using each reading program during one quarter. Eleven of twelve students made significantly more or equal improvement using the *Read Naturally* program.

B. Hypothesis Testing

Figure 3 clearly identifies the *Read Naturally* program as being consistently more effective than the multi-sensory approach to reading. A T-Test was run on the results to test the hypothesis. The T-Test score of 3.12 shows a 99+% probability that this study is accurate.

Figure 3 Reading Fluency



SUMMARY AND CONCLUSION

A. Summary of Results

The results of this study indicate that the *Read Naturally* approach to reading benefited elementary-aged students with learning disabilities the most when compared to a multi-sensory approach to reading fluency. The repeated readings strategy increases students' reading speed and accuracy. Oral repeated readings of the same text through listening and whisper reading with the audio-taped reading of the story, and independent repeated reading provides the most effective reading instruction for struggling readers. This reading instruction occurs at the appropriate reading level of the students.

B. Conclusion

A great deal of research has been done with effective reading research for struggling readers. Yet it is too common for students identified as having a learning disability to be reading one to three years below grade level expectations. With more and more testing to raise teacher accountability, administrators, teachers, and parents are searching for quick, easy solutions to optimize reading achievement for all students. This research proves the effectiveness of the *Read Naturally* approach to increasing students' reading fluency and identifies it as a best practice for teachers.

C. Recommendations

Recommendations include further study to compare the percentage of words read correct and incorrect as well as to measure student comprehension of material read. Other possibilities would be to measure and analyze students'

reading fluency growth at each individual grade level to see if reading fluency instruction is more effective at a specific grade, to measure students with fluency only problems versus fluency and comprehension difficulties.

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GOAL SETTING WILL INCREASE STUDENT SCORES IN RECALL OF MULTIPLICATION FACTS

by

Melissa Mortellito

B.A. Rutgers University, 1997

A capstone paper submitted to the

Faculty of the Graduate School of Winona State University

in partial fulfillment of the requirement for the degree of
Master's of Science

Department of Education
2006

This capstone paper entitled:
Goal setting will increase student scores in recall of multiplication facts
written by Melissa Mortellito
has been approved for the Department of Education

Dr. Thomas Sherman, Faculty Advisor _____

Heather Klees, Facilitator _____

Cheryl Moertel, Facilitator _____

Advisory Group

Colin Atkinson _____

Mindy Scheel _____

Jake Tietje _____

_____

Date _____

The final copy of this capstone has been examined by the signatories, and we find that both the content and the form meet acceptable presentation standards of scholarly work in the above mentioned discipline.

Mortellito, Melissa (M.S., Education, Department of Education)

Goal Setting Will Increase Student Scores in Recall of Multiplication Facts

Capstone Paper directed by Dr. Thomas Sherman

The benefit of goal setting to increase student scores in recalling multiplication facts was studied in 6th grade at a private, denominational school in a suburban town of a Midwestern state. Twenty-two students from the 2005-2006 school year made up the pretest and posttest groups.

Students from the pretest group worked on increasing their rate of return on multiplication facts by taking timed fact tests once per week for four weeks. Students from the post-test group set reasonable goals to achieve when taking their timed fact tests, and increased their goals after each week's tests. Students in the post test group also took timed tests once per week for four weeks.

At the end of the eight week timed test period, rates of increase were charted between students taking tests during the pretest portion of the experiment. These results were compared to the rates of increase made during the posttest portion of the experiment. The student rate of increase was not significantly greater when students were setting goals as compared to increases made when students were not setting goals.

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

As teachers, we are constantly challenged by the educational needs of our students. Usually among these concerns are questions about how to motivate children into producing their best work. Motivation is a complex subject. We are often gifted with students who need nothing more than their own internal drives to produce excellent accomplishments. Students who are intrinsically motivated enter classrooms each day as willing subjects of the learning process, ready to do what is needed—and often more—to reach their goals. Yet it is the other students that present a challenge to educators, those who seem completely disinterested by the challenges of school and often demand tangible incentives to produce the bare minimum of work.

Each day, teachers compose lessons according to objectives and standards, and then search for ways to deliver information to their classes to keep every mind engaged. Students who cannot or will not produce results that are indicative of their potential represent a significant challenge to educators. Often, instructional methods are adapted to ensure desired results within a classroom. New strategies are employed to help reach a desired end result. The focus of this study was to examine the impact that goal setting would have on effectively increasing student output on multiplication fact tests. The results of this study would guide future instruction on goal setting for all areas of curriculum and student development.

NEED FOR THE STUDY

Students are introduced to basic multiplication facts in the primary grades. Repeated, long-term exposure in grades four and five helps provide a solid foundation for internal recall when learning new math concepts. By grade six, students are expected to have their multiplication times tables through 12 committed to memory. Quite often, this is not the case. Mathematics lessons in upper elementary school textbooks begin with the assumption that all students are on an equal footing when beginning, meaning that fraction, decimal and percent instruction should build on an already solid foundation of multiplication facts that can be instantly recalled from memory.


ate[w1] exists over the best methods of teaching students multiplication facts, and relying on rote memorization with no connection to concepts has been determined to be one of the least effective ways for students to learn multiplication facts. Yet few studies dispute the necessity of learning—by any means possible—to recall facts with speed and accuracy. "Students need to learn the math facts. Estimation, mental arithmetic, checking the reasonableness of results, and paper-and-pencil calculations require the ability to give quick, accurate responses when using basic facts." (Kendall / Hunt Publishing Co., n.d.).

For those students who have little to no instant recall of math facts, another hurdle can deter them from ever reaching an equal footing with their peers. "Unfortunately, as children grow, their passion for learning seems to shrink. Learning often becomes associated with drudgery instead of delight. [They] are

physically present in the classroom, but largely mentally absent; they fail to invent themselves fully in the experience of learning." (Lumsden, 1994) Students who have experienced significant frustration with recall of math facts in the primary and middle grades are often ill-equipped to start caring about memorizing them once they have reached sixth grade.

STATEMENT OF THE PROBLEM

The experiment research focused on whether the knowledge and pursuit of a self-selected goal would increase a student's rate of output on a multiplication fact test. Research suggests that goal setting places a key role in how much progress a student will make over the course of a lesson. Goal setting is used to assist students in finding direction and establishing purpose for their learning. Goal setting mastery is essential in helping students realize both long-term and short-term goals. Research shows that "every academic goal must be achieved through a logical sequence of tasks, so that completing each task builds a stairway of success. The harder the objective, the higher the number of tasks needed to reach the top of the staircase." (Friedman, 2005) By exposing students to the same multiplication facts tests over a period of eight weeks, it was expected that students would become accustomed to the routine of the study and work to achieve their self-selected goal based on the progress they were expected to meet as a class. Their goal for rate of output would define a direction they would work towards in completing their math tests, and the purpose for completing the tests each week would be reiterated during daily math lessons as

students were made to see the importance of knowing their math facts to instant recall.

STATEMENT OF THE HYPOTHESIS

Much of the research conducted showed the positive impact that goal setting could have in enabling students to reach a desired learning objective. This capstone project focused on the use of goal setting in mathematics to enable students to reach higher rates of output when drilling multiplication facts. The hypothesis of this study was that goal setting would improve students' written performance in recall and increase speed of return of multiplication facts.

DEFINITION OF TERMS

Authentic assessment: a method of evaluating student learning or understanding that is based on live-event data, such as an in class test or quiz

Automaticity: the ability to perform a task without needing to think about it first

Basic facts: all single digits factors. For example, 8 x 7 = 56 is a basic multiplication fact; 58 / 7 = 6 and 58 / 6 = 7 are basic division facts.

Fluency: The ability to perform an activity that is simultaneously effortless and smooth

NCTM: National Council of Teachers of Mathematics

Relevance: When students believe that their learning goals are meaningful and worth learning

Task clarity: When students clearly understand a learning goal and know how teachers will evaluate their learning

VARIABLES

Independent Variable

The independent variable was the change of teaching methods by the implementation of goal setting strategies during the posttest portion of the experiment.

Dependent Variable

The dependent variable in this study is the improvement of math scores after goal setting strategies have been implemented. Students' progress in how quickly they can return multiplication facts on paper will be dependent upon whether or not they have set a goal in cooperation with the teacher and how often that goal is reviewed between the student and teacher.

Pretest Variables

The researcher conducted this study during the 2005-2006 school year at St. Francis of Assisi elementary school in Rochester, Minnesota. The sixth grade class consisted of 22 students: 12 girls and 10 boys. The students were compatible in terms of socioeconomic status (upper-middle class), race (Caucasian), grade (sixth) and age (11-12 years old). The same teacher administered the same timed tests each Tuesday at the end of the regular class mathematics lesson. Each test was limited in duration to one minute and one hundred problems. Each student took four tests per week, one on each of the fact families of six through nine. The researcher measured progress over the course of eight weeks.

Moderator Variables

Standardized testing data was available to ascertain each student's relative math aptitude, but standardized tests normally do not measure rate of speed or output on basic multiplication facts. Other variables that may have affected the outcomes of this study included: the exact number of students present to take timed tests on Tuesdays (because of absences due to illness, or school commitments), the students' attitudes towards math in general (measured anonymously at the beginning of the school year using a Baldrige survey and found to be in the "love it" to "hate it" range), the mathematical aptitude of the students, the uneven proportion of girls to boys in the classroom, and the time constraints placed on the study by the researcher. All goals were written in conjunction between the student and researcher: possible moderator variables would also include the relationship between the student and researcher that may affect the students' ability to speak freely about what they would like to accomplish in mathematics.

LIMITATIONS AND DELIMITATIONS OF STUDY

The limitations of this study were:

- Sample size: Based on 22 students randomly assigned to one of two sixth grade classrooms during the 2005-2006 school year
    - Age: The study included only students in grade six, aged 10 to 12 years
    - Aptitude: Students were measured to be at all levels of math aptitude prior to entering sixth grade. Many of the students participated in extracurricular Math teams or activities during the previous school

year and intended to continue this hobby during sixth grade. Other students received Title One help in mathematics. Title One help for students at the chosen school is discontinued once students reach sixth grade.

  - Socio-economic status: all students are from upper-middle class homes
  - Limited diversity: With one exception, all students are from Caucasian homes. The study took place in a private school with religious affiliation with limited cultural diversity
  - Location: the study took place in a large school district in southeast Minnesota. The town has tremendous support for higher education and the school district heavily promotes math programs, especially those that encourage extracurricular and inter-diocesan math tournaments.

- Teacher: one female elementary school teacher with one year's full time experience in a similar school setting from another area of the country
- Length of study: the research encompassed two months of the sixth grade school year. Mathematics was studied one hour per day four days a week. No time in class was specifically dedicated to the review or instruction of multiplication facts or times tables, as students are expected to have complete, rapid recall of multiplication times tables through 12 by grade four.
- Assessment: Students were given the same tests over a period of eight weeks. The length of the tests and order of the problems did not change. It would be

possible to assume that some students worked at memorizing the answers to the first few multiplication problems, which may have enabled them to finish more problems as the tests were repeated. Results were posted on a chart each week at the front of the classroom where students were invited to compare their progress each week.

- Independent practice: There was no way to measure which students were practicing at home or independently to try and improve their timing.

CHAPTER II

REVIEW OF LITERATURE

AUTOMATICITY OF MATH FACTS

There is little that is more frustrating to a teacher than watching students struggle. *Automaticity* is the process by which students can perform necessary tasks in school without thinking about them. Students who achieve automaticity in reading can fluently decode most texts with little effort. Likewise, students who have developed automaticity in recalling math facts have instant recall of basic math facts. Students who have developed automaticity in a subject area are at a decided advantage over those who have not. Students who lack automaticity in a subject area often grow so frustrated with the required effort that their task requires that they lose interest and focus long before their task is complete. While debate exists over the best ways to teach math facts to automaticity, there is little conflict in research over the importance of having automatic recall. "Understanding and learning basic facts to automaticity is a primary cornerstone in mathematics learning. The ability to recall basic facts automatically from long term memory makes solving more complex problems, such as basic operation multistep problems, more efficient and less likely to result in errors." (Bezuk, 2003).

As students progress through elementary school, math instruction builds upon concepts that have been introduced in earlier grades. Spiral curriculum reinforcement is meant to ensure that students who may not have understood a procedure will have additional chances to master it during later instruction. Multiplication facts are

normally introduced to students in grades two or three; these facts are constantly reviewed, drilled and practiced during the middle grades. By grade six, it is expected that students will know their facts to instant recall, and little to no time is devoted to the review of facts within the mathematics grade six curriculum. The importance of knowing the facts is continually demonstrated by the new concepts students are expected to master by grade six. Students who cannot recall multiplication facts are stymied by having to find the lowest common denominator when adding and subtracting fractions. Long division becomes arduous and laborious. Multiplying and dividing fractions becomes a hit-or-miss proposition. "Basic facts are absolutely indispensable for the understanding of more sophisticated processes. Students will not be as successful with mathematical problems such as multi-digit exercises, finding area and solving word problems if they have not mastered basic facts. The automaticity of basic facts frees up mental energy to concentrate on the more rigorous demands of a complicated problem. When a student knows his or her basic facts to automaticity, the student can focus on his or her efforts on how to properly address and solve the problem rather than getting caught up in remembering the basic facts." (Bezuk, 2003). Students who lack automaticity in recall of their basic multiplication facts often spend so much time attempting to solve basic math operations that they lose sight of the final results required in math word problems or complex computational questions. "Researchers argue that unless students can automatically retrieve facts, their ability to perform complex computational problems accurately will be impaired" (Woodward, 2005)

TEACHING MATH

The notion of how mathematics should be taught to students has changed frequently over the past few decades. In the late 1990's, encouraged by President Clinton's push for nationwide math testing for eighth-graders, methods that focused on formal math procedures were de-emphasized in favor of those that allowed students to be more creative thinkers and math problem-solvers while letting calculators perform functions such as addition and multiplication. (Phi Delta Kappan, 1990). This change in thinking was also largely driven by the idea that teachers spent so much time emphasizing "one right answer", students were not given sufficient opportunities to discover how to reach conclusions about math problems on their own. Students face the challenge of changing their thinking about mathematics around fourth grade, when instruction veers from concrete concepts like addition and subtraction, to the more abstract concepts of fractions and decimals. By grade six, students have adopted an attitude about their ability to do math that often stays with them through adulthood. "For many adults, the mere mention of math is met with downcast eyes. Fear of math is learned somewhere around the fourth grade." (Tankersley, 1993) Generating both student interest and self-esteem in mathematics is a formidable struggle for educators.

The challenge of this study was to present repeated math multiplication tests as a tool for helping students increase their own performance in sixth grade mathematics computations. It was important to draw a parallel so students could

recognize how increased automaticity of multiplication facts would benefit later work on more complex computations of multiplying and dividing fractions and decimals.

GOAL SETTING

Children, by nature, are curious. They ask questions to learn and pursue areas that are of personal interest, compelled by internal needs. Educators have a responsibility to children develop their interests into long-term pursuits and goals. "Guiding our students to respond in meaningful ways . . . is at the core of education." (Mountain, 1998).

The dynamics of personal achievement are deeply rooted in how a student perceives him or herself in relation to the rest of the world. A student who is intrinsically motivated to achieve "undertakes an activity for its own sake, for the enjoyment it provides, the learning it permits, or the feeling of accomplishment it evokes." (Lepper, 1988). From the time they are small, children work to progress in areas that matter to them. They choose their hobbies and interests based on how they can learn or perform. They set goals for themselves based upon expectations for achievement, whether it is long-term (such as discussing a future career) or short-term (what they will do when they arrive home from school in the afternoon).

There are a number of elements that are essential to achieving goals: clarity, commitment, planning and strategies, affiliation, assimilation and assessment. (Mountain, 1998) Students who set goals need clarity to see how their personal goal fit into achieving a larger objective. Instant recall of math facts allows students to free up mental space needed to perform more complex computational problems.

Committing to a goal required students to focus on their desired objective. Students who set a number of math facts to complete during a testing period had an end result in mind before beginning work. Planning and strategy helped students dedicate a plan or method to achieve their goal within the permitted time frame. Affiliation helped students to build camaraderie within the classroom: if all students were working to increase scores, the average achieved by the class would therefore increase. Assimilation helps students realize their individual strengths and weaknesses, and how each could be targeted to help achieve a desired outcome. Assessment enables students to evaluate previous performance and make a determination on how methods could be adjusted to achieve a different end result.

Yet personal goal setting alone is not enough to ensure that students will achieve a desired result. If students are to meet goals they have set for themselves, it is important that a number of other factors be present. "[Students] need encouragement, examples, guided experiences and appropriate tools." (Mountain, 1998) Long term studies on feedback, conducted by John Hattie, show that "the most powerful single moderator that enhances achievement is feedback". (Hattie, 2003). Students need to be given opportunities to practice skills needed to achieve their goals, and conversations between the teacher and student help to solidify the intent behind the goal, as well as the capability of each student in achieving their goal.

When setting a goal in an academic area, it is important to communicate to the student why a particular goal is worthwhile, or relevant. Students who do not believe there is meaningful purpose behind their effort are less likely to dedicate any focused

time or effort into achieving their goal. If benchmarks are set for students as a group, individual students can evaluate their performance in relationship to a benchmark, and determine ways to improve their performance to meet the targeted standard. Emphasizing what students are to achieve before instruction begins provides a purpose for effort and dedication. Task clarity provides students with a clear understanding of why achieving a goal is important and how this achievement will effect them in the long term. "How many soccer players would practice corner kicks or run exhausting wind sprints if they weren't preparing for the upcoming game?" (McTighe, O'Connor, 2005)

"Common sense tells us that setting clear goals for students is the essential first step in teaching. Clear goals allow teachers to determine the best methods and materials for reaching our objectives and also enable us to establish appropriate criteria for assessing students' success." (Rose, et. al., 2002) Goal setting plays an important role in the classroom in providing a tool to engage students in the learning process. Yet to allow students ownership over their learning, it is equally important for students to have some flexibility in their learning. Students who have a vested interest in their performance or a specific outcome are more likely to achieve the desired end result.

After goals have been set, students should be given a general process of accomplishing the goal they have set. Goals should be short-term, concrete and written down. Setting goals should be a tool that students use to help them achieve measurable, sustainable results. Once a task has been completed, students and

educators should evaluate performance as a team to determine what steps the student took that aided or detracted them from reaching their goal. Goals should be flexible to allow for human error. Students should not feel so constrained by a goal that all desire and enjoyment for learning is sapped.

CHAPTER III

METHODS AND PROCEDURES

OVERVIEW

Sixth grade students at a private, denominational school in a suburban town of a Midwestern state completed a series of multiplication fact tests during an eight week period from October to December of the 2005-2006 school year. During the first four weeks of testing, students were given one minute to attempt as many problems as they could on a 100-question multiplication fact test. The multiplication fact test was administered four times during each testing session: once for each of the six, seven, eight and nine times tables. During the last four weeks of testing, students were first asked to chart the number of problems they had correctly answered from the week before on a line graph. They were then asked to set a reasonable goal to try and achieve on each of the four tests for that week's administration, and plotted a star on their line graph to represent the goal they were trying to achieve. They were then given one minute to attempt to achieve their goals on the 100-question multiplication fact tests.

RESEARCH DESIGN

This experiment consisted of a pretest time period where students were not instructed in goal setting strategies. Students taking multiplication fluency drills during the posttest portion of the testing were asked to choose a reasonable goal to work towards when taking multiplication fluency tests. The independent variable of the study was the application of goal-setting in achieving math fact fluency. The rate

of increase during the posttest portion of the testing was the dependent variable of the study.

SELECTION OF STUDENTS

The participants of this study included 22 sixth grade students enrolled at a denominational school in a suburban town of southeast Minnesota during the 2005-2006 school years. The students attended classes in a self-contained classroom and were taught curriculum in all subjects by the same teacher. The students ranged in age from 10 to 12 years old. The student population was 96% Caucasian, with one student of Hispanic descent. None of the students in the class currently receive special education services. One student received special education services through a neighboring public school, but tested out at the end of fifth grade. Two of the students received Title I services for math and reading through grade five, but this was discontinued upon entrance into sixth grade due to lack of funding. One student is on medication for attention deficit hyperactivity disorder. All students except two are from two parent families. The majority of families were upper-middle class. Many students had parents who worked outside the home in advanced medical professions. The group consisted of 10 boys and 12 girls.

INSTRUMENTS

The instruments used in this study were four 100-problem multiplication fact tests from the book *Timed Math Drills-Multiplication* (Appendix C). Student also used weekly quiz score sheets to graph their progress (Appendix D).

VALIDITY AND RELIABILITY MEASURES

Students were administered the same tests by the same teacher at the same time each week. The reliability of this experiment produced results that would need further investigation. Although the reviewed literature and research found that goal setting will empower students to find direction in achieving a desired outcome, the results gathered from the four-week testing period where students were working towards a self-selected goal showed that students did not increase their average rate of output by a greater amount than when they were working with no goal in mind. During the sixth week of testing (second week of goal setting), student scores actually decreased to an average below that they had achieved during the first week of goal setting. The average amount of multiplication facts the class was able to complete rebounded during week seven, but the overall class average increase was not greater than had been measured during the weeks when no goal-setting was present. One factor that could have had a direct impact on the results gathered during the goal-setting portion of the experiment was student stress.

PROCEDURES

At the beginning of the experiment, all students in the classroom were told that they would be taking timed multiplication fact tests of the six, seven, eight and nine times tables with the purpose of improving their fact fluency. Students were given one-minute multiplication drills of one hundred problems each once a week for four weeks. Students were drilled on their memorization of multiplication tables six, seven, eight and nine. During the initial four week test period, no long term goals for progress were discussed, but the researcher kept tabulations on which students

seemed to be making the most progress independent of any counseling (those who seemed the most intrinsically motivated to work on their multiplication facts with no outside encouragement). After the initial four-week testing period, students were then instructed in the benefits of setting goals for learning, and asked to develop goals on the type of progress they wished to make in the rate of return of their multiplication facts. Students were shown the format of the test and were told that they should focus their efforts completing as many problems possible within the given time frame of one minute. The decision to test students on their six through nine times tables was based on information gathered from informal polling of student knowledge of times tables. It was determined that students felt most comfortable with the one, two and five times tables, followed by four and three. The six, seven and eight fact families seemed to present the most hesitation in oral drilling. Students were also told that they should not feel they needed to complete all 100 problems on each test. The tests were copied back-to-back, with times six and times seven on one page and times eight and times nine on a second page. Students were given the fact test on the times six table first. A timer was set for one minute, and students worked to complete as many problems as possible on that test before time was up. Next, they flipped the test over and were given one minute to complete the times seven facts. At the completion of the times six and times seven tests, the tests were collected, and the times eight and times nine tests were distributed and administered in a similar fashion. These tests were administered in an identical fashion for the first four weeks of the testing period. At the end of each test session, the tests results were calculated.

The number correct was written at the top of each test, and each paper was labeled with the week number of the test.

At the beginning of the fifth week of the testing period, students were given four line graphs, one for each of the fact families six through nine. At the bottom, lines were labeled “Week 1” through “Week 8”. The vertical axes of the graphs were not labeled. Students were then given back the multiplication fact tests from the previous four weeks. They were asked to organize the test papers into “Week 1” through “Week 4”. Using a sample graph on the overhead, students were asked to look at the results they had achieved from week one through week four of their six times tables. Using their results, they were to choose an interval for the vertical axis of their times six graphs and label the axis according to that interval. They were then to graph their results with points from week one through week four and connect the points to make a line graph. They repeated this procedure for their times seven through times nine graphs. The first four weeks worth of tests was collected, and then students were asked to examine their line graphs on their times six graph and determine how many facts they would like to try and complete for the Week 5 test. Students were engaged in a class discussion about the importance of goal setting to try and make academic progress. They were asked to visualize what they wanted their graph to look like once they had completed charting their results for Week 5. At the beginning of Week 6, students were engaged in the same conversation about goal setting and progress visualization. They were to think about reasonable number they would like to complete for each fact family during that week’s test. Once they had

this number in mind, they were to draw a star at the appropriate place on the Week 6 line on their graph. They repeated this procedure for Week 6 on their seven through nine graphs. The graphs were then collected, and the Week 6 tests were administered.

Goal setting conversations were repeated, and students charted self-selected goals with stars on their graphs for the remaining weeks of the multiplication fact testing. Students were given back the previous week's test, asked to chart their results, set a goal for the current week's test, and then take the test to try and achieve that goal.

CONCLUSION

This study measured the effect that goal setting would have on assisting students with achieving a predetermined score on multiplication fact fluency tests. Students were provided with data to assist them in making a determination on what a reasonable goal should be for fact fluency output. Individual student results were charted through line graphs. The class average was also charted on a bulletin board at the front of the room. Tests were administered each week for eight weeks, and the results of each test were compared to the results from the week before.

CHAPTER IV

RESULTS AND DISCUSSION

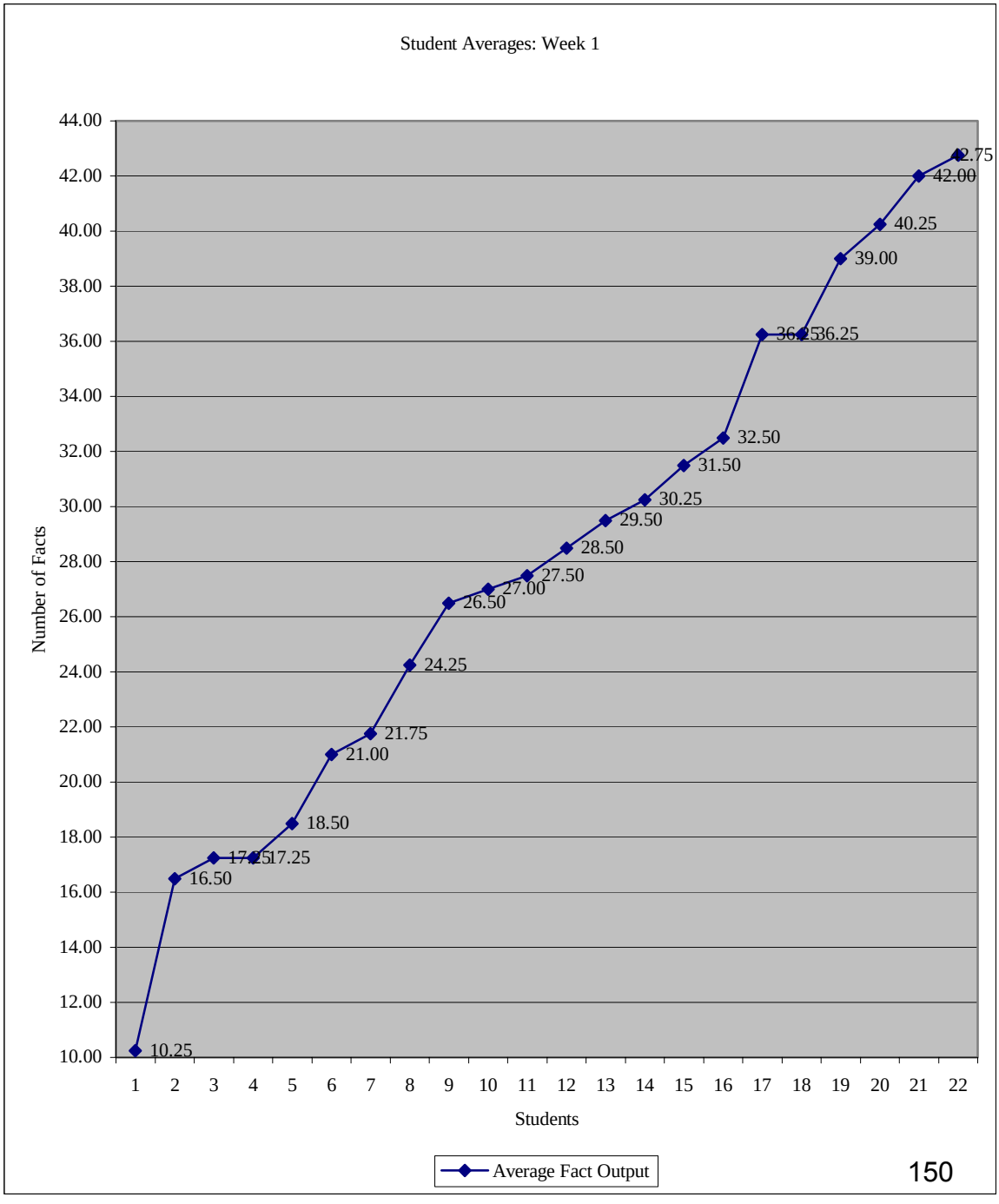
INTRODUCTION

The purpose of this study was to determine whether or not goal setting would result in increased multiplication fact test scores for students. Students were provided with an overview on the importance of knowing their multiplication facts to automaticity. They were also provided with instruction on why goal setting could provide beneficial results in their learning. A total of 32 weekly quizzes were administered through the duration of the testing.

Data was collected and compared each week. Since students were taking the same tests each week, it was expected that the average scores on the tests would increase each week. However, it was also expected that the scores would eventually plateau at some point, as students can only complete so much in a minute working at maximum capacity. The determination was made that students who were able to complete between 45 and 60 facts in a minute would probably not show a tremendous rate of growth. Therefore, the potential for increase lie with the students who were working at an average of 40 or less facts per minute, which was most of the class. Maintained data included each student's scores on the times six, times seven, times eight and times nine tests, individual student averages for each week's four tests, class averages for each week's four tests and rate of increase and / or decrease when comparing one week's test to a previous week's test.

The first graph shows the average number of facts that each student in the class able to complete during the first week of testing, listed in ascending order. This information was used as a baseline to determine how much improvement could be reasonably expected.

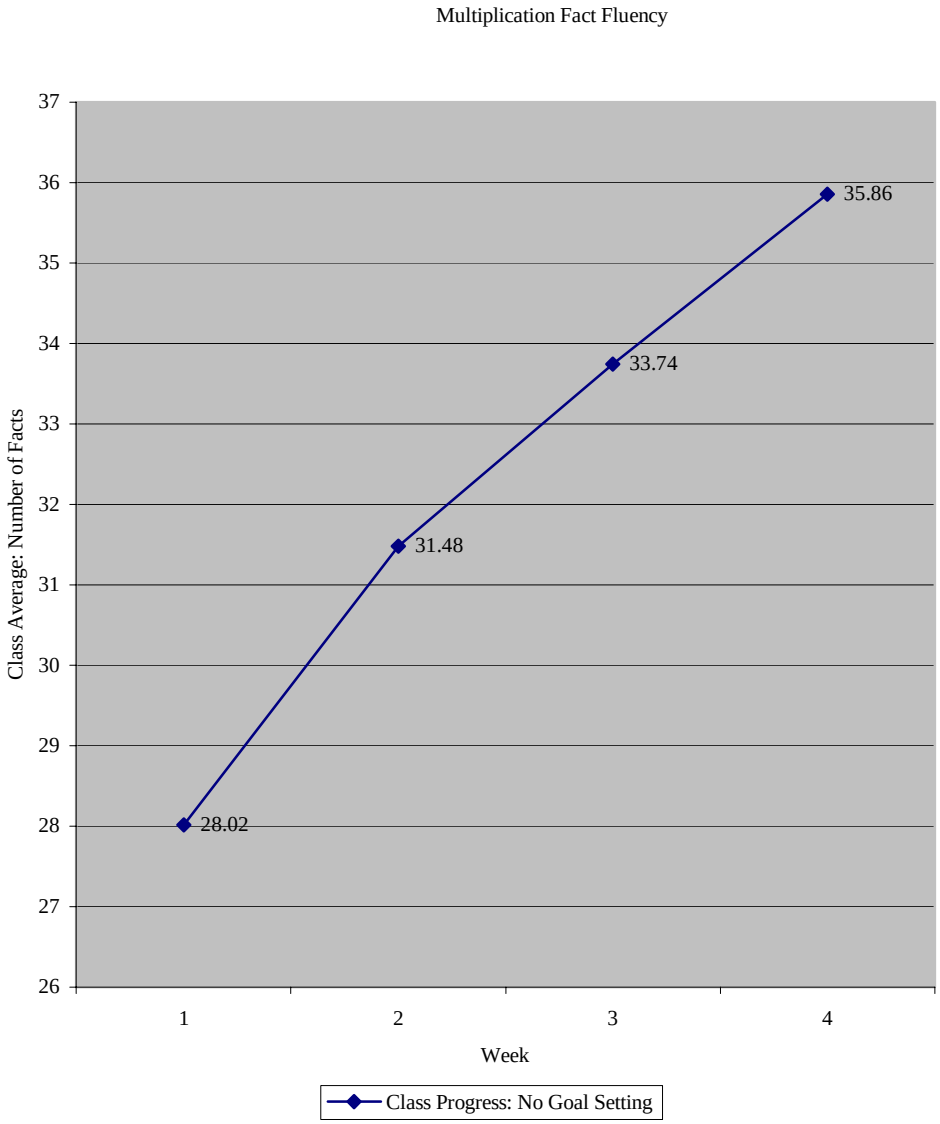
GRAPH 4.1



Three of the 22 students in the class were able to recall an average of 40 facts or higher during the first testing session. These students could reasonably be expected to increase their output, but since their performance was the highest compared to the other students, but it seemed more likely that truly significant gains would come from students in some of the lower groups. Six students were able to recall an average of 30-39 facts in one minute. Eight students were able to recall an average of 20-29 facts in one minute, and five were not able to recall an average of 19 facts in one minute. 87% of the students in the classroom had potential to increase their average output and automaticity of their multiplication fact by a significant amount.

The second graph shows the average increase of class scores of multiplication facts during the first four weeks of testing. During the first week of testing, students were able to complete an average of 28 multiplication facts during one minute. At the end of the four-week pretest period, students were able to complete an average of almost 36 multiplication facts during one minute. The average number of facts that students were able to complete rose by an average of almost eight facts, or about two facts per week.

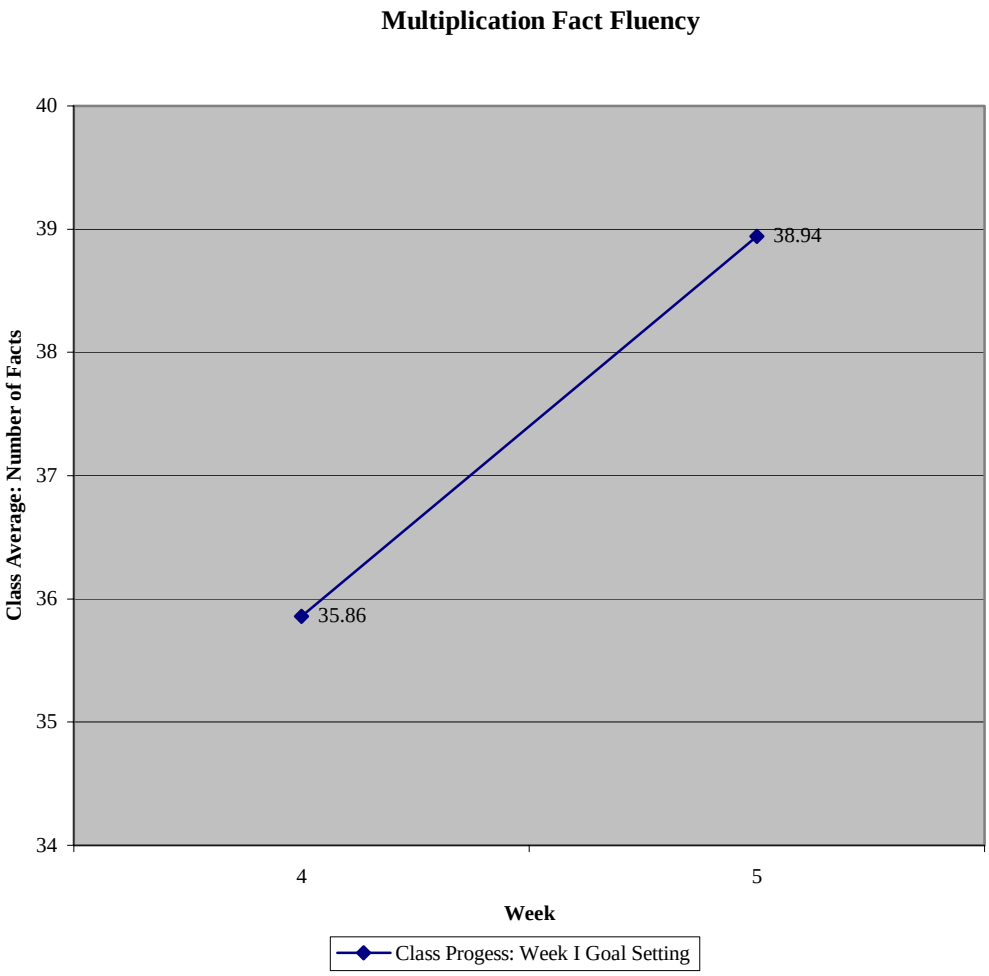
GRAPH 4.2



During Week 5, goal-setting strategies were implemented. Students were asked to analyze their progress on the previous four weeks worth of multiplication tests and set a goal for each of the six through nine fact families. During Week 5, students were asked to look at their line graphs and make an overall determination of

how they wanted their line graph to look after Week 5 was recorded. Students then took the timed tests for Week 5. Scores for Week 4 and Week 5 were then compared to see if students had maintained a two-fact per week increase. Data was also analyzed to see if the average had increased by more than two facts.

GRAPH 4.3



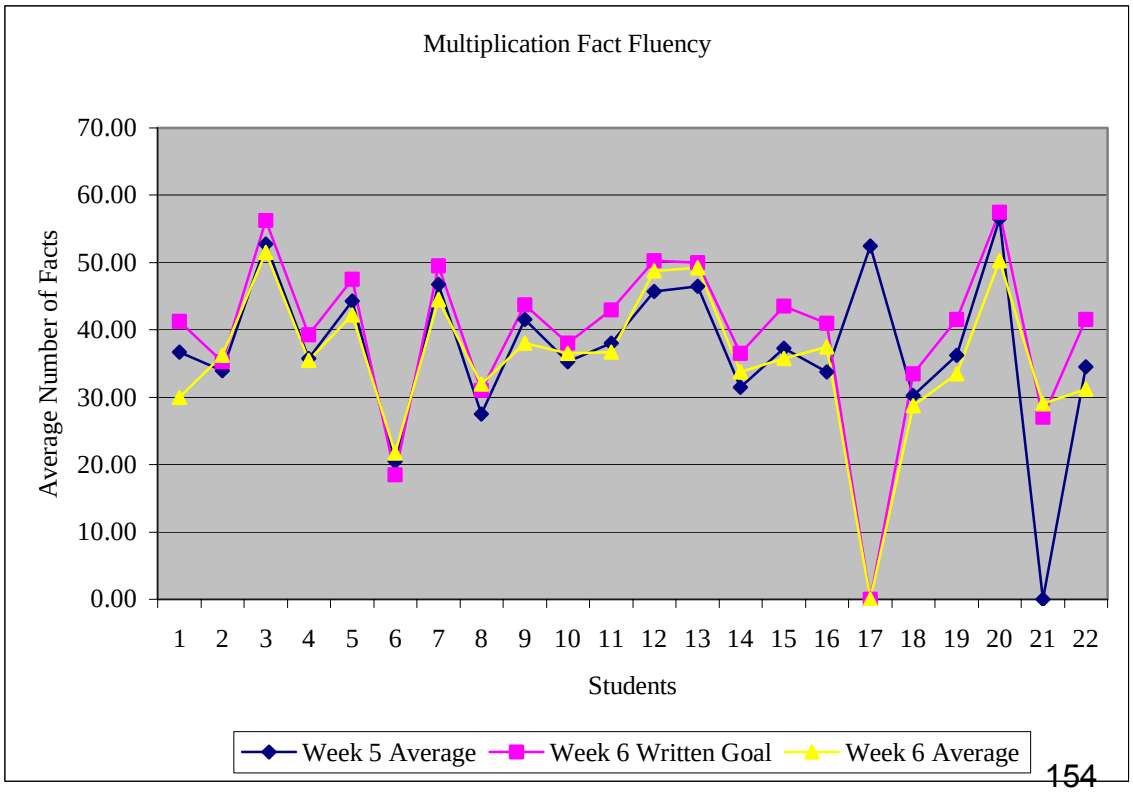
The data shows that not only were students able to maintain their pattern of increasing the average number of facts they were able to complete during each

week's test, but during the week where goal setting was initiated, students increased the average number of facts they were able to complete from two to three.

While these results were encouraging, it was important to keep track of the data to determine if the rate of increase could be maintained. At the start of the testing session for Week 6, students were asked to chart the progress they had made during Week 5. Next, they looked at their rate of progress on their graphs and made a determination of how many facts for each family they would try to set a goal to complete in Week 6. They were asked to identify their goals for Week 6 by placing a star on their graphs at the appropriate interval. The graphs were collected, and then the students took the tests for Week 6.

Graph 4.4 shows student averages for Week 5, student goals for Week 6 and actual student performance for Week 6.

GRAPH 4.4

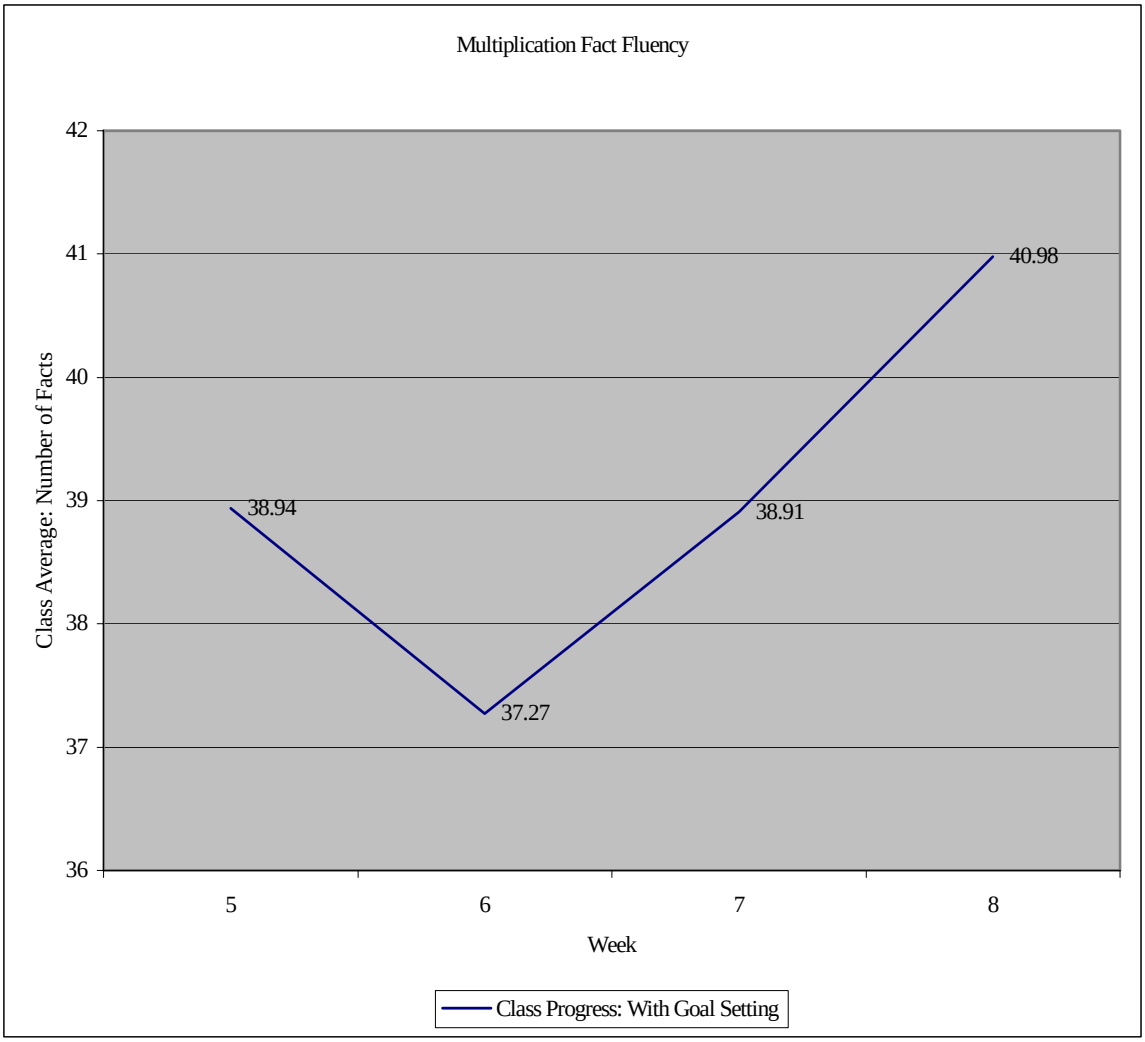


Note: Student 17 and Student 21 were absent during Week 6 testing.

Only four of 20 students reached the self-selected goal they had set for Week 6. This was not immediate cause for concern, as some students may have self-selected a goal that was unreasonable based on their past performance, and some may have misunderstood exactly what they were supposed to chart. Further analysis, however, shows that while 96% of students increased their average number of facts from Week 4 to Week 5, only 40% of students were able to increase the average number of completed facts from Week 5 to Week 6. The results from Week 5 and Week 6 saw the greatest number of students with a decline in average fact scores. During Week 7 and Week 8, student averages rebounded and the class was able to achieve their highest average during Week 8, the final week of the experiment. So what caused this decrease in Week 6? The only variable that differed from previous weeks was that students were asked write down a goal before completing their multiplication tests. Could asking a student to write a goal, then asking them to immediately meet it, have caused this decline?

Graph 4.5 shows the progress students made in the average number of multiplication facts they were able to complete during the four weeks they were asked to set and track fluency goals.

GRAPH 4.5

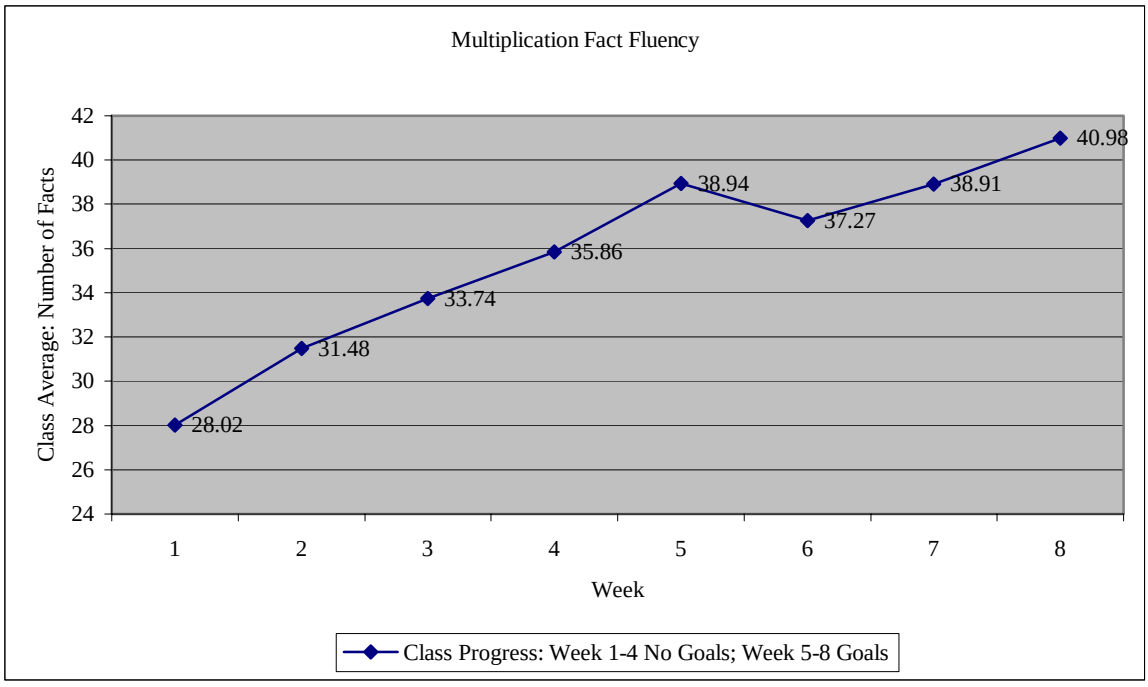


This graph shows the decrease in the number of multiplication facts that students were able to complete during the one minute time period from Week 5 to Week 6. Instead of maintaining the increase of the week before, the average number of facts that students were able to complete dropped by almost two facts, from about 39 during Week 5 to 37 during Week 6. Week 7 saw the class scores rebound back to Week 5, as the class obtained an almost identical average. Week 8, the last week of

the goal-setting experiment, saw the class increase their average by two facts, the same average increase demonstrated during the initial four week time period when students were not setting goals. Although students were able to increase their average rate of increase by about eight facts during the first four weeks of testing, during the portion of the testing when no goal-setting strategies were present, the average rate of increase was only about two facts.

The average progress of the students over the course of the complete experiment is demonstrated in Graph 4.6.

GRAPH 4.6



All students experienced a rate of increase in their multiplication facts during the eight-week course of the experiment. On average, the class was able to increase their output of multiplication facts by around 13 facts per student. The student with

the greatest average improvement was able to increase his or her output by almost 26 facts per minute. The student with the lowest average improvement made less than a one fact average gain from Week 1 to Week 8. See Appendix A to compare how individual student averages changed from Week 1 to Week 8.

VARIABLES

There were a number of variables that could have affected student performance each week during testing administration. Since students were given identical fact tests each week, it was logical to assume that some students would show an increase in the amount of facts they could recall simply because they remembered a small sequence of numbers from the week before. Many of the students who took the tests during the weeks when they were not setting goals chose to complete their fact problems out of sequence. Instead of completing the problems by row or by column, they would scan the worksheet and answer all of the zero and one facts first, then go back and try and attempt some higher facts. Another variable that may have affected the outcome of this experiment was acquisition of math concepts students obtained during math instruction each day. Students were given weekly homework assignments that focused on increasing their computation, so completing this work may have had an effect on their ability to compute during the testing period. Another factor that may have affected the outcome of the experiments were the students' moods each day when the fact tests were given. Many of the students in the testing group participate in extracurricular math activities, and therefore look forward to any opportunity where they can practice or show off their math skills. Likewise, another

group of students admitted to hating math, and was similarly unmotivated to try and prove anything by increasing their scores on their fact tests. The goal setting, to them, was little more than writing a number on paper simply because they were following a verbal instruction. Another variable that may have affected the outcome of this study was the extent of prior instruction each student received in learning math facts before entering sixth grade. Different teachers choose to focus their efforts in different areas of curriculum. Since each student had been taught multiplication facts by different teachers at different times, it was difficult to gauge whose learning of facts had been helped or hindered by their prior instruction.

HYPOTHESIS TESTING

To test the hypothesis of the study, the researcher consulted www.physics.csbsju.edu/cgi-bin/stats/t-test. After inputting the data from the pretest and posttest group scores, the t-test value obtained was 0.153.

TABLE 4.1

***t*-Test Results**

	Pretest Group Scores	**Posttest Group Scores**
Mean	2.61	1.16
Standard Deviation	0.737	1.22
Mode	N/A	N/A
Median	2.26	1.64

t-test value	1.67	
Probability	0.153	

These *t*-tests used a significance level of 0.05, a standard level used in research as the criterion for rejecting the null hypothesis. Since the probability of 0.153 is greater than the significance level, then the null hypothesis is not rejected. The outcome is not statistically significant and the results could be simply a matter of chance. More testing would need to be done to determine if these results were of statistical significance.

CHAPTER V

SUMMARY OF RESULTS

In sum, goal setting is a valuable activity for students of all ages. Goal setting allows students to undertake tasks with certain purposes and outcomes in mind. It enables students to focus their efforts and control their learning.

This goal setting activity provided a number of useful insights. Engaging the class in conversation about goal setting permitted students to realize that they should always try to work with a specific result in mind. It opened a venue of communication for students to understand how learning math facts to automaticity would allow them to be better mathematicians in the future. It gave some students an opportunity to push themselves to their very capacity for recalling math facts. Some students readily enjoyed the challenge each week of trying to beat their previous week's scores. It encouraged lively competition between some groups of students to see who could have the top average in the class each week. This goal setting activity also focused the efforts of some students who would have otherwise taken this math activity as nothing but fun or a waste of time. Since students are expected to know their facts to fluency upon entering fifth grade, some students did not really believe practicing facts was worth concentrating on as a sixth grader. However, after learning their scores would be measured each week to gauge their progress, these same students radically altered their test-taking style. Instead of jumping around the page to complete the "easy" facts, they were much more diligent in writing their answered in structured columns or rows.

However, not all students felt that setting goals was beneficial. After the drop off in results during Week 6, the class engaged in conversation about what could have caused a decrease in their scores. Students expressed feelings of stress, frustration and pressure at trying to meet their predetermined number of facts within the given time frame. Some explained they were more focused on trying to count the number of problems they had completed to ensure their goal was met instead of focusing on completing as many problems as they could. Some were too worried about how their results were affecting the class average, and therefore were not concentrating on their individual performance. Although the class, on average, increased their output by an average of 13 facts per student, further research would need to be done to see if goal-setting truly contributed to this result, or if this increase was simply the product of repeated practice for an extended length of time.

CONCLUSIONS

In conclusion, for students to increase their automaticity and fluency of math facts, more attention needs to be focused on strategies that encourage retention. It is possibly a mistake to assume that all students will enter sixth grade with full, accurate knowledge of their times tables. It is a dichotomy to moan that students cannot accurately perform long division, find common denominators or reduce fractions while at the same time refusing to make any accommodations in work schedules to allow for repeated practice of multiplication facts. Goal setting in mathematics is a useful tool to focus student efforts, but students need to be given tools to allow them

to practice the skills they are required to know for mathematics automaticity and fluency.

RECOMMENDATIONS

Although there is little time to devote to the study of math facts within the current sixth grade math curriculum, it may be necessary to encourage time for student practice through independent homework assignments or by using math drill programs in the computer lab. Multiplication fact practice can easily be integrated into many areas of math curriculum, including the studies of decimals, fractions and percents. Students could be encouraged to make multiplication flash cards and periodically be assessed within the classroom to gauge how they are making progress. Repeated class discussions are necessary for students to understand that knowing their math facts to fluency is not a choice they can make with their learning.

CHAPTER VI

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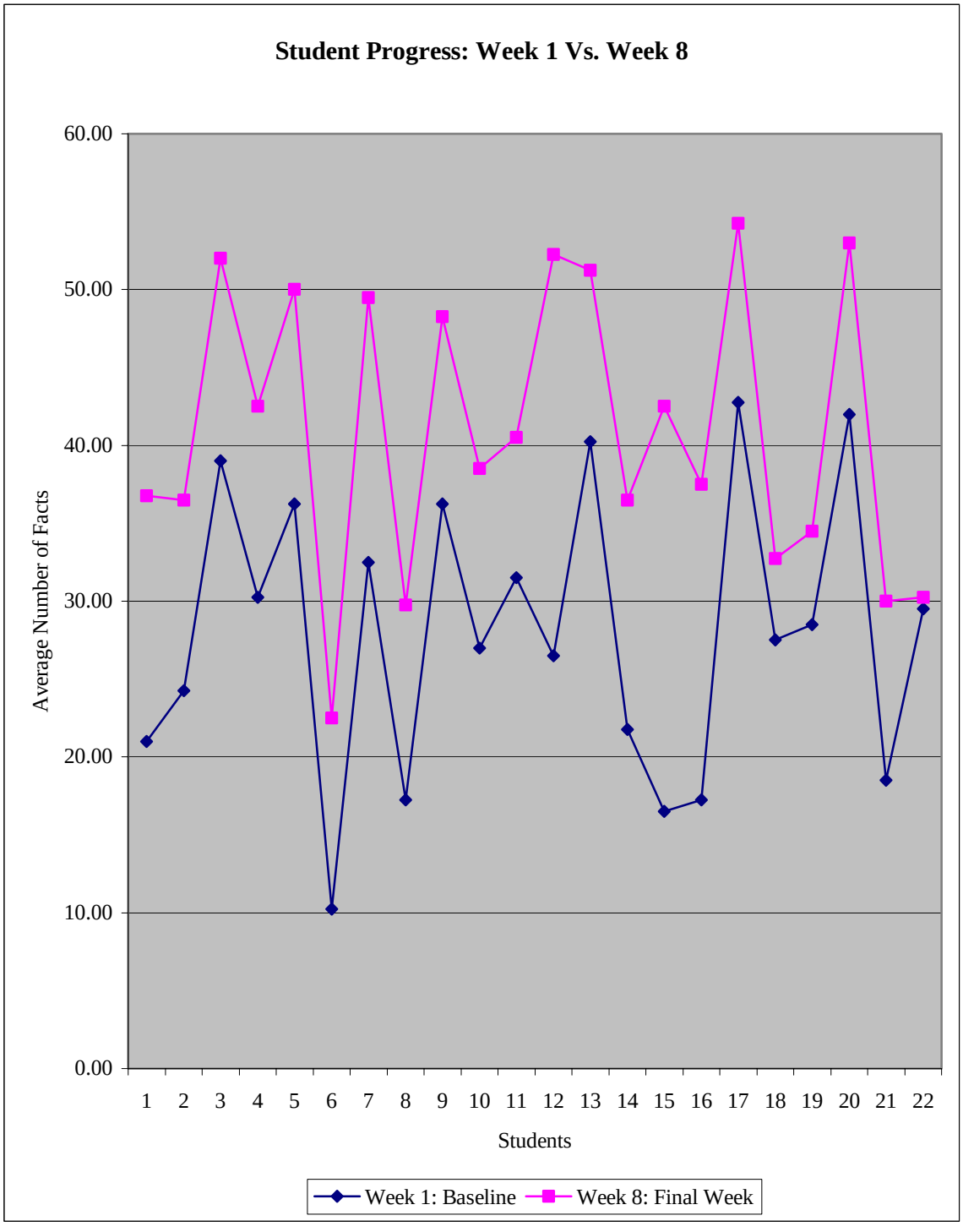
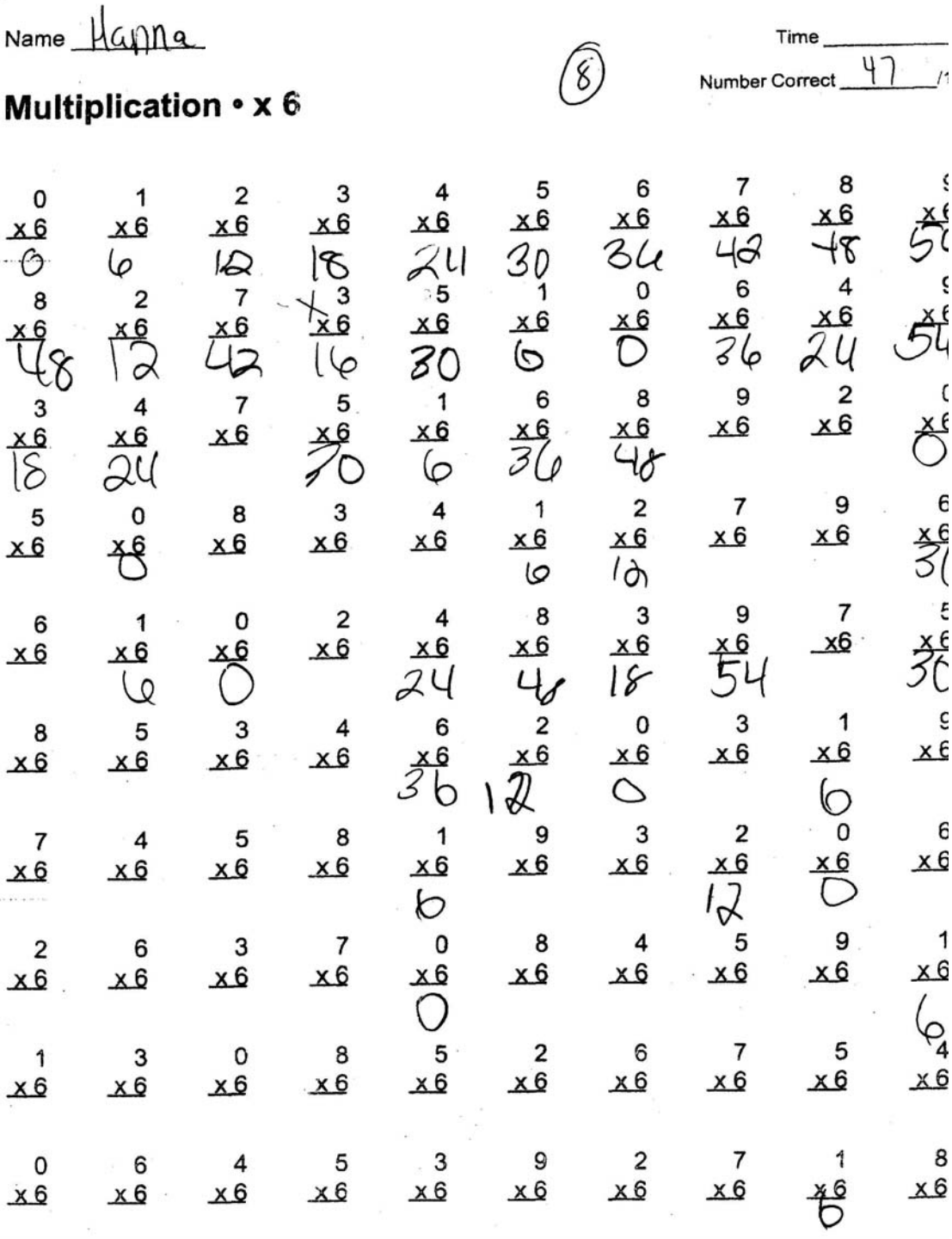
APPENDIX A
STUDENT AVERAGES: WEEK I COMPARED TO WEEK VIII



SAMPLE MULTIPLICATION TEST

TIMES 6



Name Hanna

Time _____

Number Correct 47 /1

Multiplication • x 6

0 x6 = 0	1 x6 = 6	2 x6 = 12	3 x6 = 18	4 x6 = 24	5 x6 = 30	6 x6 = 36	7 x6 = 42	8 x6 = 48	9 x6 = 54
8 x6 = 48	2 x6 = 12	7 x6 = 42	3 x6 = 16	5 x6 = 30	1 x6 = 6	0 x6 = 0	6 x6 = 36	4 x6 = 24	9 x6 = 54
3 x6 = 18	4 x6 = 24	7 x6	5 x6 = 30	1 x6 = 6	6 x6 = 36	8 x6 = 48	9 x6	2 x6	0 x6 = 0
5 x6	0 x6 = 0	8 x6	3 x6	4 x6	1 x6 = 6	2 x6 = 12	7 x6	9 x6	6 x6 = 36
6 x6	1 x6 = 6	0 x6 = 0	2 x6	4 x6 = 24	8 x6 = 48	3 x6 = 18	9 x6 = 54	7 x6	5 x6 = 30
8 x6	5 x6	3 x6	4 x6	6 x6 = 36	2 x6 = 12	0 x6 = 0	3 x6	1 x6 = 6	9 x6
7 x6	4 x6	5 x6	8 x6	1 x6 = 6	9 x6	3 x6	2 x6 = 12	0 x6 = 0	6 x6
2 x6	6 x6	3 x6	7 x6	0 x6 = 0	8 x6	4 x6	5 x6	9 x6	1 x6 = 6
1 x6	3 x6	0 x6	8 x6	5 x6	2 x6	6 x6	7 x6	5 x6	4 x6
0 x6	6 x6	4 x6	5 x6	3 x6	9 x6	2 x6	7 x6	1 x6 = 6	8 x6

GRAPH: CHARTING PROGRESS AND SETTING GOALS