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An Examination of the Relationship Between Students' Use of the *Fast ForWord*® Reading Program and Their Performance on Standardized Assessments in Elementary Schools

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A dissertation

presented to

the faculty of the Department of Educational Leadership and Policy Analysis

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Doctor of Education

---

by

G. Greg Marion

May 2004

Dr. Louise MacKay, Chair

Dr. Cecil Blankenship

Dr. Terrence Tollefson

Dr. Russell West

Keywords: Brain plasticity, Computer assisted instruction, Phonics, Reading, Whole language, *Fast ForWord*®

ABSTRACT

An Examination of the Relationship Between Students' Use of the *Fast ForWord*® Reading Program and Their Performance on Standardized Assessments in Elementary Schools

by

G. Greg Marion

The purpose of this study was to compare the academic achievement of students through the use of standardized testing to examine the relationship of participation in a computer-based phonics instructional system called *Fast ForWord*®. The sample included students enrolled in the fifth and sixth grades at four elementary schools in the Grainger County, Tennessee, school system. The comparison group consisted of same-grade peers at the four elementary schools in Grainger County who were not enrolled in the *Fast ForWord*® program. Students' scores were compared using the 2003 *Terra Nova* standardized assessment test and using their 2001 and 2002 test scores as a control. Comparisons were made using the reading, language, math, science, and social studies subsections of the *Terra Nova*. Differences between students who received *Fast ForWord*® and students who did not receive *Fast ForWord*® were analyzed.

The study examined the variables of gender, school enrollment, socioeconomic status, time of intervention, and ability grouping. These variables were examined with analysis of covariance to determine differences. When differences did exist between groups, posthoc tests were used to determine specific differences between groups.

The findings indicated that there were measurable differences in the performance of students who received *Fast ForWord*® compared to students who did not receive *Fast ForWord*®. Significant differences were found in reading and language subsections of the *Terra Nova* test for students who had participated in the *Fast ForWord*® reading program. The findings from the examination of other variables indicated that gender as well as gender x the intervention (*Fast ForWord*®) interaction were the same for females and males in their performance on the *Terra Nova*. The findings from the variable socioeconomic status were determined using system data for free/reduced or paid meals. The study determined that socioeconomic status did not significantly affect scores of students including the socioeconomic status x the intervention interaction. The study did determine differences in students' performance among schools attended. The study found some differences for intervention administration times and among ability groups. Posthoc tests were performed to determine which groups were different.

DEDICATION

I dedicate my time spent on this study to my family. My wife, Sandra, has endured happy moments and mood swings as I progressed through the program, completed comprehensive exams, and worked on this study. Sandra, I'm thankful for your love, trust, wisdom, and values. You are a loving wife, devoted mother, and special friend. I'm proud to be your husband.

To my son, Austin, I hope my absence from your life during the last two years can be replaced with memories of hunting and fishing in the coming years.

To my daughters, Rachel, Kelly, and Victoria, I hope the stress of classes, tests, and studies can be replaced by happier times and a less grumpy dad.

To Wanda Lou Peoples who always provided me reading material as a child.

I dedicate my pursuit of higher education to my blessed mother and dearly departed father, Laura M. Marion and the late Grover C. Marion. They raised me through example and trusted that experience would endure throughout my life. I hope that my pursuit of education has pleased them.

I recognize the presence of my gracious in-laws, Jimmie Roberts and the late Creola B. Roberts. I hope I can please you through the care of your daughter and grandchildren.

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CHAPTER 1

INTRODUCTION

In January 2002, President George W. Bush signed the "No Child Left Behind" (2002) legislation into law. The law established new standards of accountability for individual students, schools, and school systems. The law also provided funding for reading programs that have demonstrated success based on research. During the past decade, the state of Tennessee mandated and has implemented achievement tests for elementary school students in grades three through eight. The results of these tests can be used to determine the success of programs; they can also be used to determine failure of such programs that can lead to intervention by the State Department of Education. Individual schools and school systems can be placed on probation if students fail to produce adequate yearly progress as determined by the State Board of Education (Tennessee Department of Education, 1999).

Scientific Learning Corporation's (2003) *Fast ForWord*® is a software program for computer-assisted reading instruction designed to provide immediate positive reinforcement and corrective feedback through graphics. It is similar to a video game that could interest and engage learners. Sustained efforts by educational leaders and teachers have continued to increase availability of computers in classrooms. A report from the U. S. Department of Education (1997) estimated that $11 billion has been spent annually on computer technology over the past 10 years.

The *Fast ForWord*® reading program has been studied in both school and home settings and early information indicates *Fast ForWord*® may be an effective intervention for some students when combined with traditional reading instruction. Gilliam, Loeb, and Friel-Patti (2001) addressed the growing popularity of the program and pointed out that since 1996 interventions using *Fast ForWord*® have been provided for thousands of children in private and public settings at a considerable cost in time and money. According to these researchers, the

developers of *Fast ForWord*® claimed that children with language-learning impairments presented gains of from one to one- and-one-half years on standardized tests of language skills after six weeks of training with the program. They attributed these gains to improvements in the brain's ability to embody rapidly successive sounds with greater clarity and sharper distinctions (Gilliam et al.).

During the past few years, Grainger County, Tennessee, has continued to expand its technology programs by increasing the number of computers per classroom and by recently purchasing the *Fast ForWord*® reading program for every fifth- and sixth-grade classroom in all four of the county's elementary schools. The computers are connected to the World Wide Web and are equipped with developmental and grade-level appropriate courseware packages.

This study focused on Grainger County's use of the *Fast ForWord*® reading program to supplement the county's traditional reading program. Data were gathered from the 2002 and 2003 *Terra Nova* Standardized Assessment Test scores to determine if a relationship existed between the use of *Fast ForWord*® and students' test scores. Analysis of test data was used to identify patterns or trends that might result from use of the *Fast ForWord*® computer-based reading program in Grainger County.

Statement of the Problem

In a time when state and local governments face significant budget shortfalls, can a school and school system justify spending $60,000 for Scientific Learning Corporation's (2003) *Fast ForWord*® software? Recent state and federal mandates require schools to be accountable for students' test scores, but is there any evidence that the *Fast ForWord*® reading program supports better achievement for students' success in reading?

Although reading test scores exist for students in grades five and six in the Grainger County Schools, there was no determination as to whether these scores were affected by the students' use of and participation in the *Fast ForWord*® reading program.

The purpose of this study was to determine if a relationship existed between time spent on Scientific Learning Corporation's (2003) *Fast ForWord®* reading program as a supplement to traditional reading instruction and reading achievement as measured by the *Terra Nova*, a standardized achievement test used in Tennessee for testing elementary school students. The independent variables for this study were gender, school enrollment, socioeconomic status, time of intervention, and ability grouping.

Definitions of Terms

For the purposes of this study the following definitions were applied:

1. *Acetylcholine* is a brain chemical that has a role in learning and memory. Acetylcholine originates in the basal forebrain and that cholinergesic synopses themselves into the site of memory storage (Deutsch, 1971).
2. *Brain plasticity* refers to the phenomenon in which "experiences excite individual neurons and influence connections between networks of neurons" (Gilliam, 1999).
3. *Computer-assisted instruction* is an "educational or instructional technique that is based on a two-way interaction between a student and a computer that is used to promote human learning and understanding" (UNESCO, 1987, p. 30).
4. *Dystonias* are movement disorders in which sustained muscle contractions cause twisting and repetitive movements that are involuntary and sometimes painful, may affect a single muscle; a group of muscles such as those in the arms, legs, or neck; or the entire body (National Institute of Neurological Disorders and Stroke, 2001).
5. *Dopamine* as a chemical messenger is similar to adrenaline. Dopamine affects brain processes that control movement, emotional response, and ability to experience pleasure and pain (University of Texas, 2003).
6. *Endorphins* are pepticle hormone neurotransmitters and they affect one's mood, perception of pain, memory retention, and learning abilities (Zilberter, 2002).
7. *Fast ForWord®* is a registered reading program developed by the Scientific Learning

Corporation (2003) that uses computer-assisted instruction and headphones to provide video-game style instruction that modifies volume and speed of acoustic sounds to promote phonemic awareness.

8. *Norepinephrine* is a neurotransmitter in the catecholamine family that mediates chemical communication in the sympathetic nervous system (eLibrary, 2003).
9. *Phonics* is a method of reading instruction that is based on the ability to make speech sounds from letters of the alphabet. The method was originally called sound-out when it was used in early colonial America. Today, phonics is the understanding of the 40 or so basic speech sounds (phonemes) and hundreds of blended sounds used to teach reading (Palmaffy, 1997).
10. *Serotonin* is a neurotransmitter that is involved in many behaviors such as depression, obsessive-compulsive disorder, hunger, sleep, and perception. Serotonin synopses are abundant in the cerebral cortex making it likely they are involved in the processes of perception (Cassem & Coyle, 2003).
11. *Whole language* is a method of reading instruction developed to promote understanding of units or groups of words that are used in context and with meaning. Whole language was believed to help learners develop an appreciation of reading compared with the teaching of isolated skills (Blumenfeld, 1993).

Research Questions and Hypotheses

The researcher investigated the following questions as they related to the use of Scientific Learning Corporation's (2003) *Fast ForWord*® reading program as a supplement to traditional reading instruction for fifth- and sixth-grade students in Grainger County's elementary schools.

1. What are the demographic characteristics of fifth- and sixth-grade students in the Grainger County schools?
2. What level of performance exists for 2002-2003 students enrolled in the fifth and sixth grades in the Grainger County school system taking the *Terra Nova* test?

3. Do students who participate in *Fast ForWord*® score higher than students who did not participate in *Fast ForWord*® on the *Terra Nova* test while controlling for prior academic differences? (The question will use analysis of covariance. The analysis will look for differences in scaled scores, comparing reading, language, math, science, and social studies scores of the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*).

   Ho3: There is no difference in the performance of students who received *Fast ForWord*® and students who did not receive *Fast ForWord*® on the 2003 *Terra Nova* while controlling for the 2001 and 2002 test results.

4. Are there gender differences in the performance on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*? (The question will use analysis of covariance for gender).

   Ho4: There is no difference in the performance of males and females on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

5. Is there a gender by intervention interaction?

   Ho5: There is no gender by intervention/interaction effect on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

6. Are there school differences in the performance on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*?

   Ho6: There is no difference in school performance on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

7. Did students who received free or reduced meals score higher than students who do not receive free or reduced meals on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*?

   Ho7: There is no difference between those who received free/reduced priced meals and those who did not receive free/reduced price meals on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

8. Is there a socioeconomic status (free and reduced meals and paid meals) by intervention (participation in *Fast ForWord*® and no participation in *Fast ForWord*®) interaction?

   Ho8: There is no significant difference in the performance of students who receive free/reduced/paid meals and their participation in the intervention (participation in *Fast ForWord*®) in their scores on the *Terra Nova* test.

9. Do students who receive *Fast ForWord*® early in the year (1st semester) perform differently on the 2003 *Terra Nova* than students who receive *Fast ForWord*® later in the year (2nd semester) while controlling for the 2001 and 2002 *Terra Nova*?? (This question will use analysis of covariance to compare early (1st semester) intervention with last (2nd semester) intervention.

   Ho9: There is no difference in performance on the *Terra Nova* test of students who received the *Fast ForWord*® reading program early in the school year and students who received *Fast ForWord*® reading program late in the school year.

10. Dividing the students in 4 ability groups (1st, 2nd, 3rd, and 4th quartiles) based on their 2002 *Terra Nova* scores, are there ability group differences on the performance of the 2003 *Terra Nova* while controlling for the 2001, 2002 *Terra Nova* scores?

    Ho10: There is no difference in the performance of students on the *Terra Nova* who were in the 1st, 2nd, 3rd, and 4th quartiles after receiving the *Fast ForWord*® reading program.

11. Is there an ability group (grouping for each subject on the 2002 *Terra Nova*) by intervention (participation in *Fast ForWord*® and no participation in *Fast ForWord*®) interaction on the 2003 *Terra Nova* while controlling for the 2001, 2002 *Terra Nova*?

    Ho11: There is no ability group (X) interaction/intervention effect on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

Background and Significance of the Study

Recent research into learning and brain function has indicated that learning processes can be influenced and students' achievement can be enhanced (American Psychological Association, 2001). Researchers have learned to help victims of trauma and brain injury as well as individuals who are born with congenital impairments through understanding physical and chemical processes involved with learning. Working with a team in the 1990s, several scientists collaborated to develop a new learning system (American Psychological Association, 2001).

Merzenich (2001) and his associates developed a training program that they named *Fast ForWord®*. This program was designed to provide improvements in the speech-reception and language-use abilities of participants who were identified with language impairments that interfered with achieving successful reading skills. The team initiated controlled studies to determine whether the results could benefit countless numbers of children with reading impairments. Merzenich, along with partners from the University of California at San Francisco and Rutgers University, founded Scientific Learning Corporation to develop learning programs designed to improve reading skills. According to Merzenich, "Scientific Learning Corporation's intensive listening-training program has positively benefited more than 100,000 language and reading impaired children" (p. 878). As noted on Scientific Learning Corporation's (2003) website, studies indicated that participants who received *Fast ForWord®* intense phonics instruction showed marked improvements in speech and language function regardless of their ages. Scientific Learning Corporation documented these changes through "behavioral, neuropsychological, and brain-imaging indices" (Merzenich, p. 879).

Merzenich's (2001) research over the past 10 years has focused on brain plasticity in learning that overlapped with research in brain plasticity for other medical conditions in human subjects. The purpose of the plasticity research was to develop new treatment strategies to correct underlying neurological problems in people with such impairments or disabilities. Merzenich and his team have helped advance the understanding of the neurological origins of the symptoms of acquired dystonias, generalized developmental dystonias, pervasive development

disorder, cerebral palsy, and schizophrenia. Developments that led to the understanding of plasticity have brought attention to the importance of brain-based chemicals such as dopamine, acetylcholine, norepinephrine, serotonin, and endomorphines and their roles in the learning process (Merzenich). The team explored the relationship of these chemical control systems as they related to brain plasticity in the learning process.

Merzenich (2001), while noting the implications that understanding brain plasticity had in advancing neurological medical science, stated,

> We are coming to understand how brain plasticity contributes to variations in human performance ability and to catastrophic neurological and psychiatric illnesses. We now understand that learning-driven plasticity contributes importantly to every neurological and psychiatric illness. Our great challenge is to harness its power for potentially great human rehabilitative good. (p. 880)

Limitations

This study was conducted in four elementary schools in Grainger County using students enrolled in the fifth and sixth grades. The *Fast ForWord*® reading program was provided to all students in three of the elementary schools and not provided in the fourth elementary school. The students who were enrolled in *Fast ForWord*® served as the study group and students who were not enrolled served as the control group.

The results of this study reflected the use of nonequivalent control group design for a quasi-experimental study. The study analyzed relationships of both students who received *Fast ForWord*® and those who did not receive *Fast ForWord*®. The relationship was examined through the use of the *Terra Nova*, the state of Tennessee's annual student assessment instrument (Tennessee Department of Education, 1999). An exhaustive search of the literature resulted in no studies found using students who were not impaired in language or reading.

The Grainger County director of schools and the Grainger County technology director instructed teachers of reading in the three schools to provide *Fast ForWord*® instead of their regular curriculum. The instruction was provided in the student's regular reading period (which

varied throughout the day) for a minimum of 90 minutes per day for six weeks. At the end of the six weeks, students were required to score 90% on the program "Circus Sequence" or they were required to continue the program until they scored 90% (some students were enrolled for eight weeks).

Research Design

This study used a quasi-experimental design through the use of a nonequivalent control group design. The purpose of this study was to determine if a difference existed for students who received *Fast ForWord*® and students who did not receive *Fast ForWord*® and their performance on the *Terra Nova*, the state of Tennessee's annual assessment examination. Scores obtained by students enrolled in the fifth and sixth grades in Grainger County during the 2002-2003 school year were compared with their scores from the 2000-2001 school years. The use of nonequivalent control group is similar to the pretest/posttest control group design except some students were assigned to the treatment (*Fast ForWord*®) and some were not. The researcher used the 2000-2001 and the 2001-2002 *Terra Nova* assessments as pretest, the *Fast ForWord*® program as the intervention, and the 2002-2003 *Terra Nova* as posttest.

The students who participated in the *Fast ForWord*® program were assigned to the experimental group and students who did not participate in *Fast ForWord*® were assigned to the control group. In this study, achievement test scores were collected from the Grainger County school system's reporting documents and comparisons were made for the students in both the experimental and control groups. Findings might suggest a link between use of the program and academic achievement.

Overview of the Study

This study is organized into five chapters. Chapter 1 included an introduction to the study, the statement of the problem, definition of related terms, a list of research questions and

hypotheses, the background and significance of the study, limitations, and an overview of the study.

Chapter 2 includes a review of the literature as it relates to the history of reading instruction, whole-language instruction, phonics instruction, data regarding reading performance, methods of computer-assisted instruction, *Fast ForWord*® intervention, and test data implications.

Chapter 3 contains research methodology. Information is provided on research design, population, student achievement, descriptions of Grainger County's program implementation, a description of the *Fast ForWord*® courseware, data collection, and data analysis.

Chapter 4 contains analysis of the data and Chapter 5 presents a summary of the findings, conclusions, and recommendations for further research and practice.

CHAPTER 2

REVIEW OF LITERATURE

In order to explore new and innovative reading programs, a review of the history of reading instruction must be conducted. In early America, colonial students were taught to read using Noah Webster's blue-backed speller and the Bible. Students were taught the 40 or so sounds in speech and then they were taught the hundreds of speech sounds that are used in English. According to Palmaffy (1997), one of the first laws passed in America for education was the Old Deluder Satan Act passed in 1647 in Massachusetts to promote religion and teach people to read the Bible. Colonial students were taught the basics of reading and pronunciation that allowed them to read on a primitive level; however, these students were limited by their own speaking vocabulary (Palmaffy). Colonial students later used a basal reading series or groups of stories that were compiled by an educator who sought to keep the material on the same skill/achievement level so that groups of students could be taught at the same time (Czubaj, 1997). This method of reading instruction was used until the mid-1800s, when Horace Mann, an influential and respected educator, made a report to the Massachusetts Board of Education in which he said the letters of the alphabet were "skeleton-shaped, bloodless, ghostly apparitions" (as cited in Hancock & Wingent, 1996, p. 75). Mann recommended that students should not be taught speech sounds but instead should focus on comprehension by learning the whole word first (Palmaffy).

Although Mann suggested a new focus on reading instruction, the use of sounding out letters continued to be the main type of instruction used in American schools. Progressive educators at Columbia University and the University of Chicago rejected the code-emphasis approach as an unnatural way of learning (Palmaffy, 1997). The highly respected educator, John Dewey, recommended a holistic method that would become known as the look-say method (Palmaffy). Educational leaders discouraged the rote memory and skill/drill methods because they did not promote learning to read for pleasure. By the middle of the 20th Century, the early

materials had been replaced by a series of readers developed by Gray in 1930 known as the *Dick and Jane* readers. Students were no longer sounding out words but were expected to learn many words that they should recognize on sight (Palmaffy).

The look-say method of teaching reading had its share of detractors, with many suggesting that it was not the best or only method for reading success. In 1929, Orton (as cited in Blumenfeld, 1993), a reputable neuropathologist, pointed out that the sight method could cause reading problems:

> I wish to emphasize at the beginning that the strictures which I have to offer here do not apply to the use of sight method of teaching reading as a whole, but only to its effects on a restricted group of children for whom I think we can show this technique is not to reading progress, and moreover, I believe that this group is one of considerable size and because here faulty teaching methods may not only prevent the acquisition of academic education by children of average capacity, but may also give rise to far reaching damage to their emotional life. (¶ 20)

In 1955, Flesch wrote the book *Why Johnny Can't Read and What You Can do About It* wherein he questioned then-current methods of reading instruction. Flesch stated, "The teaching of reading all over the United States, in all the schools, is totally wrong and flies in the face of all logic and common sense" (p. 17). Flesch explained that in the 1930s, the professors had changed the way reading was taught in American schools. They discarded the sounding-out method and replaced it with the look-say method. Flesch stated,

> We have decided to forget that we write with letters and learn to read English as if it were Chinese. One word after another after another after another. If we want to read material with a vocabulary of 10,000 words, then we have to memorize 10,000 words. We have thrown 3,500 years of civilization out the window and have gone back to the age of Hammcerabi. (p. 33)

Chall (1967) wrote in *Learning to Read: The Great Debate*, that students who were taught to read with phonics performed better than those who were not. She suggested that phonics instruction should not be a series of mindless drills and should not be done in the absence of reading stories. Chall stated that phonics instruction should occur only in the early grades and should not be viewed as the only method "or we will be confronted in 10 or 20 years with another bestseller: *Why Robert Can't Read*" (p. 78).

Whole Language

In the late 1960s, Goodman (1989) a professor at the University of Arizona and a cognitive psychologist, Smith, developed the theories behind whole language instruction. Goodman studied adults and children as they read aloud. He observed they used context clues to guess an upcoming word instead of using the word's spelling to sound it out. Goodman alleged that if looking for speech sounds was discouraged and the ability to guess improved, then reading would become more fluent. Smith argued that readers did not see every letter in a word or every word in a text. He contended that if readers tried to translate everything they saw into sounds, reading would become much too cumbersome. To explain how this process of reading worked, Smith adapted theories of oral language acquisition (Goodman).

Goodman (1989) reported that whole language was different from the look-say method of instruction because of new theories of how children acquired written language abilities. He contended that drilling students in sound-symbol relationships did not follow the way children developed oral language skills. He asserted that learning to read should be as natural as learning to talk and this should best be achieved by using meaning and purpose in communication. (Goodman). However, whole language is difficult to define. According to Watson (1989), "Advocates reject a dictionary-type definition because each teacher evolves his or her own version of whole language instruction" (p. 131). Bergeron (1990) inferred that whole language contained many concepts, but he identified six basic features:

1. construction of meaning,
2. functional, relevant language,
3. literature,
4. the writing process,
5. cooperative student work, and
6. student-effect. (p. 321)

Whole language instruction allows teachers to use materials outside the traditional reading text. If a student has an interest in science, the teacher can use a book that meets the

student's interest and provides meaningful reading instruction. Whole language allows the teacher to select books and reading sources that meet the individual skill level of every student. Czubaj (1997) suggested that the whole language literature approach could be custom-tailored toward the students' reading potential, whereas, the basal reader fell short. He found that the instructor often placed students within reading groups depending upon the reading level he or she deemed appropriate. He added, "All too often, the student becomes 'trapped' within these groups" (p. 538). If a student's reading skills improved, the student generally remained within the same group to which he or she had originally been assigned. Students often became labeled by the reading group to which they were assigned. Czubaj further explained that the basal reading group model was challenging a teacher's time and creativity. The whole language literature approach allows each student to learn on his or her own level and pace through teacher-assigned, individualized material.

The whole language approach works differently compared to other reading instruction methods. Whole language emphasizes whole word recognition skills. One method of teaching these skills is to have children follow along as their teacher reads to them from oversized books. The students follow as the teacher reads aloud and points at the words during the story. After several readings, the students learn to recognize the words. The students remember the words as they learn the story (Czubaj, 1997).

This method of reading instruction allows students to develop an understanding of context clues and relate meanings to stories. The idea of whole language instruction usually involves a teacher with an oversized book reading to his or her classroom, but the definitions that Jeynes and Littell (2000) used for their meta-analysis were quite different. Their meta-analysis divided whole-language instruction into four functional categories:

1. Pure--We wanted this to be a group of studies that whole language enthusiasts would agree represented the best features of whole language. Coding specifications were as follows: (a) no abridgement adaptations, or segmented texts; (b) no teacher-sponsored, whole-class assignments; and (c) no direct instruction in isolated skill sequences.
2. Specific--This group comprised studies that offered no evidence contradicting our

three-part definition but provided insufficient evidence for both raters to classify them as pure whole language.

3. Broad--These treatments were labeled language experience or whole language, and the spirit of the intervention seemed to be to establish a richly integrated, student-centered class, but the raters found clear evidence that features were included, perhaps inadvertently, to which purists might object. For example, spelling workbooks were part of one morning's class and the treatment was implemented in an afternoon block.
4. Eclectic--These treatments represented deliberate combinations of whole language with more direct, teacher-sponsored instruction in reading strategies such as phonics. Basal instruction (the control) was defined in opposition to the whole language features such as: (a) uses basal reader; (b) uses abridged or segmented texts; (c) includes a preponderance of whole-class, teacher-sponsored assignments; and (d) includes substantial direct instruction in isolated skill sequences. (p. 21)

There are no agreed upon pedagogical definitions of whole language instruction; generally, whole language is considered a philosophy, not a method, about how children learn and are taught to read.

Phonics

Phonics instruction has a long history in the United States, dating back to colonial times. Phonics, simply defined, is the ability to decode and sound out letters of the alphabet, groups of letters in the alphabet, and complete words. Phonics can be divided into phonological awareness, phonological memory, and rate of access for phonological information (Palmaffy, 1997).

Phonics instruction was first used in the United States in churches and later in schools in colonial America. During the 1700s and early 1800s, students were taught to read by memorizing the alphabet and speech sounds of the letters. The publication in 1783 of Noah Webster's *The American Spelling Book* (blue-backed speller) led to continuation of phonics-based instruction (Palmaffy, 1997). In the 1800s, the publication of the McGuffey Readers brought a basal series of reading texts into American schools. The McGuffey Readers were considered very phonics-oriented. In the early 1900s, Ginn and Company's Beacon Readers became the next series of readers primarily used in American schools. The Beacon Readers were

designed to use a sequence of systematic phonics. In the 1930s, the Foresman Company introduced the *Dick and Jane* reading series. The *Dick and Jane* series was endorsed by educational leaders such as Dewey who promoted sight-reading (Palmaffy). In the 1950s, Flesch (1955) wrote *Why Johnny Can't Read and What You Can do About It*, a book that attacked the look-say method. Flesch urged a return to phonics-based instruction. In the 1960s, Chall (1967) wrote *Learning to Read: The Great Debate*, a book in which she endorsed direct instruction in phonics. After the 1984 Federal Commission on Reading issued the report *Becoming a Nation of Readers*, many states passed mandates that phonics become a component in reading instruction in public schools (as cited in Hancock & Wingent, 1996). Even private marketers became involved and products like *Hooked on Phonics* gained widespread public attention.

In their longitudinal studies of phonological processing and reading, Torgesen and Wagner (1994) described three types of phonological processing skills:

> Phonological awareness is generally defined as one's sensitivity to, or explicit awareness of the phonological structure of the words in one's language. It is measured by tasks that require children to identify, isolate, or blend the individual phonemes in words. Usually, children do not attain full development of explicit phonological awareness until reading instruction begins, in first grade, although they can frequently perform quite well on simpler measures of phonological sensitivity in kindergarten.
>
> Phonological memory is typically assessed by tasks that require the brief, verbatim retention of nonmeaningful sequences of verbal items. The most commonly accepted explanation for performance difficulties on this type of task involves problems in mentally representing the phonological features of language. Difficulty with this type of task is one of the most frequently reported cognitive characteristics of children with severe reading disabilities, and performance on span tasks in kindergarten is also predictive of individual differences in word reading skill at the end of first grade.
>
> Children's ability to easily and rapidly access phonological information that is stored in long-term memory was first introduced as a way of predicting and understanding individual differences in reading ability; typically, it requires the child to name, as rapidly as possible, a series of 30 to 50 items (digits, colors, letters, or objects) printed on a page. Individual differences in the speed with which children can name these types of items in kindergarten is strongly predictive of later differences in the rate at which they acquire word-reading skills in first grade and beyond. (p.276)

Phonics instruction has evolved over the past 200 years from simply being a sound-out method for letters and words to today's more complex system of phonemes and blended sounds.

Phonics instruction was one of the first methods of reading instruction; it fell out of favor with experts, and then regained its popularity both as a useful method and as a component part of whole language (Torgesen & Wagner, 1994).

Today, phonics instruction can be seen with flash cards, on video-based tapes, and as computer-assisted educational programs. Studies have provided evidence that phonics instruction can be used when traditional methods fail with students who are below average and with low socioeconomic students (Jeynes & Littell, 2000). Reading is considered the most basic of educational skills. Recent studies and government reports show that an educational life quality and economic impact will negatively affect those individuals without basic literacy skills (Jeynes & Littell; Torgesen & Wagner, 1994).

Is There One Best Method to Teach Reading?

The subject of whole-language versus phonics as the best method of reading instruction has been debated for many years. In her 1967 book, *Learning to Read,* Chall (1967) referred to the whole language and phonics dilemma as the "great debate." Today, educational leaders in states and school districts understand that the two methods of reading instruction can be used together. Collins (1997) argued, "About 70% of children can learn to read no matter how you teach them, but they will read more quickly if they are taught phonics, and without phonics the remaining 30% may have real problems" (p. 78).

Hancock and Wingent (1996) discovered that the most successful schools were those that compromised, blending the best of phonics and whole language. The researchers found that teachers at Rosendale Elementary School in Niskayuna, New York, realized that whole language methods were not enough without daily phonics; therefore, they developed a system combining the two. The researchers reported that after just two years, the number of children needing remedial reading was reduced considerably.

In the past, state departments of education and state boards of education have adopted whole language reading programs. Because of declining test scores, this practice is declining.

Educators in Florida and California have become leaders in revamping the whole language curriculum to include sections of phonic skills (Hollis, 1996). Many learners who have problems with traditional reading instruction have had success with programs that include phonics. African Americans, students who speak English as a second language, low socioeconomic students, and students with special needs demonstrated positive improvements when phonics instruction was added to the regular reading curriculum (Collins, 1997). Therefore, the debate about whole language versus phonics instruction in teaching reading should be considered as two successful instructional approaches that are best used together to promote success for all.

The Need for Effective Reading Instruction

On January 9, 2002, President George W. Bush signed into law the No Child Left Behind (2002) legislation. The law was a reauthorization of the 1965 Elementary and Secondary Education Act. No Child Left Behind was a comprehensive (1,080 pages) law designed to ensure accountability, flexibility, and choice in American schools. This legislation authorized $26.5 billion for kindergarten through 12th-grade education programs in 2002 alone. The law specifically authorized monies for reading programs. In 2001, $410 million was available for reading programs; in 2002, the money for reading increased to $1.24 billion (NEA Today Online, 2002).

A National Assessment of Educational Progress (1999) report stated that 40% of fourth graders could not read at the most basic level. Researchers for *First Book*, a national nonprofit organization dedicated to the distribution of books to low-income children, observed, "A lack of basic reading skills will follow students through their school years into their adult lives. Adults with the lowest literacy skills earn a median income of $240 per week, compared to $681 for people with literacy skills" ("Magnitude--Facts on Illiteracy," 2003, ¶ 5). The National Assessment of Educational Progress report also noted that 44% of U. S. students in elementary and high school read below the basic level, meaning they exhibited little or no mastery of the knowledge and skills necessary to perform work at each grade level. Among minorities, the

statistics were even more tragic. On average, African American and Hispanic children scored four grade levels below their Caucasian peers on reading tests.

Another group identified as having problems with basic reading skills was children who were considered low-socioeconomic status. These children started school with disadvantages that their middle and upper income peers did not have. McQuillan (1998) reported,

> Of low-income families, 61% have no books at all in their homes for their children. Children in middle-income homes have been exposed to 1,000 to 17,000 hours of one-on-one picture book reading, compared to low-income students who have only been exposed to 25 hours. (¶ 8)

Because of students' varying abilities, their problems with understanding, and problems they bring to school from home, educators must employ a variety of methods and strategies to teach reading. George W. Bush in his No Child Left Behind (2002) legislation has set a goal that all students will read on grade level by 2012. In order to meet this goal, educators will have to modify their current methods of teaching reading and identify new resources to help students who need additional help.

Computer-Assisted Instruction

The *Fast ForWord*® reading program is a computer-based learning system that uses phonics and word games with graphics similar to a video game to engage and interest students in becoming better readers. To better understand the computer's role in the modern classroom, a history of the computer, the manner in which computers have been used in the classroom, and guidelines that have been developed for the computer's use in reading instruction will follow.

The history of the modern computer is a relatively short one going back about 50 years. Two of the first computers developed were the MARK in 1944 at Harvard and the ENIAC in 1946 at the University of Pennsylvania (Levien, 1980). These early computers were used primarily for problem solving with math, science, and engineering. In 1959, the University of Illinois began using Programmed Logic for Automatic Teaching Operations (PLATO) that was the first large-scale project involving computers for education. The project placed terminals,

used by undergraduates, in elementary schools and community colleges and campuses around Chicago that were used for reading instruction (Molnar, 1997).

Molnar (1997) gave details of a computer-assisted instruction program that Suppes and Atkinson established in 1963 at Stanford University. Their program focused on mathematics and reading, subjects that could provide students with rapid feedback for individualized instruction. The program was considered a form of drill-and-practice instruction for mastery.

By 1975, the development of the microcomputer made low-cost personal computers available for the office, the classroom, libraries, laboratories, and the home. The 1980s resulted in the development of sophisticated color graphics and new technologies like the CD-Rom for storage and easy distribution of software (Becker & Hativa, 1994).

According to Vargas (1986), the development of educational software occurred in four primary areas:

1. Drill-and-practice--to increase speed and accuracy on academic skills
2. Simulations--to enable students to make determinations and decisions that are similar to those they would make in actual situations
3. Tutorials--to provide students with text, pictures, or graphics about a subject (usually followed by a test over the material)
4. Writing and creating--to promote creativity and provide frameworks for students to develop and design ideas. (p. 738)

In the 1980s, the development of supercomputers allowed scientists and educators to work on problems and complete simulations in very little time. In 1984, the National Science Foundation established five supercomputer centers and connected them with high-bandwidth connections so the computers could communicate with other computers. Infrastructures were developed so that high schools, colleges, and universities could be linked to research centers and laboratories through the Defense Advance Research Projects Agency's network that would later be known as the Internet (Office of Science and Technology Policy, 1992).

During the 1990s, the Internet Dot-Com section of the economy highly influenced the stock market while it was at its highest point in history. The Internet provided a venue to buy, sell, and operate in ways never before imagined in business. Software developers were able to

create new and innovative programs that helped with special education, regular education, and with reading instruction. Researchers at new companies, such as Scientific Learning Corporation (2003), were creating software for specific markets like phonics-based reading instruction. The economic boom of the 1990s promoted research and competition in both hardware and software production.

The education community engaged in three phases of computer use in the 1990s. The first phase was computer literacy, in which users were asked to gain computer awareness and learn basic computer programming. Educators in the second phase considered computers as a method to solve such problems as depletion of the ozone or how injuries occur in automated crashes. In the third phase, computer-users addressed issues through applications in support of the curriculum (Reinking, 1998). The computer is currently used by students in both group and individual instruction. In 1993, Simic suggested five guidelines for computer-assisted reading instruction:

1. Computer instruction in reading should focus on meaning and stress reading comprehension.
   a) Learners should have opportunities to work with whole, meaningful texts. Programs that offer learners a chance to process large chunks of related text, rather than bits and pieces of unrelated language fragments, allow students to use and extend what they know about reading comprehension.
   b) Learners should have opportunities to work with word-recognition programs that stress the use of word meanings in conjunction with phonics and structural analysis. Care must be taken to make sure that when programs feature the study of individual words and phrases, they are offered within a contextual framework that help them make sense to the learner. Assessment programs for teachers should also be provided in meaningful context.
   c) Learners should have the opportunities to apply the skills being taught in some meaningful way. Programs that deny the learner an opportunity to make use of what is being 'taught' are merely assessment tools and do little to further the learner's growth. Learners should have the opportunity to work with computer materials that use content and language that are within the range of their conceptual development. Tasks should be challenging but not frustrating. Student interests, previous experiences, and purpose play a role in determining whether or not a computer task is comprehensible and worthwhile.
   d) The use of the computer in reading instruction should promote active involvement and stimulate thinking in the student. The learner should be involved and allowed to make decisions that control or influence the computer task. The program should have an assessment activity that allows the learner to self-check

his or her work for errors to promote independent learning.

e) The use of the computer in reading instruction should support and extend the learner's understanding of text structures. Students should be provided with a variety of text structures that they could use to apply and refine their comprehension skills. The program should include narrative and expository structures designed by a variety of sources that promote reading comprehension. Students should be provided with opportunities to experiment with the text in ways that foster their creativity. Allowing students the freedom to change the format and style will strengthen their abilities in the structuring of text.

2. Computer instruction in reading should foster active involvement and stimulate thinking.
   a) Learners should have opportunities to discuss the purpose of the computer task or program as well as its nature. They should be aware not only of what they are supposed to do, but also of why doing it is important.
   b) Learners should have opportunities to make decisions that control or influence the computer task. Programs that build in opportunities for students to make choices and test predictions help them learn to think and act on their own rather than merely react to someone else's thinking.
   c) Learners should have opportunities to monitor their own learning. Tasks that offer students opportunities to self-check and correct their own errors support the development of independent learners.
3. Computer instruction in reading should support and extend students' knowledge of text structures.
   a) Learners should have opportunities to encounter a wide variety of text structures upon which to apply and refine their comprehension skill. A variety of narrative and expository structures should be provided. Commercially prepared, teacher-authored, and student-authored materials should also be included. Reading instruction can take place through all kinds of computer-based materials, not merely those designated specifically for that purpose.
   b) Learners should have opportunities to experiment with text in creative ways to suit their purposes. When students reorganize a story or an informational piece on the computer, they are employing and strengthening what they know about the structure of texts.
4. Computer instruction in reading should make use of content from a wide range of subject areas.
   a) Learners should have opportunities to use the computer as a means of applying reading strategies to all areas of the curriculum. Programs related to science, social studies, and math require the use of strategies for reading comprehension.
   b) Unless students are being helped to use what they know about reading comprehension under these circumstances, they are not progressing ass competent readers.
   c) Learners should have opportunities to use the computer in conjunction with other modes of instruction. The computer should not operate as a separate and isolated means of learning. Its use should be integrated with that of books and other learning materials. Students need to think of the computer as one additional means of sharing and retrieving information and practicing skills in interesting

and meaningful ways.

5. Computer instruction in reading should link reading and writing.
   a) Learners should have opportunities to create text with the computer for sharing and use by others. When students enter information into the computer for someone else to retrieve and use, they must compose with the reader in mind. This frequently involves making explicit use of what they know about what makes a text comprehensible. Revision and proofreading strategies clearly involve the combined application of reading and writing skills. (n. p.)

Assessment of Students' Performance

In 1990, the state of Tennessee began implementing the Tennessee Comprehensive Assessment Program (TCAP) to measure students' performance in reading, language arts, science, and social studies in grades two through eight (Sanders, 1998). In 1992, the Tennessee State Legislature voted to expand the testing program to include what is known as the Tennessee Value-Added Assessment System (Tennessee Department of Education, 1999). A group of researchers at the University of Tennessee under the direction of Sanders developed a statistical model that used scaled scores from the TCAP to create a profile of academic growth for individual students. The TCAP did not use stanines or percentile scores that are commonly used to report norm referenced test results; instead, they used scaled scores because they can indicate a student's current level of academic attainment. Although this method is controversial, these test scores are compiled over years and are used to establish student profiles of past and future academic growth. Sanders reported, "By statistically aggregating the dimples and bubbles, the assessment tool can be used to determine the impact of school systems, individual schools, and individual teachers" (p. 341).

To establish a baseline score for students and to assess the relationship to expected gain, this study used the TCAP test results. The test was developed by CTB/McGraw-Hill (1997) for the State of Tennessee to evaluate students' performance in several academic areas. The *TerraNova* Standardized Assessment test was chosen because of the high degree of alignment with the state curriculum framework (Tennessee Department of Education, 2001). The Tennessee test has a second component called value-added; these scores provide information that

allow comparisons for time on task and level of performance. This component allows parents, educators, and leaders to look at past and current scores to determine the amount of academic growth that has occurred with students. Value-added scores provide projections as to the amount of attainment students should achieve in one academic year (Sanders, 1998).

History of Fast ForWord®

To better understand the physiological basis for the *Fast ForWord®* reading instruction program, the past work of some of its developers must be considered. Merzenich (2001) received his doctorate from John Hopkins University. He completed his doctoral dissertation by studying "psychophysical and physiological approaches in human and macaque monkey models to address issues of sensory coding" (p. 881).

In 1971, Merzenich moved to the University of California at San Francisco where he was appointed director of the Coleman Laboratory (Merzenich, Byers, White, & Vivion, 1980). While there, his research included studying the "basic features of functional organization of the auditory system" (p. 361). Working with an engineer from Beckman Corporation, Merzenich developed one of the first single-channel Cochlear implants. The team studied patterns of acoustic inputs using their new prosthetic device. These studies provided the researchers with information about how people who were deaf reacted when devices were used to restore hearing. The single channel device was later modified by Advanced Bionics Corporation into a multi-channel device that is now implanted into 200 deaf patients each year (Merzenich, 2001). In 1978, Merzenich, along with colleagues at Vanderbilt University, developed theories in plasticity while working with auditory, somatosensory, and motor cortices in experiments following peripheral or central brain damage (Merzenich, Kaas, Sur, & Lin, 1978).

In the early 1990s, Merzenich and Jenkins joined Tallal, of Rutgers University, who was studying how language-impaired children have problems processing "rapidly successive acoustic and overall speech stimuli" (as cited in Merzenich et al., 1996, p. 78). The group examined the phenomena of how infants born with problems could have their deficits reversed with

appropriate intensive training. Working together, the researchers devised a training program (*Fast ForWord*®) that quickly demonstrated large-scale improvements in speech-reception and language-usage abilities of children with language impairments that, consequently, might enable the initiation of more successful reading. Considering that the new program might benefit millions of children, the group founded Scientific Learning Corporation (2003). The corporation expanded the potential consumers of *Fast ForWord*® to include children and adults with physical problems, developmental disorders, and individuals who were identified as having a learning disability.

The concept that led to the development of the *Fast ForWord*® program for reading instruction came from experiments demonstrating that children with language impairments were incapable of perceiving auditory information at a normal rate, and that this constraint on speed of auditory processing could underline language impairment. The problem is reported to exist because of a deficit in processing acoustic signals entering the nervous system in rapid succession (Tallal, Miller, & Fitch, 1993).

Fast ForWord® was designed to use amplification of particular frequencies, modified time durations of stimuli, and phonemes. According to Scientific Learning Corporation (2003), the number of frequency alterations and timed stimulus is reduced with each successful lesson until the participant is hearing natural, unmodified speech at the end of the *Fast ForWord*® lessons. Students receive immediate feedback for generating correct and incorrect responses. When a child responds incorrectly, there is an auditory cue and the correct response is provided. When the student chooses the correct response, he or she is awarded points, short songs, and extra animations (Scientific Learning Corporation).

The program is divided into seven computer exercises, three sound exercises (circus sequence, old McDonald's flying farm, and phoneme identification), and four word exercises (phonics words, phonics math, block commander, and language comprehension builder) (Scientific Learning Corporation, 2003). The company recommends that students be given five

of the seven exercises each day for periods of 20 minutes each. Each child continues the training program until he or she has a 90% completion on any five of the seven exercises. The company anticipates that the student will gain from one to one- and one-half years of reading improvement in four to eight weeks of the *Fast ForWord*® intervention (Scientific Learning Corporation). The developers of *Fast ForWord*® reading instruction stated, "The computer-based intervention leads to neural reorganization that causes an increased ability to perceive rapidly changing acoustic input" (Merzenich et al., 1996, p. 77).

The new understanding of brain plasticity has pushed researchers to develop new programs that can be used to treat many learning disorders. The new understanding also opens possibilities that the training can be used to treat other conditions and impairments that will benefit all humankind.

In a 1997 *Nature* article (Wright et al., 1997), several scientists explored the relationships in children with auditory deficits who were language impaired. The team reported, "Between 3% and 6% of children who are otherwise unimpaired have extreme difficulties producing and understanding spoken language" (p. 8). The researchers were exploring whether the problems with language were related to cognitive processing or if they were the result of the children not being able to distinguish sounds in speech. After evaluating the students with both psychological and physical tests, the researchers concluded, "Children with specific language impairments have severe auditory perceptual deficits for brief but not long tones in particular sound contexts" (p. 8). The team concluded that language difficulties were caused by problems with auditory perception in children. The process of lengthening the short sounds in language is how the developers of *Fast ForWord*® consider their program will benefit children who have language impairments.

In the *Fast ForWord*® game "Bug Out," a computerized voice slowly pronounces syllables of words while the corresponding words crawl across the screen on beetles. The child tries to shoot the bugs; the faster the child responds, the faster the bugs crawl. This process retrains the child's brain to work at faster speeds. Educators report that the students love it; they

eagerly use the computer programs to play. The computers at schools are connected to Scientific Learning Corporation's (2003) network. The company can daily analyze a student's performance and red flag any problem they might identify. It is recommended that students work 100 minutes a day for six weeks. This allows larger numbers of students to use the program in a short time (Fischman, 2001).

Research on Fast ForWord®

In the fall of 1997, The Callier Center for Communication Disorders located on the campus of the University of Texas at Dallas, started using the *Fast ForWord®* language program (Turner & Pearson, 1999). The members of the staff who were speech-language pathologists were trained and certified by Scientific Learning Corporation. Staff members identified participants after they scored below normal range on standardized tests including the Test of Language Development (TOLD), Test of Language Comprehension, and the Preschool Language Scale-3 (PLS-3). The children at the Callier Center used the *Fast ForWord®* program for "one hour and forty minutes per day, five days a week, for a six to eight week period" (p. 4). Four students were identified by the staff members as candidates for the *Fast ForWord®* program and were included in four individual case studies by the center (Turner & Pearson).

Case study one was a male, six years old, who had been identified with a severe speech-language delay at age three. The participant was evaluated with the Clinical Evaluation of Language Fundamentals-3 (CELF-3) on which he scored a 73, "two standard deviations below normal limits for his chronological age range" (p. 5). On the first day using the *Fast ForWord®* program, the participant scored 10% on Block Commander, 12% on Phonic Math, and 3% on Circus Sequence. After 13 days of using *Fast ForWord®*, the participant scored 68% on Block Commander, 94% Phonic Math, and 60% on Circus Sequence. On his final day using *Fast ForWord®*, he scored 73% on Block Commander, 94% on Phonic Math, and 95% on Circus Sequence. His mother reported that he "made telephone calls for the first time and created

invitations to a slumber party at his house with his friends" (p. 7). The center reported that prior to using *Fast ForWord®*, the participant used sentence fragments and after the program, he was using complete sentences (Turner & Pearson, 1999).

Case study two was an 11-year-old male who was born to a mother suspected of abusing drugs and/or alcohol during pregnancy. After neglect was alleged, the child was placed in foster care and later adopted. Earaches from birth to age three resulted in surgery and tubes being placed in both ears. At age eight, he was diagnosed with Attention-Deficit/Hyperactivity Disorder, and prescribed medication. After two weeks using *Fast ForWord®*, this participant scored 74% on Block Commander, 72% on Phonic Math, and 0% on Circus Sequence. After four weeks using the program, he scored 71% on Block Commander, 91% on Phonic Math, and 10% on Circus Sequence. On his last day using the program, this participant scored 96% on Block Commander, 94% on Phonic Math, and 20% on Circus Sequence. The speech-language pathologist who had treated this participant reported "a significant improvement in his expressive language and semantic abilities after he completed the *Fast ForWord®* language program" (Turner & Pearson, 1999, p. 10).

Case study three was a 13-year-old male who had been diagnosed with "language-learning disabilities and dyslexia" (Turner & Pearson, 1999, p. 11). After one week using *Fast ForWord®*, he scored 96% on Block Commander, 54% on Phonic Math, and 18% on Circus Sequence. After his second week, participant three scored 97% on Block Commander, 94% on Phonic Math, and 28% on Circus Sequence. On his final day using the program, he scored 96% on Block Commander, 95% on Phonic Math, and 47% on Circus Sequence. According to posttesting information, participant three improved in his auditory processing from below normal limits on the Goldman-Fristoe Woodcock Auditory Discrimination Test to within normal limits on the Scan-A. Scores on the Peabody Picture Vocabulary Test-III increased from below normal limits into the high average range (Turner & Pearson).

Case study four was a 12-year-old male. A private school had referred the participant to

the center specifically for *Fast ForWord*® intervention. Participant four had been reported as having "an inability to communicate clearly with difficulty following directions" (Turner & Pearson, 1999, p. 14). Participant four had been diagnosed with "Attention-Deficit Disorder and was receiving medication" (p. 14). The participant had scored "significantly below normal limits on all subtests on the Test of Language Development" (p. 16). On his first day using *Fast ForWord*®, this participant scored 16% on Block Commander, 11% on Phonic Math, and 5% on Circus Sequence. After using *Fast ForWord*® for six days, he scored 97% on Block Commander, 53% on Phonic Math, and 34% on Circus Sequence. At the end of the program, participant four scored 98% on Block Commander, 95% on Phonic Math, and 91% on Circus Sequence. The center reported that "subtests that were extremely delayed during the pretesting were now within normal limits" (Turner & Pearson, p. 16).

The results of these four case studies completed at the Callier Center showed that each student reacts differently and progress must be looked at individually to further understand *Fast ForWord*®. The Callier Center reported that their results were "similar to those obtained by the Scientific Learning Corporation with their own field experiments and clients" (Turner & Pearson, 1999, p. 16).

The availability of research on *Fast ForWord*® is limited. The program is relatively new and, therefore, has not been subjected to the numerous research studies and test of time standards as other programs. In addition, the cost of the program and software limits its use in both public and private sectors. The website for Scientific Learning Corporation provides only basic information on one large study and two smaller ones conducted for the company that are used in their marketing material (Scientific Learning Corporation, 2003).

In one study, seven children between the ages of five and nine with language disorders and reading difficulties participated in computer-aided activities that used acoustic modification with gradual normalization for three hours each day, five days per week, for four weeks. The participants used the *Fast ForWord*® video game style program called "Circus Sequence" and

"Phoneme Identification" along with individualized instruction on eight language progressing tasks (Scientific Learning Corporation, 2003). In addition, they used audio-based acoustically modified prerecorded stories in their homes for one to two hours per day. Five of the seven participants' performance on *Fast ForWord*® exercises improved substantially over the treatment period (Scientific Learning Corporation). The participants' performance on norm-referenced tests of speech discrimination and language comprehension improved significantly. The study's researchers also found that changes in temporal processing (evaluated by performance on a nonverbal auditory sequential perception task) were highly correlated with posttest performance in language comprehension (Merzenich et al., 1996).

The website noted a second study with 22 participants between the ages of 5 and 10 with language and reading impairments. In the study, they were matched for age, nonverbal intelligence, and receptive language skills. They were then randomly assigned to groups. Group one used the *Fast ForWord*® program's circus sequence, phoneme identification, Old McDonald's flying farm, and phonics match that had acoustically modified signals. The second group used the same four *Fast ForWord*® programs that had unmodified acoustic waveforms, or natural speech. Both groups received additional individual language instruction and homework. Participants in both treatment groups showed significant improvements in speech discrimination, memory, and receptive language skills after four weeks of daily training, but those who completed the activities using acoustically modified signals demonstrated significantly greater gains (about two years growth) that were maintained six weeks later (Scientific Learning Corporation).

The results of large-scale field trials of the entire *Fast ForWord*® program are available on the Scientific Learning Corporation (2003) website, but they have not yet been published in peer-reviewed journals. Scientific Learning Corporation reported that in their first field trial, over 500 children with language comprehension deficits between 4 and 14 years of age received *Fast ForWord*® from 63 specifically trained clinicians at 35 sites in the United States and

Canada. The children varied in their diagnosis and severity of disability, but according to Tallal, Miller, Jenkins, and Merzenich (1997), approximately 90% of the participants achieved a gain of about one standard deviation on one or more norm-referenced test of auditory perception and discrimination and oral language development.

In 2001, the *American Journal of Speech-Language Pathology* published several articles in the August issue that examined the *Fast ForWord*® program. Gilliam, Crofford, and Hoffman (2001) reported on a small study where they compared *Fast ForWord*® with Laureate Learning System software:

> The study was designed to evaluate functional language changes during and after treatment with language intervention software. Two students with language impairments were provided interventional programs using *Fast ForWord*® and two students were given laureate learning systems language programs. All four children received 100 minutes of intervention each day for 20 days. Progress in language skill gains were measured using the Oral and Written Language Scales (OWLS). All four children made clinically significant gains (post-test scores outside the 95% confidence interval of the pre-test scores) on the OWLS. (p. 233)

In addition, as reported in the August 2001 *American Journal of Speech-Language Pathology*, Loeb, Stoke, and Fey (2001) measured language changes of four children after training with *Fast ForWord*®. These researchers evaluated *Fast ForWord*® by measuring the language changes of the four students who received the program in their homes. The evaluation occurred immediately after the intervention and three months later using standardized language measures, spontaneous measures of syntactic complexity, reading measures, pragmatic measures, and parent and teacher reports. Three of the four children successfully completed FFW-L and all made gains on some of the same standardized measures used by Tallal et al. (1997), although the improvements observed were generally smaller than those previously reported (Loeb et al.). Of the 595 items assessed at pretest and posttest, significant positive change occurred on 58, or 10% of the items. The use of *Fast ForWord*® at home may lead to improvement on structured tasks, but the improvement may not be long lasting.

Summary

This chapter began with a review of the historical methods of teaching reading in America. Students in colonial America learned to read with the Bible and Noah Webster's blue-backed speller. They were taught to read by word recognition and through learning the speech sounds of the alphabet. Great educators like Mann, and later Dewey, recommended wholistic methods of instruction that promoted reading for pleasure. A new series emerged like the *Dick and Jane* readers [Gray] that were used for many years. The most recent reading method uses more comprehensive methods that combine multiple instructional strategies to reach learners with different learning styles.

Whole language instruction was examined and found to contain a variety of instructional practices that promote readers to learn whole groups and units of words in context of sentences and stories. The reviewer found several definitions of whole language, but the basic principle of the method was found in learning to read through word identification and through context clues.

Phonics instruction can best be described as a sound-out method for letters and corresponding sounds. Very basic sound-out methods were used in colonial America several hundred years ago. Today, phonics is used on flash cards, on video-based tapes, and through computer-assisted instruction. Newer methods go beyond the phonemes and blended sounds into changing the speed and rate of delivery of these sounds to increase comprehension.

The question, "Is there one best method to teach reading?", includes the ongoing debate over whole language and phonics. The conclusion reached by many researchers of reading instruction calls for a balanced program where both methods are used, but students identified with reading problems should be remediated with an intense phonics program to provide success.

The need for effective reading instruction is vital during the school years and for success later in life. Many educators consider that a basic ability to read can be the single most important factor in the scholastic success of students. Literacy can affect the total quality of life through employment opportunities, range of salaries, and ability to communicate and transact the most basic of business experiences.

Computer-assisted instruction is the concept that instruction can be delivered through technology that will allow teachers to use material that is specifically matched with the abilities and needs of the student. There are several types of computer-assisted instruction that promote learning through drill and practice, simulations, tutorials, and frameworks that promote creativity in writing. The development of new technologies and the reduction in price of personal computers have made computer-assisted instruction more available in both the school and in the home. Information on the Internet and the development of new educational software continue to expand the application of computers in the classroom. New programs like *Fast ForWord*® use color and video game style graphics to hold the attention span of learners.

Education reform on both the national and state levels continues to push the concept of accountability. To measure students', teachers', and school systems' performances, leaders are using standardized test scores to evaluate effectiveness. The state of Tennessee uses the *TerraNova* Standardized Assessment test to measure students' performance in both elementary and middle schools. In this study, Grainger County Schools' scores in the areas of reading will be used to establish a relationship between the use of the *Fast ForWord*® reading program and changes in standardized test performance for third and fourth graders based on the test scores of 2002 and 2003.

Fast ForWord® is a new reading program that uses computer-assisted instruction and intense phonics training to increase reading ability and comprehension. The developers of *Fast ForWord*® have studied the use of modification on the speed and volume of recorded audio instruction to provide phonemic reading instruction.

A very limited review of research on the *Fast ForWord*® program was included. The *Fast ForWord*® program is so new and in such limited use, that considerable data on its effectiveness is not currently available. The majority of information about *Fast ForWord*® is available only from Scientific Learning Corporation's (2003) Website.

CHAPTER 3

RESEARCH METHODOLOGY

The purpose of this study was to determine if a relationship existed between time spent on Scientific Learning Corporation's (2003) *Fast ForWord*® reading program as a supplement to traditional reading instruction and reading achievement as measured by the *Terra Nova*, a standardized achievement test used in Tennessee for testing elementary school students. The Grainger County, Tennessee, public schools implemented the *Fast ForWord*® reading program in fifth and sixth grades in three of its four elementary schools during the 2002-2003 school year.

Research Design

Recent state and federal mandates require schools to be accountable for students' test scores, but is there any evidence that the *Fast ForWord*® reading program supports better achievement for students' success in reading? The study used a quasi-experimental design through the use of a nonequivalent control group design. The purpose of this study was to determine if there were differences in the academic achievement of students enrolled in the *Fast ForWord*® reading program. Scores obtained by students in the fifth and sixth grades in Grainger County were compared with scores from the two previous years of standardized achievement test scores to examine the use of *Fast ForWord*®. This design was similar to the pretest/posttest control group design. The difference was that nonequivalent control group design involves assignment of intact groups to treatments, not random assignment of individuals (Gay & Airasion, 2003). The study used as the research group individuals who had taken the 2001, 2002 *Terra Nova* as a pretest, received the intervention (*Fast ForWord*®), then took the

2003 Terra Nova as posttest. The control group took the 2001, 2002, and 2003 Terra Nova but did not receive the intervention (*Fast ForWord*®). The inability to randomly assign individuals to treatments will add validity threats such as regression and interactions between selection, maturation, history, and testing" (p. 378). The groups came from the Grainger County Schools as intact groups and had similar qualities. If differences between the groups on any major extraneous variable were identified, "analysis of covariance [was] used to statistically equate the groups" (p. 378). In this study, achievement test scores were collected from the system reporting documents and comparisons were made for students who were enrolled in the *Fast ForWord*® reading program. I developed 11 research questions to act as a guide in completing the study:

1. What are the demographic characteristics of fifth- and sixth-grade students in the Grainger County Schools?
2. What level of performance exists for 2002-2003 students enrolled in the fifth and sixth grades in the Grainger County School System taking the *Terra Nova* test?
3. Do students who participate in *Fast ForWord*® score higher than students who did not participate in *Fast ForWord*® on the *Terra Nova* test while controlling for prior academic differences?
4. Are there gender differences in the performance on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*?
5. Is there a gender by intervention interaction?
6. Are there school differences in the performance on the 2003 *Terra Nova* while controlling for the 2001, 2002 *Terra Nova*?
7. Did students who received free or reduced meals score higher than students who do not receive free or reduced meals on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*?

8. Is there a socioeconomic status (free and reduced meals and paid meals) by intervention (participation in *Fast ForWord*® and no participation in *Fast ForWord*®) interaction?
9. Do students who receive *Fast ForWord*® early in the year perform differently on the 2003 *Terra Nova* than students who receive *Fast ForWord*® later in the year while controlling for the 2001 and 2002 *Terra Nova*?
10. Dividing the students in 4 ability groups (1st, 2nd, 3rd, and 4th quartiles) based on their 2002 *Terra Nova* scores, are there ability group differences on the performance of the 2003 *Terra Nova* while controlling for the 2001, 2002 *Terra Nova* scores?
11. Is there an ability group (grouping for each subject on the 2002 *Terra Nova*) by intervention (participation in *Fast ForWord*® and no participation in *Fast ForWord*®) interaction on the 2003 *Terra Nova* while controlling for the 2001, 2002 *Terra Nova*?

From the research questions, the following hypotheses were developed:

Ho3: There is no difference in the performance of students who received *Fast ForWord*® and students who did not receive *Fast ForWord*® on the 2003 *Terra Nova* while controlling for the 2001 and 2002 test results.

Ho4: There is no difference in the performance of males and females on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

Ho5: There is no gender by intervention/interaction effect on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

Ho6: There is no difference in school performance on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

Ho7: There is no difference between those who received free/reduced priced meals and those who did not receive free/reduced price meals on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

Ho8: There is no significant difference in the performance of students who receive free/reduced/paid meals and their participation in the intervention (participation in *Fast*

ForWord®) in their scores on the *Terra Nova* test.

Ho9: There is no difference in performance on the *Terra Nova* test of students who received the *Fast ForWord*® reading program early in the school year and students who received *Fast ForWord*® reading program late in the school year.

Ho10: There is no difference in the performance of students on the *Terra Nova* who were in the 1st, 2nd, 3rd, and 4th quartiles after receiving the *Fast ForWord*® reading program.

Ho11: There is no ability group (X) interaction/intervention effect on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

Population

Students' scores on the *Terra Nova* Standardized Assessment Test were examined for students enrolled in the fifth and sixth grades in Grainger County who were enrolled in the system for their entire academic career. Students were eliminated from the study if they had transferred into the system from another county or state school system.

The population for this study included all students enrolled in the fifth and sixth grades in Grainger County who participated and who did not participate in the *Fast ForWord*® reading program.

Instrumentation

Test scores obtained by students in each of the four groups (1st, 2nd, 3rd, and 4th quartiles) were compared using the *Terra Nova Comprehensive Tests of Basic Skills* (CTB/McGraw-Hill, 1997). Tennessee's schools test students in grades three through eight each spring as part of the state mandated Tennessee Comprehensive Assessment Program. The objective of this test is to provide an accurate measure of basic academic skills. Content knowledge in subject areas is assessed as well as the application of such knowledge. The test uses multiple-choice questions and has established time limits. These multiple-choice questions are designed to evaluate higher

order thinking skills as required by state curriculum frameworks. The test format is similar to the one used on the National Assessment of Education Progress (Tennessee Department of Education, 1999).

The *Terra Nova* published by CTB/McGraw-Hill (1997) provides both norm-referenced and criterion-referenced information. The test uses the most recently available national norms from 1996. The use of norm-referenced information allows comparisons with a national sample of students. The use of summary reports presents results expressed as national percentiles. Median national percentile performance data are provided for reading, language, math, science, and social studies. The use of criterion-referenced information allows the comparison of students' achievement against a specific level of performance.

The test questions are designed to be visually stimulating using color and graphics to encourage students' involvement and to clarify test items. The math section involves problem solving that requires more reading comprehension. The reading section uses literature and articles from magazines and newspapers to stimulate students' interest. The test is reported to measure thinking, computational, and mechanical skills of students. Students in the third grade use the test booklet to record their answers and students in grades four through eight use a separate answer sheet (Tennessee Department of Education, 1999).

CTB/McGraw-Hill (1997) reported that the use of statistics has indicated the test as being both reliable and valid. The company conducted testing for standardization in the fall and spring of 1996. The public school samples were stratified by region, community type, size, and Orshansky percentile (an indicator of a district's socioeconomic status). Standardization and norming procedures as well as research studies addressing reliability and validity issues can be found in the *Tennessee Coordinates Handbook* (CTB/McGraw-Hill).

Data Collection

Prior to data collection, approval was obtained from the Institutional Review Board at East Tennessee State University. Oral permission was given by the technology coordinator and director of schools.

Data collection was proposed for June/July 2003 at the director's central office of the Grainger County School System. Reports provided to the school system by the testing service for the fifth and sixth grade were provided to the researcher with names and identifying information removed. Each student was given a coded identity to protect his or her privacy and to comply with state and federal regulations. Students' information included gender, special education status, free or reduced lunch status, and other information needed to conduct the study. The technology director served as the designated information officer to protect and further ensure the integrity of the study and the confidentiality of identities.

Normal Curve Equivalent Scores (NCES) were used as a source for data comparisons. These scores were used to calculate gains from one test to the next. The NCES is an interval score that can be treated arithmetically (Cannon, 2000). The NCES for reading were used to make comparisons for statistically significant differences.

Data Analysis

Descriptive statistics were used to provide a profile of the population. Data that were used for this study came from the *Terra Nova Comprehensive Tests of Basic Skills*. The data were analyzed using the Statistical Program from the Social Sciences (SPSS). The researcher requested the assistance of the research specialist (Dr. West) to use the appropriate *t*-test, ANCOVA.

CHAPTER 4

ANALYSIS OF DATA

The findings of the *Fast ForWord*® study are addressed in this chapter. The purpose of the study was to compare the academic achievements of students enrolled in Grainger County's school system who participated in the *Fast ForWord*® reading program and those who did not participate in the *Fast ForWord*® program. The scores of the students who participated in *Fast ForWord*® were compared with those who did not participate using a standardized test, the *Terra Nova Comprehensive Test of Basic Skills* (CTB/McGraw-Hill, 1997). The study focused on students' performance on the five subtests (reading, language, math, social studies, and science) as well as gender, ability grouping, school attended, test time, and socioeconomic status comparing students who received the *Fast ForWord*® program and those who did not receive the program. The students whose scores were compared in the study were fifth and sixth graders enrolled in the four elementary schools in Grainger County.

Eleven research questions were formulated to guide the investigation. The first research question called for a descriptive profile for the sample.

Research Question #1

What are the demographic characteristics of fifth- and sixth-grade students in the Grainger County Schools?

The population studied consisted of 446 students who were enrolled in the fifth and sixth grades at the four elementary schools in Grainger County, Tennessee. Demographic information of the population included gender, race, fifth graders, sixth graders, socioeconomic status (free or reduced meal recipients), and the school attended. Table 1 shows the demographic profile of the sample.

Table 1

Demographic Profile of the Sample

Classroom Structure and Gender	*F*	%
Gender		
Female	219	49.1
Male	227	50.9
Total	446	100.0
Race		
Caucasian	439	98.4
African American	2	0.4
Hispanic	5	1.1
Total	446	100.0
Grade 2003		
5^{th}	217	48.7
6^{th}	229	51.3
Total	446	100.0
Socioeconomic Status		
Free/Reduced	233	52.2
Paid	213	47.8
Total	446	100.0
School		
Bean Station	137	30.7
Joppa	94	21.1
Rutledge	141	31.6
Washburn	74	16.0
Total	446	100.0

Research Question #2

What level of performance exists for 2002-2003 students enrolled in the fifth and sixth grades in the Grainger County school system taking the *Terra Nova* test?

Table 2 presents the level of performance for each grade and subject comparing national percentiles, scale scores, and normal curve equivalents.

Table 2

Level of Performance for 2002-2003 Students in Fifth and Sixth Grades in Grainger County Schools

Subtest, Test Type, Grade	*n*	*M*	*Mdn*	*SD*
Reading 5th Grade				
NP 2003	217	51.55	56.00	27.065
Scale Scores 2003	217	650.25	657.00	35.758
NCE 2003	217	50.35	53.0	19.028
Reading 6th Grade				
NP 2003	229	54.77	58.00	26.309
Scale Scores 2003	229	664.31	669.00	38.819
NCE 2003	229	52.97	54.00	19.449
Language 5th Grade				
NP 2003	217	61.75	70.0	30.896
Scale Scores	217	666.42	671.00	44.486
NCE	217	58.91	61.00	23.835
Language 6th Grade				
NP 2003	229	65.55	73.00	28.790
Scale Scores	229	676.05	678.00	41.541
NCE	229	61.31	63.00	22.437
Math 5th Grade				
NP 2003	217	58.12	59.00	28.799
Scale Scores 2003	217	650.87	651.00	40.858
NCE	217	56.29	55.00	21.290

Table 2 (continued)

Subtest, Test Type, Grade	*n*	*M*	*Mdn*	*SD*
Math 6th Grade				
NP 2003	229	53.18	55.00	26.151
Scale Scores 2003	229	662.56	666.00	37.742
NCE 2003	229	51.90	53.00	18.669
Science 5th Grade				
NP 2003	217	51.84	50.00	23.661
Scale Scores 2003	217	653.72	653.00	33.444
NCE 2003	217	51.34	50.00	16.278
Science 6th Grade				
NP 2003	229	56.58	59.00	24.336
Scale Scores 2003	229	669.32	671.00	30.222
NCE 2003	229	54.17	55.00	15.896
Social Studies 5th Grade				
NP 2003	217	54.93	54.00	25.487
Scale Scores 2003	217	657.76	656.00	33.185
NCE 2003	217	53.51	52.00	17.596
Social Studies 6th Grade				
NP 2003	229	54.14	55.00	23.119
Scale Scores 2003	229	668.81	668.00	29.720
NCE 2003	229	52.92	53.00	15.579

Research Question #3

Do students who participate in *Fast ForWord*® score higher than students who did not participate in *Fast ForWord*® on the *Terra Nova* test while controlling for prior academic differences?

This question will use analysis of covariance. The analysis will look for differences in scale scores, comparing reading, language, math, science, and social studies scores of the 2003

Terra Nova while controlling for the 2001and 2002 *Terra Nova*.

The null hypotheses associated with this research question follow:

$Ho3_1$: There is no significant difference in the performance of students who received *Fast ForWord*® and students who did not receive *Fast ForWord*® in the reading section of the 2003 *Terra Nova* while controlling for 2001 and 2002 *Terra Nova*.

$Ho3_2$: There is no significant difference in the performance of students who received *Fast ForWord*® and students who did not receive *Fast ForWord*® in the language section of the 2003 *Terra Nova* while controlling for 2001 and 2002 *Terra Nova*.

$Ho3_3$: There is no significant difference in the performance of students who received *Fast ForWord*® and students who did not receive *Fast ForWord*® in the math section of the 2003 *Terra Nova* while controlling for 2001 and 2002 *Terra Nova*.

$Ho3_4$: There is no significant difference in the performance of students who received *Fast ForWord*® and students who did not receive *Fast ForWord*® in the science section of the 2003 *Terra Nova* while controlling for 2001 and 2002 *Terra Nova*.

$Ho3_5$: There is no significant difference in the performance of students who received *Fast ForWord*® and students who did not receive *Fast ForWord*® in the social studies section of the 2003 *Terra Nova* while controlling for 2001 and 2002 *Terra Nova*.

Analysis of covariance tests were conducted to determine if significant differences existed in the groups of students after some received *Fast ForWord*® and some did not. The 2003 *Terra Nova* tests were used to analyze results while the 2001 and 2002 *Terra Nova* was used to control for previous achievement.

Research Question #3 results of AVCOVA from the reading subtest are provided in Table 3 illustrating a comparison using scale scores for students who received *Fast ForWord*® and for students who did not receive *Fast ForWord*®.

Table 3

Comparison of Adjusted Means of Students Who Received the Intervention Fast ForWord® Reading Program and Those Students Who Did Not Receive the Intervention Fast ForWord® Reading Program.

Subtest	Intervention	*n*	*Adj. M*	*M*	*SD*	*F*	*p*
Reading Scale Scores 2003							
	No FFW	134	651.76	652.248a	38.276	11.257	. 001
	FFW	215	661.38	661.073a	35.442		
Language Scale Scores 2003							
	No FFW	120	660.30	664.072a	39.659	17.076	.000
	FFW	201	680.78	678.524a	41.377		
Math Scale Scores 2003							
	No FFW	134	655.76	654.938a	38.923	3.585	.059
	FFW	213	658.21	660.965a	37.751		
Science Scale Scores 2003							
	No FFW	134	656.91	659.374a	34.678	1.854	.174
	FFW	215	664.90	663.362a	29.991		
Social Studies Scale Scores 2003							
	No FFW	134	660.48	662.488a	35.504	1.854	.174
	FFW	215	666.04	664.783a	29.457		

$Ho3_1$: Reject the null hypotheses: There is a significant difference in the reading subsection scores for the 2003 *Terra Nova* for students who participated in the *Fast ForWord®* program and students who did not participate in *Fast ForWord®*.

$Ho3_2$: Reject the null hypotheses: There is a significant difference in the language subsection scores for the 2003 *Terra Nova* for students who participated in the *Fast ForWord®* program and

students who did not participate in *Fast ForWord*®.

$Ho3_3$: Retain the null hypotheses: There is no significant difference in the math subsection scores for the 2003 *Terra Nova* for students who participated in the *Fast ForWord*® program and students who did not participate in *Fast ForWord*®.

$Ho3_4$: Retain the null hypotheses: There is no significant difference in the science subsection scores for the 2003 *Terra Nova* for students who participated in the *Fast ForWord*® program and students who did not participate in *Fast ForWord*®.

$Ho3_5$: Retain the null hypotheses: There is no significant difference in the social studies subsection scores for the 2003 *Terra Nova* for students who participated in the *Fast ForWord*® program and students who did not participate in *Fast ForWord*®.

As shown in Table 3, the results of the analysis of covariance tests indicated that for the reading and language subsections of the 2003 *Terra Nova*, there were statistically significant differences in the groups who received the *Fast ForWord*® program and students who did not receive the *Fast ForWord*® program.

The students who received *Fast ForWord*® had a reading mean of 661.38 compared to those students not receiving *Fast ForWord*® who had a reading mean of 651.76. The analysis used the 2003 *Terra Nova* test (subsection reading), and used the 2001 and 2002 *Terra Nova* test (subsection reading) as a control for the test.

The students who received *Fast ForWord*® had similar results in the language subsection of the *Terra Nova* compared to students who did not receive *Fast ForWord*®. The students who received the *Fast ForWord*® program had a language mean of 680.78 compared to students who did not receive *Fast ForWord*® who had a language mean of 660.30. The analysis used the language subsection of the 2003 *Terra Nova* while controlling with the results of the 2001 and 2002 language subsection of the *Terra Nova*.

The analysis determined that in the math, science, and social studies subsections of the 2003 *Terra Nova*, there were no significant differences of scores of students who received the

Fast ForWord® reading program and students who did not receive the *Fast ForWord*® reading program.

The use of the five subsections of *Terra Nova* indicated that there were significant differences among the mean scores for reading and language that would cause the rejection of null hypotheses for $Ho3_1$ and $Ho3_2$ but that significant differences did not exist for the math, science, and social studies subsections thereby retaining the null hypotheses of $Ho3_3$, $Ho3_4$, and $Ho3_5$.

Research Question #4

Are there gender differences in the performance on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*?

This question used analysis of covariance for gender. The question compared the performance of boys and girls using the five subsections of reading, language, math, social studies, and science on the 2003 *Terra Nova* while controlling with the 2001 and 2002 *Terra Nova*. The null hypotheses associated with this research question were as follows:

$Ho4_1$: There is no significant difference in the test results for males and females who took the reading subsection of the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

$Ho4_2$: There is no significant difference in the test results for males and females who took the language subsection of the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

$Ho4_3$: There is no significant difference in the test results for males and females who took the math subsection of the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

$Ho4_4$: There is no significant difference in the test results for males and females who took the science subsection of the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

$Ho4_5$: There is no significant difference in the test results for males and females who took the social studies subsection of the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

Table 4 shows the results of ANCOVA for Research Question #4 comparing gender in the reading subtest using scale scores.

Table 4

Comparison of Adjusted Means of Reading Scale Scores by Gender

Subsection	Gender	*n*	*M*	*Adj. M*	*SD*	*F*	*p*
Reading Scale Scores 2003							
	Female	171	662.56	658.233a	34.999	.167	.683
	Male	178	653.01	657.159a	37.964		

Table 4 retained the null hypotheses; there was no significant difference in the performance of males and females on the reading subsection of the 2003 *Terra Nova*.

Table 5 shows the results of ANCOVA for Research Question #4 comparing gender in the language subtest using scale scores:

Table 5

Comparison of Adjusted Means of Language Scale Scores by Gender

Subsection	Gender	*n*	*M*	*Adj. M*	*SD*	*F*	*p*
Language Scale Scores 2003							
	Female	156	684.35	675.777a	37.940	2.055	.153
	Male	165	662.51	670.611a	43.165		

Retain the null hypotheses: There was no significant difference in the performance of males and females on the language subsection of the *Terra Nova*.

Table 6 shows the results of ANCOVA for Research Question #4 comparing gender in the math subsection using scale scores:

Table 6

Comparison of Adjusted Means of Math Scale Scores by Gender

Subsection	Gender	*n*	*M*	*Adj. M*	*SD*	*F*	*p*
Math Scale Scores 2003							
	Female	173	661.75	658.996a	34.130	1.249	.264
	Male	174	652.80	655.544a	41.420		

Retain the null hypotheses: There was no significant difference in the scores of females and males on the math section of the *Terra Nova*.

Table 7 shows the results of ANCOVA for Research Question #4 comparing gender in the science subtest using scale scores:

Table 7

Comparison of Adjusted Means of Science Scale Scores by Gender

Subsection	Gender	*n*	*M*	*Adj. M*	*SD*	*F*	*p*
Science Scale Scores 2003							
	Female	173	660.58	660.114a	33.073	1.440	.231
	Male	176	663.03	663.519a	31.078		

Retain the null hypotheses: There was no significant difference in the performance of males and females on the science subsection of the *Terra Nova*.

Table 8 shows the results of ANCOVA for Research Question #4 comparing gender in the social studies subsection using scale scores

Table 8

Comparison of Adjusted Means of Social Studies Scale Scores by Gender

Subsection	Gender	*n*	*M*	*Adj. M*	*SD*	*F*	*p*
Social Studies Scale Scores 2003							
	Female	171	663.60	661.742a	26.457	2.690	.102
	Male	177	664.19	665.983a	36.618		

Retain the null hypotheses: There was no significant difference in the performance of males and females on the social studies subsection of the *Terra Nova* test.

Research Question #5

Is there a gender by intervention interaction?

This research question examined the performance of the males and females and the interrelationship of participation in the *Fast ForWord*® reading program and their combined effects relating to the *Terra Nova* test. The null hypotheses associated with this research question were as follows:

$Ho5_1$: There is no significant difference in the performance of males and females nor is there a significant intervention (*Fast ForWord*® program) interaction for students taking the *Terra Nova* reading subsection.

$Ho5_2$: There is no significant difference in the performance of males and females nor is there a significant intervention (*Fast ForWord*® program) interaction for students taking the *Terra Nova* literature subsection.

$Ho5_3$: There is no significant difference in the performance of males and females nor is there a significant intervention (*Fast ForWord*® program) interaction for students taking the *Terra Nova* math subsection.

$Ho5_4$ There is no significant difference in the performance of males and females, nor is there a

significant intervention (*Fast ForWord*® program) interaction for students taking the *Terra Nova* science subsection.

$Ho5_5$ There is no significant difference in the performance of males and females nor is there a significant intervention (*Fast ForWord*® program) interaction for students taking the *Terra Nova* social studies subsection.

Table 9 presents the results of the gender by participation interaction (participation in *Fast ForWord*®) in the overall ANCOVA, with the 2003 *Terra Nova* reading subtest scale scores as the dependent variable while controlling for the 2001 and 2002 scores. This interaction test was embedded within the overall ANCOVA comparison of adjusted means for fifth- and sixth-grade students, with main effects for gender and participation status. Only the interaction test is shown in the table.

Table 9

Results of ANCOVA: Comparisons of Adjusted Means of Gender and its Interaction With the Intervention (Participation in Fast ForWord®)in the Reading Subtest

Subsection Intervention	Gender	*n*	*M*	*Adj. M*	*SD*	*F*	*p*
Reading Scale Scores 2003							
No FFW	Female	71	653.73	652.548a	34.565	.097	.755
	Male	63	649.54	651.903a	42.242		
FFW	Female	100	668.82	662.305a	34.106		
	Male	115	654.90	660.006a	35.454		

Retain the null hypotheses: There was no significant difference interaction between gender and participation in the *Fast ForWord*® program.

Table 10 provides results for Research Question #5 and shows the relationship between gender and its interaction with the intervention (participation in *Fast ForWord®*) in the language subtest using scale scores.

Results of ANCOVA: Comparison of adjusted means for fifth- and sixth-grade students examining males and females, and the interaction of the *Fast ForWord®* reading program using the 2003 *Terra Nova* while controlling with the 2001 and 2002 test results in the language subsection.

Table 10

Results of ANCOVA: Comparisons of Adjusted Means of Gender and its Interaction With the Intervention (Participation in Fast ForWord®)in the Language Subtest

Subsection								
	Intervention	Gender	*n*	*M*	*Adj. M*	*SD*	*F*	*p*
Language Scale Scores 2003								
	No FFW	Female	61	668.21	666.606a	35.607	.032	.858
		Male	59	652.12	661.185a	42.206		
	FFW	Female	95	694.71	682.122a	34.997		
		Male	106	668.29	675.448a	42.798		

Retain the null hypotheses: There was no significant difference between males and females who participated or did not participate in the *Fast ForWord®* program on their language subsection of the *Terra Nova*.

Table 11 provides results for Research Question #5 and shows the relationship between gender and its interaction with the intervention (participation in *Fast ForWord®* in the math subtest using scale scores.

Results of ANCOVA: Comparison of adjusted means for fifth- and sixth-grade students

examining males and females, and the interaction of the *Fast ForWord*® reading program using the 2003 *Terra Nova* while controlling with the 2001 and 2002 test results in the math subsection.

Table 11

Results of ANCOVA: Comparisons of Adjusted Means of Gender and its Interaction With the Intervention (Participation in Fast ForWord®)in the Math Subtest

Subsection Intervention	Gender	*n*	*M*	*Adj. M*	*SD*	*F*	*p*
Math Scale Scores 2003							
No FFW	Female	72	659.82	663.791a	36.774		
	Male	62	651.05	657.633a	41.075a		
FFW	Female	101	663.13	655.475a	32.231	.670	.414
	Male	112	653.78	654.481a	41.762		

Retain the null hypotheses: There was no significant difference between males and females who participated or did not participate in the *Fast ForWord*® program on their math subsection of the *Terra Nova*.

Table 12 provides results for Research Question #5 and shows the relationship between gender and its interaction with the intervention (participation in *Fast ForWord*® in the science subtest using scale scores.

Results of ANCOVA: Comparison of adjusted means for fifth- and sixth-grade students examining males and females and the interaction of the *Fast ForWord*® reading program using the 2003 *Terra Nova* while controlling with the 2001 and 2002 test results in the science subsection.

Table 12

Results of ANCOVA: Comparisons of Adjusted Means of Gender and its Interaction With the Intervention (Participation in Fast ForWord®)in the Science Subtest

Subsection Intervention	Gender	*n*	*M*	*Adj. M*	*SD*	*F*	*p*
Science Scale Scores 2003							
No FFW	Female	72	651.32	654.021a	37.156	5.522	.019
	Male	62	663.40	655.572a	30.583		
FFW	Female	101	667.19	664.481a	28.201		
	Male	114	662.87	662.382a	31.477		

Failure to retain the null hypothesis: There was a significant difference in the scores of males and females through the interaction of participation in the *Fast ForWord®* reading program.

To further understand the reason that a significant difference occurred with males and females interacting with participation in *Fast ForWord®*, simple main effects *t*-tests were used. To examine this relationship, the researcher selected males only and ran *t*-tests between *Fast ForWord®* participation and non-*Fast ForWord®* participation. Next, the tests were performed choosing females only and running *t*-tests between *Fast ForWord®* participation and non-*Fast ForWord®* participation. The next analysis was completed by examining *Fast ForWord®* and running *t*-tests to see if males differed from females in test performance. Finally, the researcher selected non-*Fast ForWord®* and ran *t*-tests to examine differences in male and female test results. The first *t*-test examined female (gender) and its interaction with the Intervention (participation in *Fast ForWord®*). The second *t*-test examined male (gender) and its interaction with the intervention (participation in *Fast ForWord®*).

Table 13 provides the results of posthoc *t*-tests that were used to examine the results found in the science subtest results. Two *t*-tests were performed but the results were combined

into one table to remain consistent with other findings provided in this research.

Table 13

Results of Simple Main Effects t-Test: Examination of Gender and the Interaction With the Intervention (Participation in Fast ForWord®)

Subtest	Intervention	Gender	*n*	*M*	*SD*	*t*	*p (2-tailed)*
Science Scale Scores 2003							
	No FFW	Female	91	652.12	36.975	2.929	004
		Male	87	661.77	33.075	.725	.469
	FFW	Female	126	665.14	28.473	2.811	.006
		Male	140	664.99	32.259	.725	.472

Table 14 provides results for Research Question #5 and shows the relationship between gender and its interaction with the intervention (participation in *Fast ForWord®* in the social studies subtest using scale scores.

Results of ANCOVA: Comparison of adjusted means for fifth- and sixth-grade students examining males and females and the interaction of the *Fast ForWord®* reading program using the 2003 *Terra Nova* while controlling with the 2001 and 2002 test results in the social studies subsection.

Table 14

Results of ANCOVA: Comparisons of Adjusted Means of Gender and its Interaction With the Intervention (Participation in Fast ForWord®) in the Social Studies Subtest

Subtest	Intervention	Gender	*n*	*M*	*Adj.*	*SD*	*F*	*p*
Social Studies Scale Scores 2003								
	No FFW	Female	71	658.79	659.441a	28.140	.561	.462
		Male	63	662.38	665.948a	42.462		
Social Studies Scale Scores 2003								
	FFW	Female	100	667.02	663.389a	24.772		
		Male	114	665.18	665.992a	33.111		

Retain the Null Hypotheses. There was no significant difference between males and females who participated or did not participate in the *Fast ForWord®* program on the social studies subsection of the *Terra Nova*.

Research Question #6

Are there school differences in the performance on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*?

This research question examined the performance of the four elementary schools in Grainger County (Bean Station, Joppa, Rutledge, Washburn) on the 2003 *Terra Nova*. The Null hypotheses associated with this research question were as follows:

$Ho6_1$: There is no significant difference in the scores of students who are enrolled in the four elementary schools in Grainger County on the reading subsection of the *Terra Nova* test.

$Ho6_2$: There is no significant difference in the scores of students who are enrolled in the four elementary schools in Grainger County on the language subsection of the *Terra Nova* test.

$Ho6_3$: There is no significant difference in the scores of students who are enrolled in the four elementary schools in Grainger County on the math subsection of the *Terra Nova* test.

$Ho6_4$: There is no significant difference in the scores of students who are enrolled in the four elementary schools in Grainger County on the science subsection of the *Terra Nova* test.
$Ho6_5$: There is no significant difference in the scores of students who are enrolled in the 4 elementary schools in Grainger County on the social studies subsection of the *Terra Nova* test.

Table 15 presents the results of Research Question #6 and shows the results of fifth and sixth graders' performance on the *Terra Nova*, comparing the results of the four elementary schools in Grainger County on the reading subtest using scale scores.
Results of ANCOVA: Comparison of adjusted means for fifth- and sixth-grade students enrolled in the four elementary schools in Grainger County (Bean Station, Joppa, Rutledge, Washburn) examining their performance on the 2003 reading subsection of the *Terra Nova* exam.

Table 15

Results of ANCOVA: Comparison of the Four Elementary Schools in the Grainger County School System in the Reading Subtest

Subsection	School	*n*	*M*	*Adj. M*	*SD*	*F*	*p*
Reading Scale Scores 2003							
	Bean Station	114	665.29	662.733a	29.801	3.000	.031
	Joppa	75	652.27	658.056a	41.101		
	Rutledge	104	654.18	654.142a	39.226		
	Washburn	56	655.96	653.490a	37.469		

Reject the Null Hypotheses: There was a significant difference in the performance of students at the four elementary schools in the Grainger County School System.

Posthoc tests were completed to examine the schools' performance. The Tukey HSD tests were applied to determine which pairs were different. Table 16 provides the results of posthoc testing examining the difference between the four elementary schools using Tukey HSD tests to determine differences among pairs on the reading subtest using scale scores.

Table 16

Results of Tukey HSD Used to Provide Posthoc Analysis Comparing School Performance in the Reading Subtest Using Scale Scores

Subsection	(I)School	(J) School	M Diff. (I-J)	*p*
Dependent Variable Reading Scale Scores 2003				
	Bean Station	Joppa	18.71*	.001
		Rutledge	10.68	.083
		Washburn	11.96	.121
	Joppa	Bean Station	-18.71*	.001
		Rutledge	-8.03	.375
		Washburn	-6.75	.653
	Rutledge	Bean Station	-10.68	.083
		Joppa	8.03	.375
		Washburn	1.28	.995
	Washburn	Bean Station	-11.96	.121
		Joppa	6.75	.653
		Rutledge	-1.28	.995

*Based on observed means. The mean difference is significant at the .050 level. Appropriate for data use from SPSS although modifications in programming may have occurred.

In comparison of the pairs, there was significant difference between Bean Station and Joppa. Bean Station scored significantly higher in reading than the other elementary schools in Grainger County.

Table 17 provides the results for research question #6 and shows the results of the four elementary schools in Grainger County on the language subtest using scale scores.

Results of ANCOVA: Comparisons of adjusted means for fifth- and sixth-grade students enrolled in the four elementary schools in Grainger County (Bean Station, Joppa, Rutledge, Washburn) examining their performance on the 2003 language subtest of the *Terra Nova* exam.

Table 17

Results of ANCOVA: Examination of the Performance of the Four Elementary Schools in the Grainger County School System in the Language Subtest

Subsection	School	*n*	*M*	*Adj. M*	*SD*	*F*	*p*
Language Scale Scores 2003							
	Bean Station	109	691.83	685.513a	32.873	9.821	.000
	Joppa	66	663.80	670.113a	45.114		
	Rutledge	94	661.31	664.808a	40.859		
	Washburn	52	667.10	665.994a	43.824		

Reject the Null Hypotheses: There was a significant difference in the performance of students at the four elementary schools in the Grainger County School System. Posthoc tests were completed to examine the schools' performance. The Tukey HSD were run to determine which pairs were different.

Table 18 provides the results of posthoc testing examining the difference between the four elementary schools using Tukey HSD tests to determine differences among pairs on the language subtest using scale scores.

Table 18

Results of Tukey HSD Used to Provide Posthoc Analysis Comparing School Performance in the Language Subtest Using Scale Scores

Subsection	(I)School	(J) School	*M Diff. (I-J)*	*p*
Dependent Variable Language Scale Scores 2003				
	Bean Station	Joppa	33.11*	.000
		Rutledge	29.60*	.000
		Washburn	27.36*	.000
	Joppa	Bean Station	-33.11*	.000
		Rutledge	-3.52	.918
		Washburn	-5.75	.804

Table 18 (continued)

Subsection	(I)School	(J) School	*M Diff. (I-J)*	*p*
	Rutledge	Bean Station	-29.60*	.000
		Joppa	3.52	.918
		Washburn	-2.23	.981
	Washburn	Bean Station	-27.36*	.000
		Joppa	5.75	.804
		Rutledge	2.23	.981

Based on observed means. *The mean difference is significant at the.05 level.

In comparisons of the pairs for language, there were significant differences among Bean Station, Joppa, Rutledge, and Washburn; there were significant differences between Joppa and Bean Station; significant differences between Rutledge and Bean Station; and significant differences between Washburn and Bean Station. Bean Station scored significantly higher in language than the other schools in Grainger County.

Table 19 presents the results for Research Question #6 and shows the results of the four elementary schools in Grainger County on the math subtest using scale scores.

Results of ANCOVA: Comparisons of Adjusted Means for Fifth- and Sixth-Grade Students Enrolled in the Four Elementary Schools in Grainger County (Bean Station, Joppa, Rutledge, Washburn) Examining Their Performance on the 2003 math Subtest of the *Terra Nova* Exam

Table 19

Results of ANCOVA: Examination of the Performance of the Four Elementary Schools in the Grainger County School System in the Math Subtest

Subsection	School	*n*	*M*	*Adj. M*	*SD*	*F*	*p*
Math Scale Scores 2003							
	Bean Station	112	666.61	661.366a	29.770	3.363	.019
	Joppa	74	643.11	648.205a	40.781		
	Rutledge	103	655.07	658.511a	40.603		
	Washburn	58	661.19	658.693a	39.775		

Reject the null hypotheses: There was a significant difference in the performance of students at the four elementary schools in the Grainger County School System.

Posthoc tests were completed to examine the schools' performance. The Tukey HSD were run to determine which pairs were different.

Table 20 provides the results of posthoc testing examining the difference between the four elementary schools using Tukey HSD tests to determine differences among pairs on the math subtest using scale scores.

Table 20

Results of Tukey HSD Used to Provide Posthoc Analysis Comparing School Performance in the Math Subtest Using Scale Scores

Subsection	(I)School	(J) School	*M Diff. (I-J)*	*p*
Dependent Variable Math Scale Scores 2003				
	Bean Station	Joppa	26.60*	.000
		Rutledge	13.14*	.025
		Washburn	6.79	.616

Table 20 (continued)

Subsection	(I)School	(J) School	*M Diff. (I-J)*	*p*
	Joppa	Bean Station	-26.60*	.000
		Rutledge	-13.46*	.045
		Washburn	-19.81*	.006
	Rutledge	Bean Station	-13.14*	.025
		Joppa	13.46*	.045
		Washburn	-6.36	.661
	Washburn	Bean Station	-6.79	.616
		Joppa	19.81*	.006
		Rutledge	6.36	.661

Based on observed means. *The mean difference is significant at the.05 level.

In comparison of the pairs for math, there were significant differences among Bean Station and Joppa and Rutledge; significant differences between Joppa and Rutledge, and Washburn; significant differences between Rutledge and Washburn; and significant differences between Washburn and Joppa. Bean Station and Washburn scored significantly higher in the math subsection than the other two schools in the Grainger County School System.

Table 21 presents the results for Research Question #6 and shows the results of the four elementary schools in Grainger County on the science subtest using scale scores.

Results of ANCOVA: Comparisons of adjusted means for fifth- and sixth-grade students enrolled in the four elementary schools in Grainger County (Bean Station, Joppa, Rutledge, Washburn) examining their performance on the 2003 science subtest of the *Terra Nova* exam.

Table 21

Results of ANCOVA: Examination of the Performance of the Four Elementary Schools in the Grainger County School System in the Science Subtest

Subsection	School	*n*	*M*	*Adj. M*	*SD*	*F*	*p*
Science Scale Scores 2003							
	Bean Station	112	668.22	665.339a	26.888	1.492	.216
	Joppa	75	659.60	661.720a	32.236		
	Rutledge	103	658.69	661.182a	35.604		
	Washburn	59	658.02	656.445a	33.328		

Retain the null hypotheses: There was no significant difference in the performance of students at the four elementary schools in the Grainger County School System.

Table 22 presents the results for Research Question #6 and shows the results of the four elementary schools in Grainger County on the social studies subtest using scale scores.

Results of ANCOVA: Comparisons of adjusted means for fifth- and sixth-grade students enrolled in the four elementary schools in Grainger County (Bean Station, Joppa, Rutledge, Washburn) examining their performance on the 2003 social studies subtest of the *Terra Nova* exam.

Table 22

Results of ANCOVA: Examination of the Performance of the Four Elementary Schools in the Grainger County School System in the Social Studies Subtest

Subsection	School	*n*	*M*	*Adj. M*	*SD*	*F*	*p*
Social Studies Scale Scores 2003							
	Bean Station	113	669.09	667.724a	24.536	1.886	.132
	Joppa	75	658.13	660.399a	34.242		
	Rutledge	104	662.94	664.139a	37.714		
	Washburn	56	662.93	660.425a	29.740		

Retain the Null Hypotheses: There was no significant difference in the performance of students on the social studies subsection at the four elementary schools in the Grainger County School System.

Research Question #7

Did students who received free or reduced meals score higher than students who do not receive free or reduced meals on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*?

The Null Hypotheses associated with this research question are as follows:

$Ho7_1$: There is no significant difference in performance on the reading subsection of the 2003 *Terra Nova* of students who receive free and reduced meals and students who do not receive free and reduced meals while controlling for the 2001 and 2002 *Terra Nova*.

$Ho7_2$: There is no significant difference in performance on the language subsection of the 2003 *Terra Nova* of students who receive free and reduced meals and students who do not receive free and reduced meals while controlling for the 2001 and 2002 *Terra Nova*.

$Ho7_3$: There is no significant difference in performance on the math subsection of the 2003 *Terra Nova* of students who receive free and reduced meals and students who do not receive free and reduced meals while controlling for the 2001 and 2002 *Terra Nova*.

$Ho7_4$: There is no significant difference in performance on the science subsection of the 2003 *Terra Nova* of students who receive free and reduced meals and students who do not receive free and reduced meals while controlling for the 2001 and 2002 *Terra Nova*.

$Ho7_5$: There is no significant difference in performance on the social studies subsection of the 2003 *Terra Nova* of students who receive free and reduced meals and students who do not receive free and reduced meals while controlling for the 2001 and 2002 *Terra Nova*.

This research question used ANCOVA to determine if differences existed between the groups who received free and reduced meals and students who did not receive free and reduced meals on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

Table 23 provides results for Research Question #7 by examining the results of socio-economic status (free/reduced and paid meals) of students and their performance on the 2003 *Terra Nova*.

Table 23

Results of ANCOVA: Comparison of Adjusted Means for Students Who Receive Free and Reduced Meals and Students Who Do Not Receive Free and Reduced Meals on Their Performance on the 2003 Terra Nova While Controlling for the 2001, 2002 Terra Nova

Subtest	Meal Status	*n*	*M*	*Adj. M*	*SD*	*F*	*p*
Reading	Free/Reduced	189	657.43	656.985a	38.961	.340	.560
	Paid	160	657.98	558.511a	34.192		
Language	Free/Reduced	181	672.53	673.033a	45.106	.003	.953
	Paid	140	673.89	673.236a	37.428		
Math	Free/Reduced	188	657.06	655.898a	39.058	.931	.335
	Paid	159	657.51	658.882a	37.217		
Science	Free/Reduced	190	660.17	659.663a	34.570	2.794	.095
	Paid	159	663.82	664.421a	28.757		
Social Studies	Free/Reduced	188	664.28	664.000a	32.876	.068	.933
	Paid	160	663.46	663.781a	31.005		

Results $Ho7_1$: Retain the Null Hypotheses: There was no significant difference in the scores of students who receive free and reduced meals and students who do not receive free and reduced meals in their performance on the 2003 *Terra Nova* reading subsection while controlling for the 2001 and 2002 *Terra Nova*.

Results $Ho7_2$: Retain the Null Hypotheses: There was no significant difference in the scores of students who receive free and reduced meals and students who do not receive free and reduced meals in their performance on the 2003 *Terra Nova* language subsection while controlling for the 2001 and 2002 *Terra Nova*.

Results $Ho7_3$: Retain the Null Hypotheses: There was no significant difference in the scores of

students who receive free and reduced meals and students who do not receive free and reduced meals in their performance on the 2003 *Terra Nova* math subsection while controlling for the 2001 and 2002 *Terra Nova*.

Results $Ho7_4$: Retain the Null Hypotheses: There was no significant difference in the scores of students who receive free and reduced meals and students who do not receive free and reduced meals in their performance on the 2003 *Terra Nova* science subsection while controlling for the 2001 and 2002 *Terra Nova*.

Results $Ho7_5$: Retain the Null Hypotheses: There was no significant difference in the scores of students who receive free and reduced meals and students who do not receive free and reduced meals in their performance on the 2003 *Terra Nova* social studies subsection while controlling for the 2001 and 2002 *Terra Nova*.

Research Question #8

Is there a socioeconomic status (free and reduced meals and paid meals) by intervention (participation in *Fast ForWord*® and no participation in *Fast ForWord*®) interaction?

The Null Hypotheses associated with this research question were as follows:

$Ho8_1$: There is no significant difference in the performance of students in the reading subsection of the 2003 *Terra Nova* who received free and reduced meals and those who paid for meals, comparing students who received the *Fast ForWord*® reading program and students who did not receive the *Fast ForWord*® reading program while controlling for the 2001 and 2002 *Terra Nova*.

$Ho8_2$: There is no significant difference in the performance of students in the language subsection of the 2003 *Terra Nova* who received free and reduced meals and those who paid for meals, comparing students who received the *Fast ForWord*® reading program and students who did not receive the *Fast ForWord*® reading program while controlling for the 2001 and 2002 *Terra Nova*.

$Ho8_3$: There is no significant difference in the performance of students in the math subsection of the 2003 *Terra Nova* who received free and reduced meals and those who paid for meals, comparing students who received the *Fast ForWord*® reading program and students who did not receive the *Fast ForWord*® reading program while controlling for the 2001 and 2002 *Terra Nova*.

$Ho8_4$: There is no significant difference in the performance of students in the science subsection of the 2003 *Terra Nova* who received free and reduced meals and those who paid for meals, comparing students who received the *Fast ForWord*® reading program and students who did not receive the *Fast ForWord*® reading program while controlling for the 2001 and 2002 *Terra Nova*.

$Ho8_5$: There is no significant difference in the performance of students in the social studies subsection of the 2003 *Terra Nova* who received free and reduced meals and those who paid for meals, comparing students who received the *Fast ForWord*® reading program and students who did not receive the *Fast ForWord*® reading program while controlling for the 2001 and 2002 *Terra Nova*.

This research question used analysis of covariance to determine if an interaction occurred between the socioeconomic status of students (free and reduced meals, and paid meals) and intervention (participation in *Fast ForWord*® and no participation in *Fast ForWord*® interaction.

Table 24 provides the results for Research Question #8 by examining the interaction of the student's socioeconomic status (free/reduced and paid meals) and the intervention (participation in *Fast ForWord*®). Table 24 provides students' scores using National Percentiles.

Table 24

Results of ANCOVA: Comparison of Adjusted Means of Student's Socioeconomic Status and Intervention Interaction on the 2003 Terra Nova While Controlling for the 2001, 2002 Terra Nova

Subtest	*Intervention*	*SES*	*n*	*M*	*Adjusted*	*SD*	*F*	*p*
Reading NP 2003								
	No FFW	Free/Reduced	67	49.79	48.062a	29.256 .	001	.981
		Paid	67	48.06	49.427a	26.127		
	FFW	Free/Reduced	122	54.70	55.338a	24.601		
		Paid	93	57.19	56.614a	24.565		
Language NP 2003								
	No FFW	Free/Reduced	66	56.71	58.506a	30.004 .	263	.609
		Paid	54	53.37	56.677a	27.485		
	FFW	Free/Reduced	115	68.79	68.478a	30.069		
		Paid	86	72.01	68.977a	24.491		
Math NP 2003								
	No FFW	Free/Reduced	67	54.85	57.352a	28.303	.127	.772
		Paid	67	56.15	59.153a	27.403		
	FFW	Free/Reduced	121	55.39	53.000a	27.652		
		Paid	92	57.24	56.372a	25.660		
Science NP 2003								
	No FFW	Free/Reduced	67	49.91	52.355a	25.525	1.535	.216
		Paid	67	53.58	54.413a	21.837		
	FFW	Free/Reduced	123	55.28	53.927a	23.215		
		Paid	92	57.29	56.712a	23.505		
Social Studies NP 2003								
	No FFW	Free/Reduced	67	51.69	51.191a	28.057	.057	.812
		Paid	67	52.73	54.151a	25.550		
	FFW	Free/Reduced	121	55.68	55.439a	22.035		
		Paid	93	57.86	57.505a	22.285		

As shown in Table 24, the results of the Null Hypotheses were as follows:

$Ho8_1$: Retain the Null Hypotheses: There was no significant difference in the interaction of socioeconomic status and their participation in the intervention of students taking the reading subsection of the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

$Ho8_2$: Retain the Null Hypotheses: There was no significant difference in the interaction of socioeconomic status and their participation in the intervention of students taking the language subsection of the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

$Ho8_3$: Retain the Null Hypotheses: There was no significant difference in the interaction of socioeconomic status and their participation in the intervention of students taking the math subsection of the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

$Ho8_4$: Retain the Null Hypotheses: There was no significant difference in the interaction of socioeconomic status and their participation in the intervention of students taking the science subsection of the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

$Ho8_5$: Retain the Null Hypotheses: There was no significant difference in the interaction of socioeconomic status and their participation in the intervention of students taking the social studies subsection of the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

Research Question #9

Do students who receive *Fast ForWord*® early in the year perform differently on the 2003 *Terra Nova* than students who receive *Fast ForWord*® later in the year while controlling for the 2001 and 2002 *Terra Nova*?

The Null Hypotheses associated with this research question were as follows:

$Ho9_1$: There is no significant difference in the performance of students on the reading subsection of the 2003 *Terra Nova* who received *Fast ForWord*® early in the school year, and students who received *Fast ForWord*® late in the school year.

$Ho9_2$: There is no significant difference in the performance of students on the language

subsection of the 2003 *Terra Nova* who received *Fast ForWord*® early in the school year, and students who received *Fast ForWord*® late in the school year.

$Ho9_3$: There is no significant difference in the performance of students on the math subsection of the 2003 *Terra Nova* who received *Fast ForWord*® early in the school year, and students who received *Fast ForWord*® late in the school year.

$Ho9_4$: There is no significant difference in the performance of students on the science subsection of the 2003 *Terra Nova* who received *Fast ForWord*® early in the school year, and students who received *Fast ForWord*® late in the school year.

$Ho9_5$: There is no significant difference in the performance of students on the social studies subsection of the 2003 *Terra Nova* who received *Fast ForWord*® early in the school year, and students who received *Fast ForWord*® late in the school year.

Analysis of covariance was conducted to determine if significant differences existed for students who received *Fast ForWord*® early in the year, and those students who received *Fast ForWord*® later in the year. The student's performance on the 2003 *Terra Nova* was examined, while using the 2001 and 2002 *Terra Nova* to control for the results. Table 25 presents the ANCOVA results for the groups using the 2003 *Terra Nova* scores. The 2001 and 2002 test results controlled for the analysis.

Table 25 provides the results for Research Question #9 by examining the time of intervention (*Fast ForWord*® first semester versus *Fast ForWord*® second semester) and the effect of intervention time on the students' performance on the 2003 *Terra Nova* using scale scores.

Table 25

Results of ANCOVA: Comparison of Adjusted Mean for Students Who Received Fast ForWord® Early in the School Year and Students Who Received Fast ForWord® Late in the School Year

Subtest	Time	*n*	*M*	*Adjusted*	*SD*	*F*	*p*
Reading							
	Early	121	658.96	660.127a	31.946	.904	.343
	Late	94	665.49	662.986a	39.449		
Language							
	Early	110	678.82	683.633a	42.432	2.185	.141
	Late	91	683.14	677.323a	40.170		
Math							
	Early	121	655.01	659.599a	39.986	.691	.407
	Late	92	662.42	656.386a	34.351		
Science							
	Early	122	656.77	660.672a	30.270	8.858	.003
	Late	93	675.56	670.441a	26.166		
Social Studies							
	Early	120	663.80	663.868a	34.053	2.778	.097
	Late	94	668.90	668.817a	22.109		

Results of $Ho9_1$: Retain the Null Hypotheses: Testing would indicate there was no significant difference in the reading scores of students who received *Fast ForWord®* early in the year and students who received *Fast ForWord®* later in the year.

Results of $Ho9_2$: Retain the Null Hypotheses: Testing would indicate there was no significant difference in the language scores of students who received *Fast ForWord®* early in the year and students who received *Fast ForWord®* later in the year.

Results of $Ho9_3$: Retain the Null Hypotheses: Testing would indicate there was no significant difference in the math scores of students who received *Fast ForWord®* early in the year and students who received *Fast ForWord®* later in the year.

Results of $Ho9_4$: Reject the Null Hypotheses: Testing would indicate there was a significant difference in the science scores of students who received *Fast ForWord®* early in the year and

students who received *Fast ForWord*® later in the year.

Results of $Ho9_5$: Retain the Null Hypotheses: Testing would indicate there was no significant difference in the social studies scores of students who received *Fast ForWord*® early in the year and students who received *Fast ForWord*® later in the year.

Research Question #10

Dividing the students in 4 ability groups (1st, 2nd, 3rd, and 4th quartiles) based on their 2002 *Terra Nova* scores, are there ability group differences on the performance of the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova* scores?

The Null Hypotheses associated with this research question are as follows:

$Ho10_1$: There is no significant difference in the performance of or between the 4 ability groups on the 2003 *Terra Nova* reading subsection, basing ability groups on the 2002 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

$Ho10_2$: There is no significant difference in the performance of or between the 4 ability groups on the 2003 *Terra Nova* language subsection, basing ability groups on the 2002 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

$Ho10_3$: There is no significant difference in the performance of or between the 4 ability groups on the 2003 *Terra Nova* math subsection, basing ability groups on the 2002 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

$Ho10_4$: There is no significant difference in the performance of or between the 4 ability groups on the 2003 *Terra Nova* science subsection, basing ability groups on the 2002 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

$Ho10_5$: There is no significant difference in the performance of or between the 4 ability groups on the 2003 *Terra Nova* social studies subsection, basing ability groups on the 2002 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*.

The research question used analysis of covariance to determine if differences existed between the ability groups on the 2003 *Terra Nova*, ability grouping based on 2002 *Terra Nova*

while controlling with the 2001 and 2002 *Terra Nova*.

Each academic subsection (reading, language, math, science, and social studies) was used to create ability groups from 2002 data. Thus, the reading ability group was completely different than the language ability group, etc. ANCOVA was performed on 2003 national percentile *Terra Nova* scores, based on 2002 national percentile ability grouping while controlling for 2001 and 2002 *Terra Nova* scores.

Table 26 provides results for Research Question #10. In this table it is important to note that all five subtests and the four ability groups were developed independently developing ability groups for each of the five subjects. The ability groups were developed using 2002 *Terra Nova* data, then tested using student performance from the 2003 *Terra Nova*. The ability grouping and test analysis were developed using National Percentile scores (NP). Table 26 examines if the ability groups perform similarly on the five subtests as well as between group performance of students.

Table 26

Results of ANCOVA: Comparison of the Adjusted Means for Students Who Were Grouped With 2002 NP Terra Nova Scores Into Four Ability Groups and Tested With 2003 NP Terra Nova Tests While Controlling for 2001, 2002 Terra Nova

Subtest	Ability Group	*n*	*M*	*Adjusted*	*SD*	*F*	*p*
Reading NP 2003							
	1st Quartile	63	22.54	50.156a	19.208	.343	.795
	2nd Quartile	104	44.21	53.664a	19.633		
	3rd Quartile	109	61.94	53.290a	16.150		
	4th Quartile	73	79.16	54.774a	16.110		

Table 26 (continued)

Subtest	Ability Group	*n*	*M*	*Adjusted*	*SD*	*F*	*p*
Language NP 2003							
	1st Quartile	65	32.35	66.486a	27.981		
	2nd Quartile	59	54.76	67.946a	22.678	.569	.636
	3rd Quartile	86	66.93	62.476a	22.698		
	4th Quartile	111	86.84	63.294a	13.409		
Math NP 2003							
	1st Quartile	58	28.09	58.951a	24.483	.110	.954
	2nd Quartile	84	43.54	56.124a	20.370		
	3rd Quartile	88	59.50	55.541a	20.185		
	4th Quartile	117	75.92	54.562a	19.602		
Science NP 2003							
	1st Quartile	60	31.27	49.654a	19.961	.671	.571
	2nd Quartile	91	43.91	51.000a	17.853		
	3rd Quartile	114	59.86	55.562a	16.703		
	4th Quartile	84	75.10	60.115a	18.218		
Social Studies NP 2003							
	1st Quartile	68	30.41	56.480a	19.169	.465	.707
	2nd Quartile	102	46.47	55.377a	17.619		
	3rd Quartile	104	63.54	55.757a	16.670		
	4th Quartile	74	77.00	51.705a	18.269		

As shown in Table 26, the results of the Null Hypotheses were as follows:

$Ho10_1$: Retain the Null Hypotheses: There was no significant difference between ability groups (based on 2002 *Terra Nova*) in the performance on the 2003 *Terra Nova* reading subsection while controlling for the 2001 and 2002 *Terra Nova*.

$Ho10_2$: Retain the Null Hypotheses: There was no significant difference between ability groups (based on 2002 *Terra Nova*) in the performance on the 2003 *Terra Nova* language subsection while controlling for the 2001 and 2002 *Terra Nova*.

$Ho10_3$: Retain the Null Hypotheses: There was no significant difference between ability groups (based on 2002 *Terra Nova*) in the performance on the 2003 *Terra Nova* math subsection while controlling for the 2001 and 2002 *Terra Nova*.

$Ho10_4$: Retain the Null Hypotheses: There was no significant difference between ability groups

(based on 2002 *Terra Nova*) in the performance on the 2003 *Terra Nova* science subsection while controlling for the 2001 and 2002 *Terra Nova*.

$Ho10_5$: Retain the Null Hypotheses: There was no significant difference between ability groups (based on 2002 *Terra Nova*) in the performance on the 2003 *Terra Nova* social studies subsection while controlling for the 2001 and 2002 *Terra Nova*.

Research Question #11

Is there an ability group (grouping for each subject on the 2002 *Terra Nova*) by intervention (participation in *Fast ForWord*® and no participation in *Fast ForWord*®) interaction on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*?

The Null Hypotheses associated with this research question were as follows:

$Ho11_1$: There are no significant differences in the performance of students on the reading subsection of the 2003 *Terra Nova* while examining the interaction of ability grouping students (based on the 2002 *Terra Nova*) and the relationship of their participation in the intervention (participation in the *Fast ForWord*® reading program and not participating in the *Fast ForWord*® reading program).

$Ho11_2$: There are no significant differences in the performance of students on the language subsection of the 2003 *Terra Nova* while examining the interaction of ability grouping students (based on the 2002 *Terra Nova*) and the relationship of their participation in the intervention (participation in the *Fast ForWord*® reading program and not participating in the *Fast ForWord*® reading program).

$Ho11_3$: There are no significant differences in the performance of students on the math subsection of the 2003 *Terra Nova* while examining the interaction of ability grouping students (based on the 2002 *Terra Nova*) and the relationship of their participation in the intervention (participation in the *Fast ForWord*® reading program and not participating in the *Fast ForWord*® reading program).

$Ho11_4$: There are no significant differences in the performance of students on the science

subsection of the 2003 *Terra Nova* while examining the interaction of ability grouping students (based on the 2002 *Terra Nova*) and the relationship of their participation in the intervention (participation in the *Fast ForWord*® reading program and not participating in the *Fast ForWord*® reading program).

$Ho11_5$: There are no significant differences in the performance of students on the social studies subsection of the 2003 *Terra Nova* while examining the interaction of ability grouping students (based on the 2002 *Terra Nova*) and the relationship of their participation in the intervention (participation in the *Fast ForWord*® reading program and not participating in the *Fast ForWord*® reading program).

This research question used ANCOVA to determine if an interaction occurred for students divided into 4 ability groups (1^{st}, 2^{nd}, 3^{rd}, and 4^{th} quartiles) based on 2002 *Terra Nova* results, and students inclusion in the intervention (participation in the *Fast ForWord*® reading program and no participation in the *Fast ForWord*® reading program).

Each academic subsection (reading, language, math, science, and social studies) was used to create separate ability groups from 2002 data. Thus, each subject was used to establish separate ability groups so independent analysis could be performed pertaining to each academic subsection. ANCOVA was performed on 2003 national percentile *Terra Nova* scores, based on 2002 national percentile ability groupings while controlling for 2001 and 2002 *Terra Nova* scores.

Table 27 provides results for Research Question #11 presenting ability grouped students into five ability groups based on 2002 *Terra Nova* data and showing the relationship of interaction of the ability groups and the intervention (*Fast ForWord*®). Table 27 provides results of ability grouping and participation in the intervention (*Fast ForWord*®). Table 27 uses National Percentile scores to present the data.

Table 27

Results of ANCOVA: Comparison of the Adjusted Means for Students Who Were Ability Grouped and the Interaction With the Intervention (Participation in Fast ForWord®)

Subtest	Ability Group	Intervention	*n*	*M*	*Adj.*	*SD*	*F*	*p*
Reading NP 2003								
	1st Quartile	No FFW	29	22.24	47.734a	19.322	.781	.505
		FFW	34	22.79	50.570a	19.398		
	2nd Quartile	No FFW	32	38.13	46.849a	23.786		
		FFW	72	46.92	56.226a	16.972		
	3rd Quartile	No FFW	41	54.85	47.704a	17.839		
		FFW	68	66.21	57.110a	13.349		
	4th Quartile	No FFW	32	76.31	52.946a	27.645		
		FFW	41	81.39	57.642a	24.559		
Language NP 2003								
	1st Quartile	No FFW	28	29.11	66.312a	23.175	2.743	.043
		FFW	37	34.81	72.840a	31.220		
	2nd Quartile	No FFW	28	49.00	64.655a	20.485		
		FFW	31	59.97	73.641a	23.614		
	3rd Quartile	No FFW	30	54.57	47.634a	27.242		
		FFW	56	73.55	69.728a	16.640		
	4th Quartile	No FFW	34	82.38	55.704a	13.773		
		FFW	77	88.81	63.068a	12.847		
Math NP 2003								
	1st Quartile	No FFW	29	28.79	58.870a	23.050	1.081	.357
		FFW	29	27.38	55.845a	26.228		
	2nd Quartile	No FFW	38	48.92	60.145a	21.626		
		FFW	46	39.09	51.591a	18.331		
	3rd Quartile	No FFW	27	65.07	60.133a	18.252		
		FFW	61	57.03	53.792a	20.645		
	4th Quartile	No FFW	40	74.65	54.779a	23.843		
		FFW	88	76.58	56.150a	17.130		

Table 27 (continued)

Sub-Test	*Ability Group*	*Intervention*	*n*	*M*	*Adj.*	*SD*	*F*	*p*
Science NP 2003								
	1st Quartile	No FFW	30	29.40	48.517a	19.190	.269	.847
		FFW	30	33.13	52.059a	20.860		
	2nd Quartile	No FFW	33	47.21	54.436a	19.435		
		FFW	58	42.03	49.440a	16.772		
	3rd Quartile	No FFW	41	58.88	54.996a	16.216		
		FFW	73	60.41	55.638a	17.057		
	4th Quartile	No FFW	30	69.33	53.352a	22.450		
		FFW	54	78.30	63.072a	14.654		
Social Studies NP 2003								
	1st Quartile	No FFW	31	27.26	54.311a	17.144	1.838	.140
		FFW	37	33.05	60.427a	20.572		
	2nd Quartile	No FFW	37	42.05	50.017a	21.409		
		FFW	65	48.98	59.020a	14.642		
	3rd Quartile	No FFW	36	64.56	56.650a	17.988		
		FFW	68	63.00	54.733a	16.041		
	4th Quartile	No FFW	30	75.70	49.723a	21.396		
		FFW	44	77.89	51.243a	15.996		

As shown in Table 27, the results of the Null Hypotheses were as follows:

$Ho11_1$: Retain the Null Hypotheses: There was no significant difference in the performance of students who were placed into ability groups (based on 2002 data) and the interaction of the intervention (participation or nonparticipation in the *Fast ForWord*® reading program) in their performance on the 2003 *Terra Nova* reading subsection while controlling for the 2001 and 2002 *Terra Nova*.

$Ho11_2$: Reject the Null Hypotheses: There was a significant difference in the performance of students who were placed into ability groups (based on 2002 data) and the interaction of the intervention (participation or nonparticipation in the *Fast ForWord*® reading program) in their

performance on the language subsection while controlling for the 2001 and 2002 *Terra Nova*.

Posthoc tests were performed using the LSD function indicating that there was a significant difference in the performance of Group 1 and Group 3, and a significant difference in the performance of Group 2 and Group 3.

$Ho11_3$: Retain the Null Hypotheses: There was no significant difference in the performance of students who were placed into ability groups (based on 2002 data) and the interaction of the intervention (participation or nonparticipation in the *Fast ForWord*® reading program) in their performance on the 2003 *Terra Nova* math subsection while controlling for the 2001 and 2002 *Terra Nova*.

$Ho11_4$: Retain the Null Hypotheses: There was no significant difference in the performance of students who were placed into ability groups (based on 2002 data) and the interaction of the intervention (participation or nonparticipation in the *Fast ForWord*® reading program) in their performance on the 2003 *Terra Nova* science subsection while controlling for the 2001 and 2002 *Terra Nova*.

$Ho11_5$: Retain the Null Hypotheses: There was no significant difference in the performance of students who were placed into ability groups (based on 2002 data) and the interaction of the intervention (participation or nonparticipation in the *Fast ForWord*® reading program) in their performance on the 2003 *Terra Nova* social studies subsection while controlling for the 2001 and 2002 *Terra Nova*

CHAPTER 5

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to examine the relationship of students' participation in the *Fast ForWord*® reading program and the relationship to students' performance on the *TerraNova Comprehensive Test of Basic Skills* (CTB/McGraw/Hill, 1996) who were enrolled in the fifth and sixth grades at the four elementary schools in the Grainger County's school system. The analysis focused on the five academic subsections of the *Terra Nova* (reading, language, math, science, and social studies) using the 2003 test data while controlling for the 2001, 2002 *Terra Nova*. The study targeted the five academic subsections that were used in the analytical procedures to make comparisons associated with gender, school enrollment, socioeconomic status, participation in the intervention at the beginning and end of the school year, and ability groups.

Summary of Findings

The analysis focused on 11 research questions. The independent variables for this study were gender, school enrollment, socioeconomic status, time of intervention, and ability grouping. The scores reported for all students on the five subsections used by the study as measured by the *Terra Nova* standardized assessment were examined as the primary dependent variable. The sample consisted of 446 students. Students enrolled in the Grainger County Schools' 2002-2003 school year who were members of the fifth- or sixth-grade classes at the four elementary schools were included in the study. If three years of test data on the *Terra Nova* in each of the five subsections were not available, the student was not included in that specific analysis. The results are summarized.

Research Question #1

What are the demographic characteristics of the fifth- and sixth-grade students in the four elementary schools in the Grainger County School System?

There were 446 students selected for the study. There were 439 Caucasians, 2 African Americans, and 5 Hispanic students; 217 of the students were enrolled in the fifth grade, whereas 229 of the students were enrolled in the sixth grade; 217 students were enrolled in free and reduced meals, and 213 students paid for their meals. Bean Station had 137 students; Joppa, 94; Rutledge, 141; and Washburn, 74.

Research Question #2

What level of performance exists for 2002-2003 students enrolled in the fifth and sixth grades in the Grainger County School System taking the *Terra Nova* test?

The analysis of data examined three types of scores on the *Terra Nova* test. Scale scores, national percentiles, and N.C.E. test results were used for the analysis. Generally, scale scores were used to compare academic performance when comparing gender, socioeconomic status, time of intervention, and individual school performance. National percentiles were used when examining the ability groupings of students. Ability groups were compiled from each of the five academic subsections of the *Terra Nova* using 2002 data to group and the 2003 data to examine change.

Research Question #3

Do students who participate in *Fast ForWord*® score higher than students who did not participate in *Fast ForWord*® on the 2003 *Terra Nova* test while controlling for the 2001, 2002 *Terra Nova*?

The students enrolled in the intervention (*Fast ForWord*®) scored significantly higher than students not enrolled in the intervention in the reading and language subsections of the *Terra Nova* exams. Students' math, science, and social studies scores were not significantly

different from those enrolled or not enrolled in the intervention (*Fast ForWord*®) who tested using the 2003 *Terra Nova* while controlling for the 2001, 2002 *Terra Nova*.

Research Question #4

Are there gender differences in the performance on the 2003 *Terra Nova* while controlling for the 2001 and 2002 *Terra Nova*?

The results indicated that there were no significant differences in the 2003 *Terra Nova* test scores for the five subsection areas (reading, language, math, science, social studies) between the boys and girls. *Terra Nova* results were reported in scale scores for the 2003 results while controlling with the 2001 and 2002 *Terra Nova*.

Research Question #5

Is there a gender (male/female) by intervention (participation in *Fast ForWord*®) interaction?

The results indicated that there were no significant differences between males and females who had participated or who had not participated in the intervention (the *Fast ForWord*® reading program) in the *Terra Nova* subsections for reading, language, math, and social studies.

The results indicated that there was a significant difference between males and females as compared to those who participated and those who did not participate in the intervention (the *Fast ForWord*® reading program). To further examine the difference between males and females with participation and no participation in the intervention (*Fast ForWord*®), simple main effects *t*-tests were performed, first by examining females and their interaction with receiving and not receiving the intervention (*Fast ForWord*®). The *t*-test indicated that no significant difference occurred for the females who participated in the intervention, whereas a significant difference occurred for females who had not participated in the intervention. Next, simple main effects *t*-tests were performed on the science scores of the males who participated and did not participate

in the intervention (*Fast ForWord*®). Examination of the males' scores revealed that scores were not significantly different between males who participated and did not participate in the intervention. The simple main effects *t*-test would indicate that the ANCOVA was significant for science because of the females' no *Fast ForWord*® score.

Research Question #6

Are there school differences in the performance on the 2003 *Terra Nova* while controlling for the 2001, 2002 *Terra Nova*?

The results indicated that in the reading, language, and math subsections of the 2003 *Terra Nova*, there were significant differences in the performance of students at the four elementary schools in Grainger County.

To further examine the differences, posthoc tests were performed. The Tukey HSD tests were used to examine which pairs were different. The Tukey HSD tests revealed that there was a significant difference in Bean Station and Joppa in the reading subsection. Bean Station was significantly different from Joppa, Rutledge, and Washburn in the language subsection. Bean Station and Washburn were significantly different from Joppa and Rutledge in the math sub-section.

The results indicated that in the science and social studies subsection of the 2003 *Terra Nova*, there were no significant differences in the performance of students enrolled in the four elementary schools in Grainger County.

Research Question #7

Did students who receive free or reduced meals score higher than students who do not receive free or reduced meals on the 2003 *Terra Nova* while controlling for the 2001, 2002 *Terra Nova*?

The results indicated that there was no significant difference in the performance of students who received free or reduced meals and students who did not receive free or reduced

meals (paid) on the five subsections of the 2003 *Terra Nova* while controlling for the 2001, 2002 *Terra Nova*.

Research Question #8

Is there a socioeconomic status (free and reduced meals and paid meals) by intervention (participation in *Fast ForWord*® and no participation in *Fast ForWord*®) interaction?

The results indicated that there was no significant difference in the performance of students who received or did not receive free or reduced meals interaction with student's participation in the intervention (participation or nonparticipation in the *Fast ForWord*® reading program).

Research Question #9

Do students who receive *Fast ForWord*® early in the year perform differently on the 2003 *Terra Nova* than students who receive *Fast ForWord*® later in the year while controlling for the 2001 and 2002 *Terra Nova*?

The results indicated that there were no significant differences in the performance of students who received *Fast ForWord*® early in the year compared to students who received *Fast ForWord*® late in the year on the reading, language, math, and social studies subsection of the 2003 *Terra Nova*.

The results indicated that there were significant differences in the scores of students who received *Fast ForWord*® early in the year compared to students who received *Fast ForWord*® late in the year on the science subsection of the 2003 *Terra Nova*. Students who received *Fast ForWord*® late in the year scored significantly higher (675.56 mean) than students who received *Fast ForWord*® early in the year (656.77 mean).

Research Question #10

Dividing the students into four ability groups (1st, 2nd, 3rd, and 4th quartiles) based on their 2002 *Terra Nova* scores, are there ability group differences on the performance of the 2003 *Terra Nova* while controlling for the 2001, 2002 *Terra Nova*?

Each student was ability grouped for each of the five subsections using the 2002 *Terra Nova*. ANCOVA was then performed on the 2003 *Terra Nova*, still controlling for the 2001, 2002 *Terra Nova*.

The results indicate that there was no significant difference in the performance of students who were ability grouped on the five subsections (reading, language, math, science, and social studies) of the 2003 *Terra Nova*.

Research Question #11

Is there an ability group (grouping for each subject on the 2002 *Terra Nova*) by intervention (participation in *Fast ForWord*® and no participation in *Fast ForWord*®) interaction on the 2003 *Terra Nova* while controlling for the 2001, 2002 *Terra Nova*?

The results indicate that there was no significant difference in the performance of students using ability grouping and interacting with the intervention on the reading, math, science, and social studies subsections of the 2003 *Terra Nova*.

The results further indicate that there was a significant difference in the performance of students using ability grouping and interaction with the intervention on the language subsection of the 2003 *Terra Nova*.

To further examine the significant difference on the science subsection, posthoc tests were performed using the LSD function that showed the significant difference in Group 1 and Group 3 and the significant difference in Group 2 and Group 3.

Conclusions

The study focused primarily on the performance of students who had received the *Fast*

ForWord® reading program and students who had not received the *Fast ForWord*® reading program comparing their academic achievement through the use of the *Terra Nova Comprehensive Test of Basic Skills* (CTB/McGraw-Hill, 1997). Students' scores were compared using five subsections (reading, language, math, science, and social studies) of the 2003 *Terra Nova* test while controlling for the 2001, 2002 test.

Further examinations were performed using the gender, socioeconomic status, time of test, ability grouping, and school attended to examine the relationship of the *Fast ForWord*® program on the five subsections of the 2003 *Terra Nova*. Conclusions in the areas of intervention, gender, socioeconomic status, time of test, ability grouping, and school attended were developed as a result of the data analysis and interpretation.

Conclusion #1

The *Fast ForWord*® reading program developed by Scientific Learning Corporation (2003) has been studied to determine if a relationship exists for students who receive the intervention and students who do not receive the intervention. There appeared to be a positive relationship for students who received the intervention, specifically in the areas of reading and language. In a time when schools are being pressured to demonstrate students' success through the use of mandated standardized testing, a tool such as *Fast ForWord*® allows teachers and administrators the means to be able to provide direct, individualized instruction to all students on multiple ability groups. This study did not address the cost or cost effectiveness of the *Fast ForWord*® reading program. This study evaluated the relationship of participation in the *Fast ForWord*® reading program and the relationship to scores on standardized tests. A significant increase in the standardized test scores for the reading and language subsection of the *Terra Nova* might offer an incentive to implement a computer-based learning system in individual classrooms, individual schools, or entire school districts.

Conclusion #2

The study found no significant difference in the performance of males and females who took the 2003 *Terra Nova*. Male and female comparisons were made for reading, language, math, science, and social studies and neither sex exhibited significant differences in their abilities.

To further study gender, the study added the examination of participation in the intervention (*Fast ForWord*®) and examination of interactions. The results of the examination of gender and its interaction with the intervention revealed that in reading, language, math, and social studies, no significant differences existed. In the subsection of science, some significant differences existed. Posthoc tests revealed that females who had participated in *Fast ForWord*® and females who had not participated in *Fast ForWord*® scored significantly higher than the males.

The study further examined the school differences between Bean Station, Joppa, Rutledge, and Washburn. The study revealed that on the reading subsection, Bean Station scored significantly higher than the other schools. In the language subsection, Bean Station scored significantly higher than the other schools. In the math subsection, both Bean Station and Washburn scored significantly higher than the other schools. In the science and social studies subsections, the schools scored statistically equal in student performance.

Conclusion #3

The study then examined the relationship of socioeconomic status (using free/reduced, and paid meals) on the performance of students who took the 2003 *Terra Nova*. The study revealed no significant difference in the performance of students in regard to their socioeconomic status on the *Terra Nova*. To further examine socioeconomic status, the study explored its interaction with participation in the intervention (*Fast ForWord*®). The study revealed no significant difference in the performance of students based on their socioeconomic

status and the interaction with the intervention (*Fast ForWord*®).

The study examined the relationship of taking the intervention (*Fast ForWord*®) early in the year, and taking the intervention (*Fast ForWord*®) late in the year on the student's performance on the 2003 *Terra Nova*.

The study concluded that in the subsections of reading, language, math, and social studies, student participation in *Fast ForWord*® early and late in the school year were statistically equal. The subsection of science indicated that students who received *Fast ForWord*® late in the year scored higher than students who received *Fast ForWord*® early in the year.

Conclusion #4

Examining the students based on ability grouping revealed no significant difference in the performance between the four ability groups. To further examine the ability grouping of students, the study examined the relationship of interaction with the intervention (*Fast ForWord*®). The study revealed no significant differences between ability groups and their participation in the intervention (*Fast ForWord*®) in the subsections of reading, math, science, and social studies. There was a significant difference in the performance of students in ability group interaction with the intervention (*Fast ForWord*®) in the science subsection.

Recommendations for Practice

This study provided support to the claims made by the Scientific Learning Corporation (2003) that the *Fast ForWord*® reading program can increase students' scores on standardized exams, particularly in the areas of reading and language. The following recommendations are offered to directors, administrators, teachers, and parents who have a voice in the decision of adding a computer-based phonics learning system.

1. The addition of a computer-based phonics learning system should be considered as a viable addition to traditional reading programs to raise students' test scores in reading and language.
2. Implementation of a successful reading program could provide many benefits other than increased test scores. Attainment of skills necessary for employment, economic success, and advancement could result in a higher quality of life.
3. The decision to participate in the *Fast ForWord*® program should be voluntary for teachers, students, and parents. Mandating any specific curriculum should be the result of consideration and cooperation. Offering the choice to participate is a decision that must be made at both the school board and individual school level.
4. When purchasing a computer-based phonics program, the cost must be analyzed by the school and district to determine if adequate funding is available and that results will support the investment. Individual schools and districts have individual problems. The use of computer-based or individualized programs could provide solutions to schools or districts with these problems.

Recommendations for Further Research

Fast ForWord® and many other reading programs have been implemented to raise students' abilities and test scores in the basic areas of language development. The addition of phonics or any other program might be received with mixed feelings by teachers and parents. The demands of No Child Left Behind (2002) and self-imposed state standards require new tools and new programs to be successful with all students. Methods that enhance success in learning should always provide an area that is open to future research. In addition to exploratory studies, further research that evaluates the efficiency and economic impact of supplemental curricular programs should be explored. The need for additional research would prompt these recommendations:

1. Replication of this study to further understand the relationship of this program and the

gains made by students to evaluate group and individual profiles.

2. Replication of this study to further study the effects of gender and the interaction of the intervention (*Fast ForWord*®).
3. Studies that examine two and three year results postintervention to determine if longevity affects results.
4. Studies that compare the effectiveness of the intervention at different grade levels to determine if a specific grade level or age would produce better results.
5. Studies that evaluate teachers and schools' differences to determine if different implementation strategies could produce better results.
6. Additional examination that evaluates attendance records and determines if attendance patterns affect academic intervention and testing.
7. Studies that compare mobility rates of students who participate in the intervention (*Fast ForWord*®) and have movement between schools.
8. Studies that address cumulative effects by examining the results of the intervention's long term effect on students' success and performance.

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