The Effects of Georgia's Choice Curricular Reform Model on Third Grade Science Scores on the Georgia Criterion Referenced Competency Test

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The Effects of Georgia's Choice Curricular Reform Model on Third Grade
Science
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Abstract

The purpose of this study was to evaluate the effectiveness of the Georgia's Choice reading curriculum on third grade science scores on the Georgia Criterion Referenced Competency Test from 2002 to 2008. In assessing the effectiveness of the Georgia's Choice curriculum model this causal comparative study examined the 105 elementary schools that implemented Georgia's Choice and 105 randomly selected elementary schools that did not elect to use Georgia's Choice. The Georgia's Choice reading program used intensified instruction in an effort to increase reading levels for all students. The study used a non-equivalent control group with a pretest and posttest design to determine the effectiveness of the Georgia's Choice curriculum model. Findings indicated that third grade students in Non-Georgia's Choice schools outscored third grade students in Georgia's Choice schools across the span of the study.

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Dedication

I would like to dedicate this work to my dear wife Linda, my best friend, constant companion, inspiration, and the person from whom I learned all things wonderful about education. Her patience, understanding, and gentle prodding provided me with a source of energy through the long hours of study, writing, and time away from her.

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Chapter 1

Introduction

Background of the Problem

The impetus for this research began with a science teacher, the passage of the No Child Left Behind Act (United States Department of Education, 2001), and the dramatic change in curricula for a single Georgia elementary school. The No Child Left Behind legislation placed new accountability on schools based on standardized test scores requiring schools to demand increasing classroom time in literacy instruction. The demand for increased literacy achievement meant that the leadership of the school in question reduced the time spent in classroom instruction for science and social studies and increased the time spent in literacy instruction. The resulting curricular change caused questions in the mind of the science teacher as to the effectiveness of the change in regard to science scores on standardized tests. Reville (2007) referred to this attempt to achieve proficiency in core subjects at the expense of other subjects as narrowing the curriculum.

The move from a more traditional school curricular schedule where all subjects received relative equal status to one where literacy instruction became the focus involved the search for a curricular reform package. During this search a number of elementary schools in the state of Georgia investigated America's Choice®, a curricular reform package from the National Center on Education and the Economy. America's Choice school reform claimed to offer schools solutions that included carefully aligned instructional materials, assessments, management systems, professional development, coaching, and consulting (2006). The curricular reform of America's Choice incorporated a three-hour literacy instructional block that added Reader's Workshop, Writer's Workshop, silent-sustained reading, and a literacy skills block to the daily school schedule. The schedule change required reducing the instructional time allotment from forty to twenty minutes per day for science and social studies to allow for the increased time spent in literacy instruction.

The wide range of Georgia elementary schools choosing America's Choice as a school reform package allowed the state to refer to the package as Georgia's Choice. One hundred and twelve Georgia elementary schools implemented the Georgia's Choice school reform model during that initial 2001-2002 school year. The name change, used from this point forward in this study, refers to local adaptations to the America's Choice school reform model (Georgia's Choice – America's Choice, 2009).

Conceptual Framework

The conceptual framework for this study suggested that student's who learned to read well, comprehended the text presented in the content area of science, and learned to recognize the vocabulary of science increased their science achievement. Coupling this intensive reading instruction with curriculum aligned science instruction possessed the possibility of increasing science scores on standardized tests.

Morrow, Gambrell, and Pressley (2003) noted that learners learn best when interested and involved in the learning. Motivation exerted an influence on the difference between superficial or shallow learning and deep, internalized learning. Two key factors pointed to by the authors included a book or literacy rich environment in the classroom and the opportunities for choice by the student. A classroom with a literacy rich environment, samples from a variety of literacy genres, and opportunity for students to choose what to read allowed development of readers, particularly those motivated to read.

Atkinson, Matusevich, and Huber (2009) concluded that using nonfiction trade books provided students with easier and more interesting reading in science than traditional science textbooks. Again, students provided with exposure to quality nonfiction texts learn from the world around them and increased science content knowledge from their reading.

The National Reading Panel (2000) concluded that comprehension instruction effectively motivated and taught readers to learn and use comprehension in a manner that benefits the reader. Comprehension instructional strategies yielded increased measures of near transfer such as recall, question answering and generation and summarization of textual material. Use of comprehension strategies, according to the Panel, indicated general gains in standardized comprehension tests. The authors of the National Reading Panel report stated that empirical evidence favored the conclusion that teaching a variety of reading comprehension strategies directed increased learning of the strategies, to specific transfer of learning, to increased retention of learning, and understanding of new passages.

In another endorsement of the effectiveness of a literacy rich environment, Johns and Lenski (1997) stated that much of the vocabulary a student learned in school occurred without teacher intervention, but through the exposure to language. Robb (2003) added that teaching vocabulary is crucial particularly in science, mathematics, and social studies where reading and learning new information required exposure to unfamiliar vocabulary.

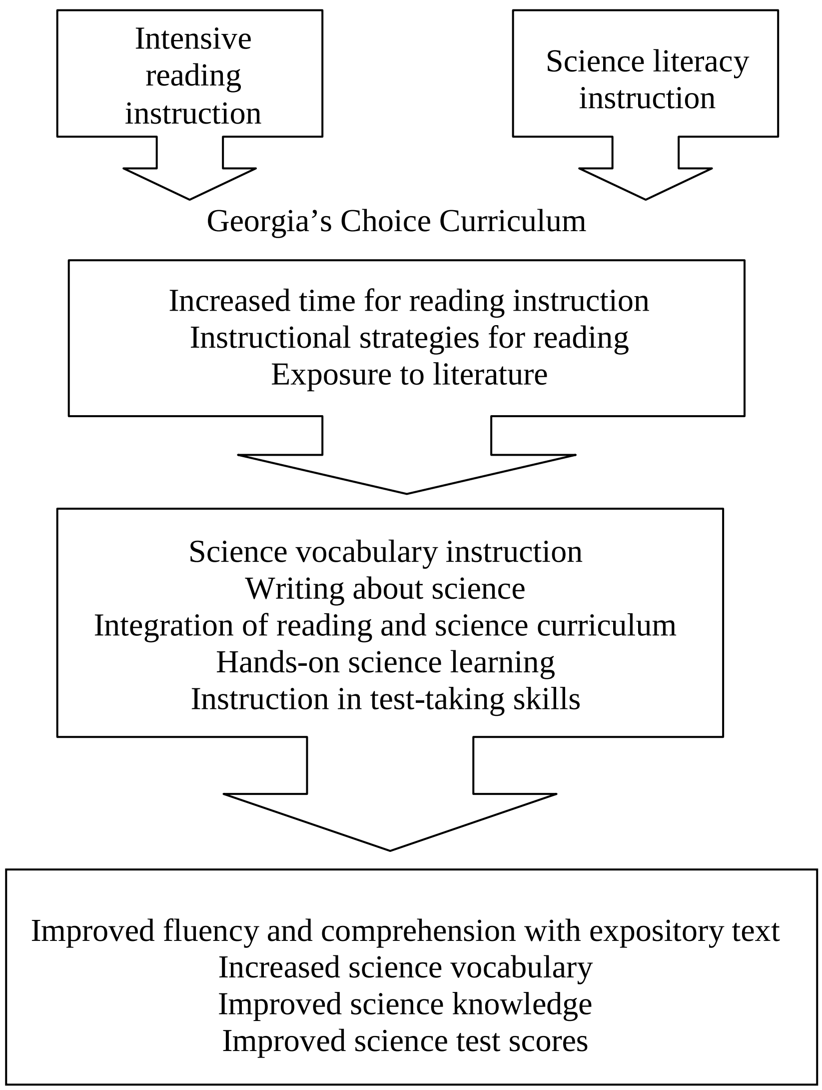
In integrating science and literacy Hapgood and Palincsar (2009) noted that science and literacy intersect when students used reading, writing, and oral language to address questions about the science curriculum. Exposing students to nonfiction texts provided them with an increased repertoire of writing strategies, opportunities for expanded vocabulary, and increased student engagement.

The National Reading Panel (2000) stated that one of the most positive findings regarding literacy was the relationship between vocabulary knowledge and reading achievement. The Panel decided that vocabulary occupied an important position in learning to read. Oral vocabulary was a vital portion to learning to make the transition from oral to written forms, whereas reading vocabulary was critical to the comprehension process.

Greene and Melton (2007) contended that test-taking was a life skill, but one rarely taught effectively to students. The authors offered three fundamental beliefs about preparing students for testing. First, successful test takers were smart readers. Students successful in testing understood that test-taking strategies were also good reading strategies. Standardized reading tests were a specific genre and required general and genre specific reading strategies. Second, successful test takers were able to translate the unique language of the test. Standardized reading tests use formal language that was foreign to most students. Students were helpless on standardized reading tests if they fail to decipher test talk. Third, learning to be a successful test taker was engaging. Carefully planned units integrated test-taking skills into daily reader workshops.

The conceptual framework of this study was teachers of both reading and science provided literacy rich environments in which students receive increased time in instruction in reading, instructional strategies in reading, and exposure to literature including informational texts as a foundation to the reading and science curricula. These components possessed the potential for positive outcomes as it related to the science curriculum. The outcomes included improved fluency and comprehension with increasingly difficult expository texts, increased science vocabulary, improved general science knowledge, and improved science scores on high-stakes tests. Figure 1.1 provides a flow chart of the factors in the conceptual framework.

Figure 1.1 Conceptual Framework



Statement of the Problem

The purpose of this study was to examine the effectiveness of the Georgia's Choice reading curriculum on third grade science scores on the Georgia Criterion Referenced Competency Test (CRCT). In 2001 (Supovitz, Poglinco, & Snyder) the Georgia State Department of Education implemented the Georgia's Choice curricular model in association with National Center for Education and the Economy (NCEE). The implementation process called for a daily three-hour block of time focused on reading instruction.

The initial 112 elementary schools involved in the Georgia's Choice curricular implementation process mandated schedule changes to accommodate the increased demand for reading instruction (NCEE, 2001). Of the initial 112 elementary schools, 105 produced CRCT results on the Georgia CRCT for the six years of the study. In 2003 the state decided against administering the CRCT to third grade students due to testing irregularities (Georgia Department of Education, 2005).

The Georgia Department of Education portrayed the Criterion Referenced Competency Test (CRCT) as an assessment of how well students acquired the skills and knowledge described in the Quality Core Curriculum (QCC) established by the department as the standards of learning for Georgia students. In 2004, the Georgia Department of Education implemented the Georgia Performance Standards (GPS), the new standards for assessing student knowledge on the CRCT. The information from the assessment diagnosed individual student strengths and weaknesses as related to the instruction of the QCC and GPS and gauged the quality of instruction throughout Georgia (Georgia Department of Education, 2005).

This causal comparative study examined the CRCT test scores of third grade students in 105 Georgia's Choice Elementary Schools and from 105 Georgia elementary schools not choosing the Georgia's Choice curricular model for the years 2002 through 2008. The examination continued with a comparison of reading and science scores from the CRCT to determine what effect, if any, increased reading instruction has on CRCT science scores over the same period.

Null Hypothesis

In comparing the science scores of third grade students who received instruction in the Georgia's Choice curriculum with third grade students who did not receive the Georgia's Choice curriculum the following null hypothesis was posed:

There will be no significant difference in the scores of third grade students with instruction in the Georgia's Choice curriculum and science scores of students who did not receive the Georgia's Choice curriculum.

Significance of the Study

National, state, and local educational leaders recognized the mandates of No Child Left Behind (United States Department of Education, 2001) and the necessity for increased student achievement. With an increased emphasis on mathematics and science achievement and the significance of high-stakes multiple choice tests, reading for meaning held importance for students and school leaders. Content specific tests became reading assessments that indicated a student's ability to decode test items and answers as applicable to the subject area.

Learning about science required the ability to access the work of other scientists. This accumulation of work and knowledge appeared mostly in informational text and students who read poorly lacked the capacity to access this information. Kamil and Bernhardt (2004) stated that the need for reading skill in the content area was crucial, regardless of the area. According to the authors, the need for literacy skill was particularly acute in science.

Specifically, the skill to comprehend and correctly answer science questions on the Georgia CRCT became an important skill for not only third grade students, but all students in Georgia schools. This study demonstrated the importance of increased time spent on reading instruction and the importance of teaching reading across the content areas.

Overview of Methodology

This quantitative research analyzed data collected from the Georgia Criterion Referenced Competency Test (CRCT). The assessment instrument, administered each spring during an April testing window, assessed the content areas of reading, English/language arts, mathematics, science, and social studies. Administration included students in grades one through eight. Passing the third grade reading and math portions of the CRCT helped determine the retention or promotion of a student. Students not passing the initial assessment acquired another opportunity for success during a subsequent re-administration of the assessment.

The subjects included each third grade student administered the CRCT in 105 Georgia's Choice schools across Georgia. The selection process for participants required the participants' membership in a class of third grade students in one of the 105 Georgia's Choice elementary schools. The study involved data from the CRCT for the academic years 2002, 2004, 2005, 2006, 2007, and 2008 and investigated gains, if any, in science scores after increased reading instruction. The Georgia's Choice required a more than two hour increase for reading instruction meaning most schools reduced instructional time in other areas. For some schools this meant reducing instructional time for science and social studies. The schools in the study represented a cross section of social, economic and cultural backgrounds and schools from a wide area of the state.

The comparison of reading and science scores on the Georgia CRCT for the academic years 2002 through 2008 provided the opportunity for a causal comparative study. The study used quantitative methods to determine the impact the Georgia's Choice curriculum model on third grade science scores on the CRCT. The study referred to the implementation of the Georgia's Choice curriculum model in 105 Georgia elementary schools as the independent variable and the CRCT as the dependent variable. Schools not choosing the Georgia's Choice curriculum model retained the CRCT as a dependent variable in the study. A t-test compared scores for the six years involved in the study and determined if a statistical significance existed between the means of the two comparison groups.

The participants in this study included students previously enrolled in Georgia elementary schools in both Georgia Choice schools and Non-Georgia Choice schools. The researcher did not manipulate either group in any manner prior to or during course of the study.

Definition of Terms

Adequate Yearly Progress. Adequately yearly progress, established by each state under the No Child Left Behind Act of 2001, determined the achievement of each school district and school (United States Department of Education, 2001).

America's Choice. A curricular school reform package offered by the National Center on Education and the Economy that offered schools professional development, technical assistance, and materials for schools with substantial groups of students who had difficulty meeting standards (National Center on Education and the Economy, 2001).

ANCOVA. An analysis of covariance presented two applications: (1) to remove error variance in randomized experiments, and, (2) equate non-equivalent groups (Ary, Jacobs, and Razavieh, 2002).

Cloze procedure. A method used to estimate reading difficulty by omitting every nth word in a reading passage and observed the number of correct words a reader can supply; an instructional technique in which words or other structures are deleted from a passage by the teacher with blanks left in their places for students to fill in by using the surrounding context (Burns, Roe, and Ross, 1999).

Georgia's Choice. An adaptation of the America's Choice schools reform model adopted by Georgia's State Board of Education in 2001 (Georgia's Choice – America's Choice, 2009).

Georgia Criterion Referenced Competency Test. The Criterion Referenced Competency Test designed by Georgia teachers measured how well students acquired the knowledge described in the Georgia education standards (Georgia Department of Education, 2005).

No Child Left Behind. The No Child Left Behind Act of 2001 reauthorized a number of federal programs with the aim of improving United States primary and secondary education by increasing the standards of accountability and provided parents increased school choice for their children (United States Department of Education, 2001).

Chapter 2

Review of the Literature

Primary Goals of Reading Instruction

According to Fielding, Kerr and Rosier (1998) reading was the first and most basic educational process. From before kindergarten to third grade children learn to read. Children who read with fluency and comprehension functioned well in school yet children who struggled at reading sometimes did poorly for the rest of their lives. The authors claimed that reading was a process skill through which a student garnered information from blackboards, books, and computer screens to learn math, science, literature, and social studies. Additionally, the authors contended that reading was the one skill most directly related to all adult economic activity and a prerequisite for most adult employment, personal fulfillment, and continued democracy. Burns, Roe, and Ross (1999) described the ability to read as vital to functioning effectively in a literate society, while Trelease (2001) portrayed reading as the single most important social factor in American life today. Reading provided the ability to comprehend and communicate in a world that demands strong interpersonal and technological skills for the successful individual.

The lack of education in basic reading skills was a penalty that often followed the child for life through a cycle of failure, lowered self-esteem, decreased effort, and diminished self-expectations. According to Kristen (2004) children not developing the pleasure reading habit had a difficult time reading and writing at a high enough level to deal with the demands of today's world.

As consequential as learning to read was, the act of learning to read involved a complex set of skills. In fact, Srickland (2003) contended that:

> Learning to and write is arguably the most complex task humans face. Becoming literate requires experiences that help make the meaning and importance of print transparent. It requires active involvement and engagement to ensure that the joys of being literate as well as the value of what literacy can do in a very practical sense is appreciated. Although it is undoubtedly true that becoming literate still involves the development of some basic skills and strategies, today low level basic skills that merely involve surface level decoding and the recall of information is hardly enough. Critical thinking and the ability to personalize meanings to individual experiences and apply what is read or written in the real world, under many different circumstances and with many different types of texts, may not be termed the ‘new basics’. (p. *xix*)

The importance of reading and the complex set of skills required in the reading process demanded that students learn to read in order to achieve success as students and, eventually, as adults. As a result, reading became a critical instructional point both in language arts and across the content areas as well.

Johns and Lenski (1997) stated that the primary goal of a reading instruction program as fostering a love of reading in students. The motivation to read became important because students who want to read became better readers. As a result, increased instruction appeared as a necessity particularly in schools where reading scores did not meet Georgia state standards. Assaf (2006) contended that students who read through a love for reading felt successful and confident in meeting other educational objectives. Students cultivating a desire to read persisted in the face of challenges from other academic areas.

Reading, once thought of as a passive process, consisted of a hierarchical list of word identification and comprehension skills that, once mastered, enabled one to comprehend what one read. The new understanding of reading recognized the interactive nature of reading as opposed to the understanding of reading as a passive process. Two theoretical models shaped the current understanding of the reading process. First, the schema theory recognized that reading involved many levels of analysis at the same time but at different levels. The levels included letters, word order, and word meaning. As students read, past experiences (prior knowledge) became a part of the reading experience in both concrete and abstract manners. Related to the schema theory, the interactive theory of reading, held that reading is an active process in which, to comprehend text, students interacted with a multitude of factors related to the reader, the text, and the context in which reading occurs (Heilman, Blair, & Rupley, 1998).

A study by the National Reading Panel (2000) suggested that instruction in early literacy included a systematic and organized teaching of five essential elements in reading. The elements consisted of phonemic awareness, phonics, comprehension, vocabulary, and fluency. The National Reading Panel (NRP) did not study the effects of motivation or the contribution motivation to read made to a successful reader. Morrow and Asbury (2003) segregated the NRP's five elements into two distinct sections of form and function. Phonemic awareness and phonics mechanics fell into the area of form while comprehension, purpose, and meaning related to the function of reading.

When considering reading in the content areas, particularly science, prior knowledge of the reader or student became a key element of understanding and success. While comprehension remained the ultimate goal of all reading, Alexander and Jetton (2000) asserted that existing knowledge served as the foundation of all future learning by guiding organization and representations, by coloring and filtering all new experiences, and by serving as a basis of association with new information. Norton (2004) explained that a reader used prior knowledge of various kinds of texts, knowledge of the world, and the clues supplied by a text to create meaning. Cognitive psychologists referred to prior knowledge, or schema, to describe how humans organized and constructed meaning of reading (Vacca & Vacca, et al., 2003). Students utilized schema to bring meaning to new events and experiences within the pages of their reading.

The information a learner acquired about a topic allowed the organization of the material cognitively into a framework, or schema (Richardson & Morgan, 2003). This framework grew to include other topics, thus creating larger and larger schemata, arranged in a hierarchy. Student's retrieved information by understanding how newly encountered material linked to what students had previously organized cognitively. McKee and Ogle (2005) added that the necessity of children learning the importance of thinking about previously known subject matter prior to beginning reading. This cognitive activity added to the content of the reading and provided additional schema through discussion with the class. Conversely, students with little schema to build upon required exposure to a wide array of reading material in order to acquire background knowledge prior to reading in the content area. According to Heilman, Blair, and Ripley (1998) the student who lacked necessary schemata in relation to the text possessed no way to hypothesize about the text content. Pressley (2000) stated that the richer a child's world experiences and vicarious experiences, the richer the child's schematic base. The author continued including students who read broadly maintained the ability to enrich their own schemata.

Calkins (2001) expressed the importance of teaching students to read nonfiction in terms of addressing the interests of children. Providing nonfiction reading that interests children became one of the first measures in promoting the reading of nonfiction and building schema. By affording students the opportunity to read nonfiction books within the interests of students, teachers cultivated a readiness for skilled nonfiction reading.

Barton and Jordan (2001) instructed teachers to activate prior knowledge by demonstrating basic pre-reading techniques that included brainstorming ideas central to the topic, previewing a passage, noting headings and bold print, and constructing graphic organizers for use in note taking. The authors stressed not only ensuring activated prior knowledge, but that students activate appropriate and accurate knowledge about the content. In activating prior knowledge teachers discovered what children already know about a topic and how to design instruction around missing or incorrect knowledge.

Comprehensive literacy efforts in science demanded attention to background knowledge as stated by Fisher, Grant, and Frey (2009). This foundation, if neglected, reduced science to a collection of memorized facts, rather than science presented as a range of processes that validate and extend real world understandings. According to the authors, an easy manner in which to build background knowledge was through wide reading. A specific time every day to read manageable texts about topics under investigation provided students with the opportunity to incorporate their previous reading experiences into freshly learned material. Reading in this manner provoked students to ask content related questions answerable in further reading.

Robb (2003) described the brain as a vast computer hard drive with folders of prior knowledge ready for use by the reader. The author suggested activating prior knowledge before reading by discussing the topic and vocabulary within as well as previewing the structure of the text. In addition, Robb suggested building prior knowledge by enlarging student knowledge with the use of photos, short passages from magazine articles, film clips, or even guest speakers. Establishing a clear and meaningful purpose for the reading aided students in how to approach the reading passage until students gained experience in reading from nonfiction text.

Another effective comprehension strategy according to Kletzien (2009) included allowing student to paraphrase reading passages as a method of monitoring and increasing their comprehension. Paraphrasing encouraged students to make connections using prior knowledge and access what was already known about the topic. Using this strategy allowed the reader to establish retrieval cues and enabled integration of previously known material with new information in the text. Kletzien contended that paraphrasing allowed student to recognize that understanding the topic is the goal of reading.

Students taught comprehension in the primary grades had difficulty transferring those comprehension skills to expository texts in the content areas according to Kinniburgh and Shaw (2009). The authors noted the decreased time spent in instruction in science classrooms as a reason that instruction in comprehension strategies not be the sole responsibility of the language arts teacher. Because language arts and science have natural connections, the authors found it important to teach comprehension in science to promote understanding of the text. Incorporating comprehension strategies into science instruction provided students with skills to become successful at reading and comprehending concepts in a variety of texts. According to Kinniburgh and Shaw improved test scores were the result of increased training in comprehension strategies in content area reading.

Differences in Text

The difference between teaching narrative and informational texts became easily apparent. Teachers often felt a lack of success in teaching narrative texts as opposed to the teaching of informational texts (Buss & Karnowski, 2002). One possible reason existed in the nature of the texts and variety of text structures found within informational books. The ability of the reader to construct meaning from the organization of the texts became paramount in understanding the full meaning. In addition, confusion concerning the reading of informational often resulted from the heavy emphasis educators placed on the structure rather than the author's purpose for writing the book. While this appeared logical, a students' understanding of the authors' purpose resulted in a visualization of the organization of the text.

Students made connections to prior knowledge by using text-to-self, text-to-text, and text-to-world connections according to Miller (2002). The connections that students made provided understanding about the reading and allowed for predictions about current readings based on previous knowledge or schema. Miller contended that connections such as the aforementioned also built schema for authors, text types and text elements.

Nonfiction text, particularly in science textbooks, added another dimension in the importance of linking science and literacy instruction. The importance of activating prior knowledge, a key element in students reaching the full comprehension of content area reading, became only one of the critical components of reading in the area of science instruction. Text structure and the elements of nonfiction text required direct instruction to ready students for the content of textbook reading.

Nonfiction texts, also known as expository or informational, communicated factual information to the reader. Expository texts contained more unfamiliar vocabulary and concepts, fewer ideas related to modern culture or knowledge, and less information directly related to personal experience (Meyer and Poon, 2001). In addition, Hall, Sabey, and McClellan (2005) pointed out that expository texts contained structural patterns differing from other types of texts more familiar to students. Expository texts often contained multiple structures that included description, sequence or procedure, enumeration, causation, problem and solution, and compare and contrast.

Vacca and Vacca (2002) discussed the more formal features of informational or expository texts that authors added to facilitate reading. Nonfiction texts normally included a preface, table of contents, a bibliography, appendices, and indexes. These features provided aid as valuable tools for prospective readers by organizing the text for easier utilization. In addition, Vacca and Vacca included the use of introductory and summary statements, headings, graphs, charts, illustrations, and guide questions in expository texts. Lapp, Fisher, and Grant (2008) insisted that many struggling readers failed to recognize the importance of text features that added to the comprehension of the text. Lapp, Fisher, and Grant (2008) encouraged teachers to instruct readers in the fact that text features aided in focusing readers on key ideas or important points in content reading.

Vacca and Vacca (2002) also distinguished between external and internal text structures. External structure of text referred to the overall instructional design or format of the text, while internal structure referred to the interrelationships among ideas within the text. The external features of the text related to the organizational structure built into the text to facilitate reading. The preface, table of contents, bibliography, glossary and index offered readers organizational cues to comprehending the content of the text. Furthermore, the headings, graphs, bold print, captions, illustrations, and visual aids represented the internal structure of the text and can aid the reader in connecting ideas in a coherent whole.

Adding to the difficulty of reading expository or informational texts, Alexander and Jetton (2000) described the linear and nonlinear nature of writing. Linear texts designated material in which the reader made decisions relative to processing. Nonlinear texts, on the other hand, amounted to connected discourse that guided or prompted the reader though the reading of the material. Goldman and Rakestraw (2000) explained a variety of cues competent readers gleaned from reading as potential processing instructions for constructing intended connections among concepts. Structural cues in the text lacked effectiveness if readers did not possess the schema necessary to recognize and interpret the cues. Surface structure order referred to the meaningful order of the written word in the English language. Poor readers often missed meaning based on word order and required direct instruction in order to comprehend text. Text often contained linguistic and graphic cues that guided readers processing of the underlying coherence relations expressed in the text. According to Goldman and Rakestraw (2000) graphic cues held particular importance in regard to titles, headings, subheadings, and paragraph spacing by highlighting the overall structure of the text for the reader. Additional forms of graphic cueing included font style such as boldface, italics, and underlining to mark words, phrases, or sentences in a special way.

Providing additional complexity to the text structure discussion, Dymock (2005) described common expository text structures as either descriptive or sequential in nature. The descriptive pattern focused on the attributes of a particular topic. Three common descriptive patterns found in expository reading for student included the list, web, and matrix (compare and contrast) text feature. The sequential text pattern presented a series of events that progressed over time, normally in a first-to-last configuration. The author stated that students with an understanding of textual patterns possessed fewer problems with comprehension of textual material. Students without this knowledge required interventions that included direct instruction in methods of comprehending expository text structure.

One method of providing students familiarity with nonfiction or expository text involved early exposure to expository text in primary grades. In Kindergarten, First, and Second grades the primary reading material involved picture and story books of the narrative genre. Donovan and Smolkin (2002) encountered teachers with feelings that nonfiction texts in the primary grades contained a foreboding aura or mysterious content too difficult for children to comprehend. Donovan and Smolkin contended that proper consideration of genre, content, and visual features excited interest in the world of science, fostered discoveries in science and language use, and invited connections to life inside and outside the classroom walls. Yopp and Yopp (2006) agreed that early exposure to nonfiction engaged children in processes common to science and literacy such as, predicting, generating questions, summarizing understandings, and used data to draw conclusions.

While acknowledging the strong correlation between reading comprehension and knowledge of text structure, Manzo, Manzo, and Estes (2001) provided a dissenting opinion in the area of explicitly teaching text structure. These content area reading specialists asserted that elaborate instruction in classification schemes remained unnecessary and counterproductive. The trio claimed that in teaching students to read for meaning, awareness of text structure increased; but when instruction included identification of text structures, comprehension did not follow to the same extent.

While dissenting views existed, some experts and researchers in the field of reading instruction appeared to agree that direct instruction in text structure provided a schema for students in the genre of informational text. In discussing the necessity for the teaching of expository text in the primary grades, Moss (2004) cited the demand of the era where information literacy continued to grow at an alarming rate. The recognition of this demand caused many teachers to aid students in developing a familiarity with and an understanding of expository text. Since the advent of NCLB classrooms teachers' felt the urgency to increase reading instruction sometimes at the expense of science instruction. Stone (2007) urged teachers to incorporate reading into the science curriculum as a means of understanding the scientific process. Reading with clarity, understanding, and making application in reading held as much importance in nonfiction texts as in fiction.

In research done by the National Reading Panel (2000), the Panel stated the critical nature of comprehension in learning to read. In the Panel's research on comprehension three predominant themes consistently emerged. First, reading comprehension, a cognitive process, integrated complex skills in which one must understand the critical role of vocabulary learning, instruction and its development. Second, interactive strategic processes became critically necessary to the development of reading comprehension. Third, the preparation of teachers to best equip educators to facilitate the complex processes remained critical and intimately tied to the development of reading comprehension. Teaching comprehension strategies yielded increases in measures of near transfer such as recall, question answering and generation, and summarization of texts. Instruction in comprehension strategies, when used in combination, indicated general gains in standardized comprehension tests.

Johns and Lenski (1997) described active readers as readers achieving a deep comprehension of text through the application of various strategies in the process of constructing meaning. First, active readers utilized prior knowledge allowing the reader to seek and select relevant ideas from the text and make predictions about the meaning. Second, active readers also used the text structure to construct meaning. Knowing the textual structure of texts allowed students to understand the organization of the text and construct meaning. Third, active readers monitored comprehension during the process of reading. Through consciously thinking about reading, students understood if a text made sense. Fourth, active readers processed text after reading which resulted in a deeper understanding of the text.

The act of teaching students to read involved the expectation that students construct meaning from the reading. Pressley (2000) maintained that most of what matters in reading instruction matters because ultimately instruction affected whether the student developed into a reader who comprehended what is in text. Pressley divided comprehension into two distinct processes of lower and higher order involvement in reading. The lower order processing involvement included word level skills that involved decoding skills and vocabulary knowledge. The processes above word level that affected comprehension were automatic relating of text content to prior knowledge and the conscious, controllable processing of reading while reading text.

In discussing decoding, Pressley (2000) pointed to evidence that skilled readers did not sound out individual letters when encountering an unfamiliar word, but rather recognized common letter chunks such as recurring blends, prefixes, suffixes, Latin and Greek root words, and rhymes of the language. In recognizing the importance of vocabulary in reading comprehension, Pressley noted the link between vocabulary knowledge and comprehension. When the comprehension of a sentence or passage depended critically on one word, the potential for lack of vocabulary knowledge undermining comprehension became obvious.

Pressley’s discussion of the conscious, controllable processing of reading included a number of processes students use while reading texts (2000). Mature readers possessed an awareness of the purpose for reading; mature readers previewed the text to determine appropriateness to the goal of the reader; skilled readers read selectively focusing on portions of the text most relevant to the goal of the reader; and, skilled readers made associations to ideas presented in the text based on prior knowledge. In addition, Pressley cited the ability of mature readers to evaluate and revise hypotheses that arose during reading, revise prior knowledge inconsistent with ideas from the text, noting the meaning of novel words in the reading, underlining, rereading, or note making during the reading process, and thinking about how to use information garnered during the reading of text.

Duke and Pearson (2002) concurred with Pressley, adding that mature readers read different types of texts differently and in reading expository texts mature readers frequently constructed and revised summaries of that material read. The two authors added that direct instruction in reading comprehension included a great deal of time actually spent in reading, the experience of reading real texts for real reasons, the experience of reading a range of genres, an environment rich in vocabulary and concept development through reading, experience, and discussion of words and word meanings, substantial facility in the accurate and automatic decoding of words, experience in the writing of texts for others to comprehend, and, finally, an environment rich in quality discussion about text.

Reading for purpose played an important role in comprehension according to Burns, Roe, and Ross (1999) in those students who read with purpose tended to comprehend the reading material better than children who read without purpose. A single purpose appeared more effective for poor readers in that a single purpose helped avoid cognitive confusion from the overload of multiple purposes. In setting the purpose for reading one strengthened the reader’s ability to differentiate between relevant and irrelevant information.

According to Block and Pressley (2003) and McKee and Ogle (2005) teaching vocabulary increased comprehension skills. However, skilled comprehension concerned much more than the processing of individual words in print. Block and Pressley (2003) stated that good readers remained active and strategic while reading through the following:

> Good readers generally read from the beginning to the end of a text; good readers encounter information especially relevant to the goal of reading the text; good readers anticipate the content of the text based on prior knowledge about the topic of the text; good readers monitor the process of reading; and good readers reflect on the text by thinking about how to use information in the text (p. 114).

Block and Pressley referred to the set of skills listed above as comprehension processes. The authors defined the process as a set of meaning making skills, strategies, and thought processes that readers initiated at specific points in a text to understand, apply, and appreciate authors' writings.

In *Literacy Navigator* America's Choice (2007) suggested that in order to comprehend a text, the reader needed to act on two items simultaneously. First, the reader was required to link the ideas expressed through the words, phrases, and clauses into a coherent whole. Second, the reader was required to pull from long-term memory relevant background information as it pertains to new material. In processing text the reader did not possess sufficient short-term memory to hold all the information. To remedy the situation the minds links the ideas into a network what America's Choice called the "textbase". Simultaneously the reader brought forth background knowledge or schema to enhance understanding and create a mental model. Comprehension is the result of interaction between the "textbase" and the mental model.

Yore, Bisanz, and Hand (2003) concurred stating that readers construct understanding in short-term memory by extracting information from the text based situation. The authors termed this bottom-up processing because readers retrieved information from their long-term memory and decided how to use that information in a specific context. Science reading, according to the authors, included an interaction between what is known, concurrent sensory experience, and information gathered from print directed at constructing specific meaning.

"Textbase" according to *Literacy Navigator* included the ability of the reader to recast or recall the meaning of a sentence or paragraph. The ability to produce work of this nature quite likely meant that the reader understood the textual material. In order to build a coherent representation of what the text means, the reader was required to link all the various parts of the text – sentence-to-sentence, paragraph-to-paragraph. America's Choice (2007) defined this first strategy of "textbase" as saying what the text means.

"Textbase" strategy two included making ideas cohere. According to America's Choice (2007) when students had difficulty with recall, factors such as misunderstandings of connectives or cohesive devices that appear in print. Connectives such as although, thus, which, and however when misunderstood provided difficulty for students attempting to recall text.

The third strategy in *Literacy Navigator* (2007) addressing vocabulary suggested that two problems existed in reading science vocabulary. First, students had difficulty with words already known in different contexts. Words such as property(ies), positive, negative, forces, and bond(ed) had different meaning outside scientific context. This lack of familiarity with words such as those mentioned provided confusion for students working through text. Second, words with domain specific context provided students with problems. Students without relevant background knowledge became lost in the language of the text. Domain specific vocabulary knowledge required a developed understanding that came through reading domain specific textual content.

Questioning during and after reading, a fifth strategy in *Literacy Navigator* (2007), or focused reading, maintained a goal of spending more time considering the ideas, information, and assertions of the text as a whole. Questioning at the end of the text forced students to support judgments gathered during the reading of the text.

Knowledge of text structures, a fifth strategy of *Literacy Navigator* (2007), allowed readers to approach a text appropriately and organize information in a manner that provided an easier manner in which to store information for later use. The domain specific vocabulary, definitions, charts, diagrams, graphs, process explanations, and details required made text structure knowledge crucial to successful reading in the content area of science.

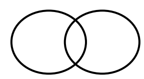
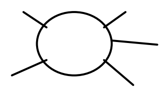
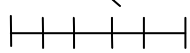
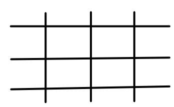
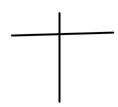
Tankersley (2005) agreed that effective readers possess a purpose for reading, use background knowledge and experience a relationship to the text, but expressed the following four factors as critical to reading comprehension: (1) command of the linguistic structure of the text, (2) adequate vocabulary in the content area, (3) degree of metacognitive control of the text, and, (4) adequate domain knowledge. The command of the linguistic structure of the text referred to the reader’s ability to decode text quickly and easily in order to not detract from the task of drawing meaning from the text. An adequate vocabulary enabled readers to process words with automaticity during reading while the degree of metacognitive control of the text referred to the ability of the reader to self-monitor and reflect on the level of understanding during the act of reading. Finally, adequate domain knowledge meant that the readers' background knowledge aided in connecting to the text during the process of reading. Without connection, Tankersley maintained the reader derived little meaning from the text and without meaning, little or no comprehension results.

The aspect of text structure also impacted the comprehension of text according to Barton and Jordan (2001). The two components of organization and presentation in text structure directly impacted comprehension. Teaching the organization of text allowed the reader to locate key information, identify relevant and irrelevant information, impose some organization on text in which the organization is only implied, synthesize information that appeared in different locations within a text or from a number of texts, connect new information with what prior knowledge, restructure schema to account for new learning, and organize the recall of information read. In a similar manner, acquainting students with text presentation also enhanced comprehension. According to the authors, well presented physical text assisted reading comprehension. In addition, text structure and student awareness of text structure offered strong correlation to reading comprehension much the same as explicit instruction aided in the physical presentation of text and/or text structure aids in reading.

Science educators taught science with a concern for how well students read and understand science content as a way to integrate science concepts into a subjective understanding of the world (Thier, 2001). Because of the above expectations, teaching and learning strategies for reading targeted the crucial area of comprehension. Thier noted the following expectations of effective readers in science: Made accurate interpretations, inferences, conclusions, and real-world connections about the text, supported personal understandings and interpretations of the text with detail and convincing evidence, used evidence to interpret and apply ideas, compared and contrasted themes and ideas, made perceptive and well-developed connections among concepts in the reading, and, identified and evaluated writing strategies to understand how the author presents a point of view. According to the author, students must understand that reading involved more than merely collecting pieces of information but also required the ability to synthesize the information into a complete, deep, and personally meaningful understanding.

Duke and Pearson (2002) asserted that instruction in reading comprehension remain balanced. That is, good comprehension instruction included both explicit instruction in specific comprehension strategies and ample time and opportunity for actual reading, writing, and discussion of text. The features of effective comprehension instruction included a great deal of time spent actually reading, experience reading real texts for real reasons, experience reading the range of text genres that teachers wish students to comprehend, an environment rich in vocabulary and concept development through reading, experience, and discussion of words and their meanings, substantial facility in the accurate and automatic decoding of words, time spent writing texts for others to comprehend, and an environment rich in high quality talk about text. The authors contended that teaching strategies and processes such as the ones above improves the comprehension of readers when used in a balanced approach.

Literacy Navigator (2007) contended that use of graphic organizers during reading allowed reading to display relationships between ideas. Students who used graphic organizers made non-linguistic representations which existed because graphic can represent what language cannot and vice versa. Graphics represented an inference from the language rather than what the language actually presented and allowed students the opportunity to compare information from the text to the graphics. *Literacy Navigator* offered a variety of graphics organizers shown below that aided student in being more successful in comprehending science or nonfiction material:

1. Venn diagrams 
2. Webs 
3. Timelines 
4. Matrices 
5. T-Charts 

Jacobs (2002) described comprehension as a three-stage process that concerned both the reader and the text. In Stage One the reader activated prior knowledge about the content that included brainstorming, utilizing graphic organizers, or cloze exercises. Pre-reading activities not only prepared students to understand the text but also aided vocabulary and study skills. In Stage Two the teacher provided students with a structured manner in which to integrate the background knowledge brought to the reading with new knowledge provided by the text. This stage, also known as guided reading, provided students an opportunity to probe the text beyond its literal meaning for deeper understanding. In Stage Three, or post-reading, teachers provided students with an opportunity to reflect and test the validity of the students' tentative understanding of the text. The Georgia's Choice curriculum provided all three components as necessary portions of reading instruction.

Proficient readers planned, self-monitored, analyzed, and synthesized information throughout the reading process (Freeman &Taylor, 2006). Proficient readers set a purpose for reading without teacher guidance, regulated the rate of reading for clarification, and reflected on reading. Strategic readers chose appropriate monitoring strategies and knew to alter the strategies according to their effectiveness. Students with competent self-monitoring strategies developed an instinct for detecting inconsistencies in their comprehension and thereby improved memory and recall of text. The ultimate goal for any reader remained extrapolating information from the words of the text.

Teale, Paciga, and Hoffman (2007) stated that instruction in comprehension began in the primary grades. The authors maintained that during the primary grades it was essential to teach children appropriate comprehension strategies and skill that enabled students to understand texts more complex than those made of everyday words already known and heard in regular conversation. Successful readers did not develop merely from reading texts that have transparent or innocuous ideas. Good books became the key to creating good readers.

Fisher, Grant, and Frey (2009) added that in addition to wide exposure to reading, solid science literacy instruction required attention to vocabulary. The authors suggested five initiatives that result in significantly increased word knowledge which generalizes to reading comprehension skills. The five initiatives include:

1. Make it intentional,
2. Make it transparent,
3. Make it usable,
4. Make it personal,
5. Make it a priority.

Making it intentional included carefully selected words that matter in instruction. Fisher, Grant, and Frey (2009) considered three types of words considered as important in science literacy. Tier one words included words basic to reading or words typically used in spoken vocabulary that students rarely need teaching. Tier two words included specialized words that often change meanings in different contexts. Tier three words included technical terms that are content specific. Planning instruction around specific words ensures that vocabulary instruction is intentional.

Making it transparent revolved around teacher modeling of specific vocabulary words. Transparent word solving occurred through the use of context clues; word parts such as prefixes, suffixes, roots, or cognates; or outside resources, including dictionaries and people.

Making it usable referred to students using vocabulary words they are learning in peer conversations and writing. The authors suggested that student use of words allowed students to incorporate target words into their daily language.

In making it personal teachers required students to apply vocabulary words to new situations. According to the authors this was a critical, but often neglected area of vocabulary instruction. Over time this intentional instruction allowed student to personalize their word learning and develop sophisticated vocabularies. The increased vocabulary provided students with increased reading skills and the ability to garner new information from their reading.

The final component, making it a priority, required daily instructional time devoted to word learning. The authors suggested that improved scientific understanding and science achievement required attention to the role of instruction in background knowledge and vocabulary learning.

The difficult nature of science vocabulary coupled with the complexity of text structure in expository texts compelled the reader to become more involved with the content as opposed to the text structure and vocabulary in many narrative readings. Students interacted with the text involving the utilization of prior knowledge and text structures in order to construct meaning in the process of decoding words and sentence structure, as well as, reading fluently. In addition, active readers processed text after reading in an attempt to build new knowledge or change existing knowledge. Manza, Manza, and Estes (2001) referred to this process as post-reading schema building. Approaches to aiding students in acquiring post-reading strategies included peer discussion and writing activities, provided students with the opportunity to process and evaluate responses to reading prior to additional classroom activities.

Post reading interaction with the text held importance because the activity assisted students in organizing and retaining information garnered from the text. Freeman and Taylor (2006) declared that writing about the reading process as a concluding activity occupied the process of synthesizing, forming generalizations, evaluating and making connections. The strategies proposed by the authors' involved higher-order thinking skills and promoted the thinking process beyond the recall of information, allowing to students to infer and analyze.

Post reading, or the reflection phase, as noted by Richardson and Morgan (2003), involved three by-products through the clarification and retention of the reading material within the text. The first by-product made students think critically about learned information and the learning to come from the reading. The second by-product induced student reflection on the reading that aided in retention of material for longer periods of time. Finally, the third by-product of reflection provided the opportunity for students to demonstrate learning through some system of evaluation.

The primary goals of reading, as a review, pertained to active readers activating prior knowledge before and during the reading process, active readers utilizing the text structure to construct meaning, active readers monitoring comprehension during the reading process, and active readers processing text after the reading of the text. Each goal maintained the necessity and critical nature of the role of remaining active before, during, and after the reading process. The overall goal then remained the process of gaining and retaining information acquired from the material within the text.

Hall, Sabey, and McClellan (2005) divided texts into two major categories of narrative and expository. The authors explained that narrative, or story texts, depict events, actions, emotions, or situations that people in a particular culture experience. Narrative texts typically following a hierarchical structure included grammar structure to highlight the hierarchical structure and provided a framework for the placements of elements and episodes within the structure.

Hall, Sabey, and McClellan (2005) defined expository texts as writings in which the focus included conveying and communicating factual information. Expository texts contained more unfamiliar words and concepts, fewer ideas related to the present and less information directly related to personal experience. The basic structural patterns of expository texts included description, sequence or procedure, enumeration, causation, problem/solution, and compare/contrast.

While classroom libraries remained divided into two large categories or genres known as fiction and nonfiction, or expository and narrative writings, Kletzien and Dreher (2004) made the case for a division of informational or expository texts into three categories that included narrative, expository, and a combination of the two. The narrative-expository text contained writing in a story form that conveyed factual information in a more appealing or easy to read approach. This format contained story elements that included characters, goals, and resolutions. The expository-informational text utilized expository text structure such as cause and effect, comparison-contrast, sequence, description, and problem solution. Expository-informational books also explained the natural and social world, including animals, places, and cultural groups. The mixed text, or combination of the narrative and expository text, combined both narrative and expository writing and while written in story form, often contained voice bubbles or text in different type face used for facts in the story.

Hall, Sabey, and McClellan (2005), reasoned that while difficulty in comprehending expository text exists due, in part, to the limited cognitive development and experience of primary aged children, the difficulty occurred from controllable sources. The manipulation of sources such as (1) availability of well-written texts, (2) limited exposure to expository texts, and (3) teachers' lack of familiarity with expository instruction resulted in increased success later in school and beyond.

The debate also existed among those that maintained that children's fiction contained anthropomorphic depictions of plants and nonhuman animals and caused confusion for students according to Gomez-Zwiep and Straits (2006). Anthropomorphic depictions caused misleading inferences according to some, but the authors maintained that texts with anthropomorphisms provided great opportunities for meaningful scientific learning about animals and their characteristics, while developing students' understanding of different types of texts.

A carefully selected classroom library provided students with a well-rounded choice of narrative and expository texts. The exposure to a variety of texts enriched the reading experience of children on the primary level and allowed for an easy from transition from narrative to expository experience in the upper elementary grades.

Nelson (2003) noted the increasing dependency of the world, in general, on science and technology. This dependency affected the effectiveness of science education meaning that a poor science education rendered a portion of the population scientifically illiterate. The definition of literacy required an expansion to include not just reading and writing, but science, mathematics, and technology.

Science instruction required time in reading informational texts, responding to informational texts, and hands-on experimental activity. When literacy instruction and content learning, i.e. science learning, used an integrated approach, literacy learning benefits from the students' interest in science topics (Morrow, Pressley, & Smith, 1995). Science learning benefited because literature provided new sources of information, and writing stimulated new active engagement with the science content. The goal of this instructional method included developing a competent, strategic reader who was motivated to read for pleasure and information.

Critical components of science instruction

While reading is a critical component of science instruction, the opportunity to include concrete, semi-concrete, and abstract instructional materials allowed learning to accrue. Concrete materials including physical items and science equipment, semi-concrete materials such as illustrations, slides, and videotapes, and abstract materials that include reading, writing, listening, and speaking activities offered a more complete instructional picture according to Ediger (2002). As a result, instructional time, and materials that included the concrete, semi-concrete, and abstract, became an important aspect of teaching the science curriculum.

Yager (2004) found that young children, in particular, often needed to have a particular experience first before reading about or discussing the underlying concept. Science experiments, hands-on experiences, or manipulating concrete materials allowed students to scaffold learning before reading or discussion. Thier (2002) contended that children learn better when experiencing an event instead of learning about the same event in a textbook or hearing about it in a lecture. Thier (2002) explained that students retain only five to ten percent of material read in textbooks as opposed to eighty percent of details of an experienced event.

The critical component of hands-on exploration with concrete materials caused the question, where do the concrete materials to conduct hands-on lessons come from? Many schools had science labs stocked with materials for allowing students to experience concrete examples during a science lesson. The National Research Council (2000) suggested teachers develop a list of common household materials and supplies and have students collect the items from home and bring the materials to school. Another suggestion for schools without classroom sets of science materials included developing a pool of materials that teachers shared in working with experiments and hands-on activities.

Semi-concrete materials also played a role in using informational or expository text in science lessons. Text, particularly in science, referred to more than words on the page according to Cervetti, Pearson, Bravo, and Barber (2006). The diversity of visual elements extended from photographs to highly complex charts, graphs, and diagrams. The use of visual representations supported new information and printed text. Visual representations offered re-representations of textual information in a visual format and aid visual learners. Visual and print representations combined to communicate complex arrays of ideas, evidence and claims about natural phenomena. Visual representations served three special functions that support students' ability to recognize relationships, solve problems and draw conclusions. First, visual representations aided relationships among facts, concepts, and patterns in a way that increased the likelihood that students develop a rich and elaborate set of connections among these elements. Second, visual representations made transparent what can otherwise be obscure. Third, visual representations condensed large amounts of information in ways that facilitate drawing of conclusions.

Multiple studies (Cervetti, Pearson, Bravo, and Barber, 2006; Kletzien and Dreher, 2004; Duke and Pearson, 2002) suggested that illustrations represent and clarify information and often extend the information within the text. The authors also agreed that reading visual elements in science required an understanding of the elements form, purpose, and function. The focus of visual texts in science invited an emphasis on instructing students' in both literal and interpretative comprehension tasks.

Smolkin and Donovan (2004) maintained that science, perhaps more than any other discipline, required the use of multiple modes of making meaning. Teachers occasionally communicated through visual channels such as drawing diagrams or displaying pictures. Science ideas communicated through both printed and visual representations complemented each other to clarify, contextualize, reinforce, extend, and expand verbal the content of the text. In order to make the best use of science information books the authors suggested that teachers view texts as both verbal and visual. The semi-concrete aspect of science instruction played a critical role in the overall success of reading in the content area of science. The ability of students to comprehend and understand printed text and visual representations added to clarification of the science content.

Writing, one of the four components of abstract science instruction, involved a variety of elements in and of itself. The simple process of writing a note, a message to a friend, or an answer to a study guide question imparted an element of commitment to writing that the process lacked previously. The process of writing something down made the process more real, more concrete, more likely to be remembered (Manzo, Manzo, and Estes, 2001). When students thought on paper to express thoughts, feelings, and opinions, the writing resulted in students responding to and exploring ideas encountered within the text. According to Vacca (2002) writing assignments allowed students the opportunity to make sense of text material. Specific writing-to-learn strategies aided students in focusing on information encountered in text beyond a level of recall.

Classroom teacher Susan Carter (2009) introduced writing in the mathematics classroom to extend students thinking about strategies used during the class and to increase mathematics vocabulary. Using this two-pronged approach connected mathematics and literacy in a new manner that allowed students to combine the precise language of mathematics and the permission to use their literary talents in describing mathematics learning. According to Carter, this approach produced results that extend to other content areas as well.

Fournier and Edison (2009) used the writing and language arts connection to extend student knowledge about ant communities. In reading a fictional story about two bad ants, students launched a hands-on investigation about live ants that introduced the process of investigation and research. In language arts the story prompted lessons about point of view, sensory details, and developing the writing process. Connections between science and language arts provided students with learning opportunities in both areas.

Yore, Bisanz, and Hand (2003) stated that effective writing-to-learn science programs required explicit instruction and writing tasks that considered the full range of genre including narrative, descriptive, explanation, instruction, and argumentation. Narrative involved the temporal, sequenced communication found in diaries, journals, learning logs, and conversations. Descriptive included personal, common-sense, and technical descriptions, informational and scientific reports, and definitions. Explanation included sequencing events in cause and effect relationships. Instruction included ordering a sequence of procedures to specify directions, such as a manual, experiment, or recipe. Finally, argumentation required ordering of propositions to persuade someone in an essay, discussion, debate, report, or review. The Georgia's Choice curriculum within Writer's Workshop consisted of the genres of narrative, persuasive, and informational.

According to the National Center on Education and the Economy (1999), the developers of America's Choice curriculum, reading was the process of understanding written language and writing was the process of communicating with written language. Reading and writing then related as parallel processes. The America's Choice authors' stated that in order for students to produce the type of writing the modern world requires, the foundation for learning writing must begin in the primary grades. The earliest form of informational writing appeared in the primary grade in the form of lists and random words students knew and could approximate the spelling. By third grade, according to America's Choice, students possessed the ability to produce coherent informational reports that introduced a topic; described characteristic activities, events related to the topic; employed a useful organizational structure; adequate elaboration; and provided some type of closure.

The National Association of Educational Progress measured the ability of children to write narrative, informative, and persuasive texts at grades four, eight, and twelve (Greenwald, Persky, Campbell, and Mazzeo, (2002). Kleitzen and Dreher (2004) stated that since the expectation for children to write these three types of texts existed, the need to begin teaching writing in these three styles became important in the primary grades. Because reading and writing develop together, teaching informational writing allowed for a natural outgrowth of the reading that primary teachers encouraged in their classrooms.

Kleitzen and Dreher maintained that writing aided students in exploring, reorganizing, and consolidating information collected from reading and exploring expository texts.

Stead (2002) described the importance of writing nonfiction texts in the context of purposes and types of nonfiction texts. Nonfiction texts described through captions, labels, illustrations, scientific reports about animals, plants, and machines, reports about countries and people, letters, definitions, and personal descriptions. Nonfiction writing also explained the how and why of occurrences and phenomenon, elaborations, and reports. Nonfiction writing also served to instruct through recipes, rules, directions, experiments, games, lists, and maps. The persuasive type of nonfiction writing debated, reviewed, advertised, evaluated, and provided opportunities for posters, cartoons, and book reports. In addition, nonfiction writing provided students with the opportunity to retell information through reports, autobiographies/biographies, journals, and historical retellings as well as exploring and maintaining relationships with others through cards, letters, and interviews.

Knipper and Duggan (2006) made the distinction between learning to write and writing to learn. Writing to learn became a catalyst for further learning and meaning making. Students discovered information concerning personal content focus, language, the ability to communicate learning to a variety of audiences. Jacobs (2002) concurred explaining that writing to learn allowed students to make meaning of learning and proceed from understanding to demonstrating understanding. Excellent written communication skills became extremely important for success not only in education, but the world beyond. The importance of nonfiction writing in relationship to science learning remained as symbiotic as reading does to writing.

Freeman and Taylor (2006) stated that integrating writing and literacy into science instruction provided additional time for instruction and established relevance between content areas. Allowing students to make text-to-text, text-to-self, and text-to-world connections promoted skills essential for developing comprehension and lifelong learning. Science skills such as classifying related well to identifying the main idea in reading and outlining information in writing. Science experimentation connected to sequencing in reading and writing procedures in writing. Observing in science curriculum corresponded to identifying cause and effect in reading and listing cause and effect in writing.

Listening, another abstract component to learning in the content area of science also held critical import in all of learning. Roth (2004) urged teachers to foster the development of science literacy through listening attentively and observing students during class discussions. Manzo, Manzo, and Estes (2001) agreed that listening to students during discussion modeled effective listening and instructs students in how to listen to one another.

Research indicated that children spent fifty percent of the classroom day listening (Norton, 2004). However, the fact that children spent half of each school day listening did not automatically mean that students learned the varied skills necessary for comprehensive listening. Teaching children to improve listening skills through explicit listening instruction aided comprehension skills in all content areas including science. Norton described listening as an active rather than passive process and encouraged teachers to develop listening skills by asking students to restate questions, directions, and explanations. Encouraging students to develop listening abilities by understanding the consequences of listening provided motivation for listening in the classroom.

Norton (2004) stated that critical reading and listening extend beyond factual comprehension; the dependant relationship required weighing the validity of facts, identifying the problem, making judgments, interpreting implied ideas, interpreting character traits, distinguishing fact from opinion, drawing conclusions, and determining the adequacy of a source of information. Explicitly teaching comprehensive listening skills encouraged students to make meaning of their learning across the curriculum.

Communicating orally, another critical abstract component of science learning, concerned the ability to effectively communicate in classroom discussions, one-on-one with the teacher, in small groups, and making presentations in large group settings. Students possessed a need to hear words spoken correctly before teachers ask students to speak, read, or write (Tankersly, 2005). Fostering rich and descriptive discussions in classrooms was one strategy for developing and expanding the vocabulary of students in the classroom. Yore (2004) added that talking, listening, reading, and writing encompassed important abilities for scientists as they make sense of experiences, present research questions, and persuade other scientists about their work.

Oral and written communication and the practices speaking, listening, writing, and reading held particular importance in the scientific community according to Yore, Bisanz, and Hand (2003). Scientists who communicated well experienced success within the scientific community, funding projects, and society as a whole. Scientist who attempted to convey a message used the linguistic tools necessary to bridge the gap between speaker and listener or writer and reader.

Researchers Hapgood and Palinscar (2007) claimed that students required opportunities to use oral and written language to learn about the world and communicate their ideas and observations. Inquiry based science required a collective effort in which students compare thinking with others' thinking, actively communicating with one another, and expressing their ideas through words and graphics. Inquiry science and literacy intersected when students used reading, writing, and oral language to address questions about science content and to built their capacity to engage in scientific reasoning and thought.

Hapgood and Palinscar (2007) continued that classroom discussion allowed students opportunities to restate concepts found in informational texts in their own words. Additionally, discussion allowed students to expand on their initial understandings, notice how their own thinking evolved with exposure to new information, and make connections between ideas found in books and their own lives. Over time, students learned to use discussions to explore theories about real world applications of science and began to appropriate specific vocabulary they had learned in reading to describe scientific concepts.

Winokur, Worth, and Heller-Winokur (2009) determined that talk is central to the practice of science and an important component of elementary science instruction. The authors contended that talk is crucial in science classrooms because of its use as a vehicle for uncovering reasoning pathways and naïve conceptions. Scientists and elementary students benefited from talking through the thought process and defending claims, and articulation of conclusions. According to the authors the process of talking became even more important when coupled with hands-on activities because of the opportunity to make meaning of direct experience through discussion. Classroom discussions of direct experiences in science inquiry engaged students in thinking and reasoning and represented connections between science and literacy.

America's Choice (2007) described oral communication in the area of classroom discussion as "accountable talk". Accountable talk is defined as seriously responding to what others in the group have said. Accountable talk used evidence in ways appropriate to the discipline such as data from experiments or investigations in science. Accountable talk sharpened students' thinking by reinforcing their ability to use knowledge in context.

Communicative skills in the content area of science held particular importance when integrating instruction and allowed for a transition from the abstract to the more concrete. Freeman and Taylor (2006) concluded that merging literacy and science instruction accelerated the development of basic cognitive and motivational processes for each of the content areas. Integrating reading and science entailed coordinating aspects of both into a unified structure for learning. The authors included eight goals that allow the science teacher to develop a literacy and science curriculum module. First, activating schema prior to reading avoided the interruption in comprehension that occurs when students read expository text with little or no schema. Second, observing allowed students to make connections between reading and science as one compared and contrasted objects in the physical environment to characters in literature. Third, questioning provided an integration of reading and science by allowing recognition of the connection between questions about a topic in the physical world to personal questions about a topic in a book. Fourth, connecting interests provided integration between reading and science by the perception that the interests of students in the two domains of learning support each other. Fifth, contrasting domain learning afforded a deeper understanding of the relationship between the two learning domains. Sixth, students unified their conceptual understanding gained from hands-on learning in science with their conceptual understanding from reading texts on a similar topic. Seventh, students integrated intrinsic motivation for reading and science by perceiving links of interest in the two domains. Eighth, by coordinating reading and science students displayed how the merger of cognitive processes, motivation, and knowledge in the two disciplines represents a network of knowledge that becomes both explanatory and valued.

The America's Choice curriculum through the National Center on Education and the Economy (1999), instructed students in understanding the concept of audience. Students learned to rely on their classmates to listen, explained information not understood, and asked questions to clarify or added details to make writing more meaningful. America's Choice introduced teachers and administrators to classrooms rituals and routines that provided predictable structure. The structure of rituals and routines facilitated instructions and empowered students to work productively. Through the rituals and routines of Writer's Workshop, student authors orally shared individual stories while students listened during share time. Students in the audience learned to respond in an accountable manner. By listening to the written material and making comments about the student authors' work other students in the classroom developed listening and speaking skills. Developing listening and speaking skills added to the critical components necessary for children to learn across the content area.

The Critical Role of Reading in Science

Because of the nature of science instruction and the necessity for tactile learning, reading well became even more important. The necessity for reading complex textbooks, following careful instructions, and writing about scientific observations made the integration of reading into science instruction more critical than ever. Yore et al. (2004) stated that language was a technology and thus an integral part of science and science literacy, particularly written language. Language was a means of doing science and constructing science understanding. In fact, science used language to communicate about inquiries, procedures, and science understanding to other people in order to allow others to make informed decisions and take informed stances. The authors embraced the definition of science as a process of inquiry conducted with language that established knowledge claims based on arguments that draw on the available evidence and canonical science.

Kamil and Bernhardt (2004) concurred stating that the need for reading skill in the content area remained a necessity and that literacy skill in science played a particularly acute role. Because the accumulation and publication of knowledge existed primarily in text, students lacking literacy skills remained unable to access that body of knowledge and data. Without the skills to read about the involvement of others in science, potential future scientists lacked the ability to pursue the profession. The critical nature of reading skills in the content area of science meant that students must understand the need for both science and reading skills to achieve success.

Wellington and Osborne (2001) stated that the justification for making reading a key part of a science curriculum resonated in two important strands. First, reading a true scientific activity meant possessing the capability of reading carefully, critically, and with a healthy skepticism. Second, most people have read far more about science than actually done science. Science texts were often concept laden in line, sentence and paragraph. This conceptual density, according to Barton, Heidema, and Jordan (2002) reasoned that many students find difficulty in the reading of science texts. The complexity of science texts remained critical for scientists and students alike.

Doing science required a high degree of literacy according to Shanahan (2004) and the author felt that a written goal in the science lessons engaged students in the process of doing science. The everyday life of a scientist involved reading research articles in journals and evaluating their worth based on both explicit and implicit criteria. The scientist then formed a hypothesis based on the readings, and wrote lab reports based on the findings of tests on the hypothesis. The scientist then reported on and interpreted the data, edited the reports for publication, and read reviews of other scientists to form new ideas based on the new readings. Shanahan continued by stating the importance of fostering lifelong, independent learning that began with the ability to learn science from reading about science.

In addition to understanding the content of science reading, science curricula demanded that the student reads carefully and follows explicit directions. Allen (2000) explained that a vital portion of science instruction contained recipe type (step-by-step) and inquiry based (one question leading to another question) investigations and required instruction on reading and writing directions. The author maintained that instructing students in writing clear and concise directions often led to a greater ability and understanding of following directions. Following directions not only meant the reading of directions, but also included the communicative area of listening for and following directions.

Instructional Reading Methods in Science Instruction

The importance of reading in science indicated the critical role that each science teacher played in integrating literacy into the science curriculum. This critical need for reading for meaning required that every science instructor teach reading and the methods for activating prior knowledge, vocabulary, and word attack skills. Cervetti, Pearson, Bravo, and Barber (2006) postulated that activating prior knowledge prepared a student to make connections, draw conclusions, and digest new ideas. In connecting literacy and science teachers encouraged students to activate schema from text experiences, hands-on experiences, and out-of-school experiences. Zimmermann and Hutchins (2003) claimed that the meaning one acquired from reading intertwined with the information brought to the passage.

Instruction in activating prior knowledge in the elementary grades held particular importance because of the importance of prior knowledge in later courses. Romance and Vitale (2006), stated that, first, the lack of prior knowledge and understanding of prior science materials required teachers in middle and high school level science courses to reduce the scope and depth of science courses in order to provide remedial instruction. Second, the resulting remedial instruction focused on the minimum skills and prerequisite knowledge that students did not acquire in preceding grades. This led to a continuing downward adjustment of an articulated sequence of increasingly rich science courses in the later grades. As a result, the lack of prior knowledge from elementary level science produced a negative effect on science instruction in the middle and high school grades.

McKee and Ogle (2005) agreed that activating prior knowledge remained a necessary component of science instruction. Helping students describe experiences through putting those experiences into words aided in building critical thinking skills. Activating prior knowledge derived from a variety of experiences that included life experiences, hands-on science experiences, and reading experiences.

The National Research Panel (2000) stated that no one single instructional method included the optimal vocabulary learning; therefore, effective instruction included a variety of methods to aid students in acquiring new words and increased the depth of word knowledge over time. Effective instruction included opportunities for both incidental and intentional vocabulary acquisition.

Findings of the NRP concerning the critical role of vocabulary acquisition through reading instruction included the following:

1. There was a need for direct instruction of vocabulary items required for a specific text.
2. Repetition and multiple exposures to vocabulary items were important. Students should be given items likely to appear in many contexts.
3. Learning in rich contexts was valuable for vocabulary learning. Vocabulary words should be those that the learner found useful in many contexts. When vocabulary items were derived from content learning materials (i.e., science), the learner was better equipped to deal with specific reading matter in content areas.
4. Utilizing vocabulary tasks as necessary. It was important to be certain that students fully understood questions asked in the context of reading, rather than

focusing only on vocabulary word in the lesson. Restructuring appeared to be most effective for low-achieving or at-risk students.

5. Vocabulary learning was effective when it entailed engagement in learning tasks.
6. Computer technology utilized effectively to help teach vocabulary.
7. Acquiring vocabulary through incidental learning. Much of a student's vocabulary had to be learned in the course of doing things other than explicit vocabulary learning. Repetition, richness of context, and motivation added to the efficacy of incidental learning of vocabulary.
8. Dependence on a single vocabulary instruction method did not result in optimal learning. Utilizing a variety of methods effectively with an emphasis on multimedia aspects of learning, richness of context in which words were to be learned, and the number of exposures to words learners receive. (National Research Panel, 2000).

The stance of the National Research Panel (2000) was that comprehension of reading material supported the understanding of the learning of vocabulary and vocabulary instruction. Clearly, the common practice of writing science vocabulary and definitions as a means of instruction in science vocabulary cannot equate to what literacy instructors considered appropriate instructional methodology. Robb (2003) asserted that this type of vocabulary instructional method created too broad a gap for students to bridge from writing and defining vocabulary to utilizing terms in comprehending new concepts. Students must learn to construct meaning through teaching words well. Proper instruction gave students multiple opportunities to learn how words related conceptually in the text (Barton, Heidema, & Jordan, 2002). Using a variety of vocabulary instructional strategies such as maps, webs, and other graphic organizers in nonlinguistic representations allowed students to manipulate new ideas, see how the ideas relate to familiar concepts, and construct a visual representation of the relationships.

Richardson and Morgan (2003) emphasized that when a student knows a concept only vaguely that no real knowledge exists at all. The authors claimed that production knowledge, knowing a word so well that knowledge allowed use in reading and speech, progressed next to learnable knowledge, where the student adds background knowledge and pertinent information concerning concepts that remain unclear. Again, the definition meant little in adding new vocabulary unless, according to the authors, new words had a connection with concrete experiences. Activities such as word inventories, graphic organizers, mapping, modified cloze procedure, possible sentences, vocabulary connections, and capsule vocabulary strengthened the relationship between what the student already knew and what the text presents.

The word inventory allowed the reader to assess prior knowledge concerning new words introduced in the text and rated their knowledge in the area. Graphic organizers allowed preparation for reading by using a pictorial road map of the text. Mapping assisted the reader in understanding concept relationships and avoids simple rote learning. The modified cloze procedure provided a means of understanding reader background. The teacher selected an important passage from the text and deleted key words to determine readability of the particular text. Possible sentences provided a combination of vocabulary and prediction. The activity acquainted students with new vocabulary in the text and guided children in verifying the accuracy of statements each generate.

With vocabulary connections, students used a term from a previous book in shared literature study to describe a situation in a book currently studied. In this manner, a connection between the two situations and vocabulary knowledge increased. Capsule vocabulary helped readers explore meaningful relationships between words. Students developed relationships between the new relationships and past relationships with words (Richardson & Morgan, 2003).

In a similar fashion, Heilman, Blair, and Rupley (1998) described definitional knowledge as word knowledge based on a definition such as one coming from a dictionary, thesaurus, word bank, or glossary. However, definitions rarely helped a reader understand the contribution of a new word to meaning.

Ediger (2005) explained the opportunity to teach phonics in science reading content, particularly when schools stressed reading across the curriculum. Emphasizing graphemes, phonemes, initial consonants, and vowel sounds along with context clues aided the student in identifying and learning new vocabulary. The ability to identify words maintained importance only if the process helped students read fluently and comprehend print material.

Labov (2003) affirmed that decoding was not limited to examination of isolated words instead all decoding applied immediately to the reading of connected and meaningful texts. The reader’s ability to understand text and the implications therein is, as a result tested continuously in reading. This concept appeared particularly true in science textbooks because of the abstract nature of many science terms to elementary school students.

Hiebert (2007) noted that the complicated nature of science vocabulary increased instructional complexities in aiding students in developing higher levels of literacy while also developing higher levels of science knowledge, skills, and strategies. Science vocabulary, described by Hiebert as dense, provided both challenges and assets to the learner. The challenges consisted of a denseness of the language, conceptual difficulty of the vocabulary, general academic vocabulary, vocabulary central to the text, and a lack of time for science instruction. The assets entailed the clear delineation of vocabulary, the build-up of ideas in the text, the teaching of thematic concepts, and the potential for high levels of engagement.

Hiebert (2007) also developed a core academic word list (CAWL) that indicated the percentages of word samples accounted for by CAWL from various types of texts from primary to middle grades. Hiebert's CAWL indicated that in third grade narrative texts have a word sample of 1.7 percent as opposed to a 7.1 percent word sample in third grade science texts and attested to the magnitude at which vocabulary grows in science.

Primary school students usually began reading with narrative texts in a broad range of subjects but with a similar textual style. Nonfiction or informational texts however, offered structural challenges very different from narrative texts. Nonfiction books offered structural challenges to young readers in the form of a table of contents, glossary, an index, headings and sub-headings, sidebars, boxed photographs or text, captions, graphs, bold-faced words, different print sizes, and the organization of print on the page.

According to Robb (2003), nonfiction texts offered six basic structural patterns of organization of text. The structural patterns included sequence, compare and contrast, cause and effect, question and answer, problem-solution, and description. Rarely do informational authors use one pattern exclusively throughout the book. Richardson and Morgan (2003) made the case that readers' learning to recognize organizational patterns and the relationship between ordinate and subordinate information took a considerable step forward to independent reading.

Buss and Karnowski (2002) described informational texts in terms of genres. First, informational texts recounted or shared a personal experience; second, procedural texts explained how to do complete a task; third, informational texts shared information; and, fourth, persuasive texts presented an opinion or an argument. Teaching students to recognize these genres of informational texts allowed students to understand and gain more from the reading.

Background knowledge was another reading issue particularly essential in the reading of science textbooks. Students sometimes possessed little background knowledge in the general principles of science and as a result brought little knowledge to bear on the reading each confronts. Also known as experiential or conceptual knowledge (Heilman, Blair, & Rupley, 1998) this component focused on determining students' past knowledge in relation to the focus of instruction. According to Richardson and Morgan (2003), experiential knowledge played a significant role in making science texts easy for students to understand. Without prior knowledge in the concept, reading became difficult because the reader could find relevance in the material.

Many teachers utilized K-W-L charts in building knowledge of textual material. The chart, What I Know, What I Want to Know, and What I Learned, provide graphic organizers that allowed children to organize material into specific categories. Robb (2003) suggested five preparation strategies to create tension between what students know and what students learn in the science text. The preparation strategies are:

1. brainstorm and categorize
2. preview, analyze, and connect
3. fast write
4. the anticipation guide
5. setting purposes

The brainstorm and categorize strategy created a free flow of ideas and thoughts about a topic where students reclaim and hear new ideas. The preview, analyze, and connect strategy asked the teacher to perform a preview of the material without the text. This method allowed children to preview the material, analyze current knowledge about the topic, and connect to other reading materials that put the facts in the present text. With the fast write strategy students quickly wrote down thoughts about the topic in the text. This strategy provided a springboard for later discussion on the topic at hand. The anticipation guide, a series of four to five statements or questions from the teachers, created disagreement or discussion among students. The setting purpose strategy removed the mystery of the purpose of learning new material. This five strategy instructional method clarified for students the information needed for understanding and remembering from the text (Robb, 2003).

Pardo (2004) stated that student use of informational books allows the building of word knowledge and provided appropriate information to the reader later. Maintaining a literature rich classroom environment also provided students with numerous opportunities for reading from a wide variety of topics. Focusing on reading a wide variety of texts added to the experiential knowledge of students in a variety of content areas.

Georgia's Choice Science Curriculum

The Georgia's Choice curriculum advocated that teachers provide one hour for Reader's Workshop, one hour for Writer's Workshop, forty minutes in language arts skills and twenty minutes in content area literacy instruction. Reader's and Writer's Workshops had similar formats with a five to ten minute mini-lesson in a concept related to the reading or writing theme of the day, a thirty to forty minute student work session where students applied knowledge learned, and a sharing time where students shared recent work. America's Choice included a science curriculum and required a one hour allotment of time similar to Reader's and Writer's Workshops.

The Georgia's Choice curriculum, modeled after the America's Choice curriculum, however, allotted only 20 minutes for instruction on the elementary school level. Schmidt, Gillen, Zollo, and Stone (2002) contended that children involved in inquiry learning become active classroom participants who connect with one's own environment and formulate high-level questions. That inquiry methodology could take place within a twenty-minute period appeared difficult at best. Hands-on or tactile experience in learning remained important in the science environment and in the connections students make to learning.

Prior to the No Child Left Behind (United States Department of Education, 2001) time spent teaching science in the self-contained classroom fell far below the time spent teaching language arts and significantly below the amount of time spent teaching mathematics. According to Weiss, Banilower, McMahon, and Smith (2001) the average number of minutes spent teaching science in self-contained kindergarten through third grade classrooms amounted to twenty-three minutes as compared to one hundred fifteen minutes for language arts.

With the advent of NCLB and the implementation of school reforms across the nation that attempt to attain grade level reading status for all students, content area subjects received a decrease in the time allowed for student instruction. A study by the Center on Education Policy (McMurrer, 2008) found that, of the districts reporting an increase in instructional time for English/Language Arts and/or mathematics and a decrease in time for one or more subjects, the percentage of decrease for science instruction reached an average level of thirty-three percent. Of the districts reporting decreases for subjects other than English/Language Arts and mathematics fifty-three percent reported decreasing the time for science instruction by a minimum of seventy-five minutes per week.

The data collected by the Center on Education Policy clearly indicated a decrease in instructional time across a variety of subjects not included in the English/Language Arts or Mathematics areas. Instructional time for science decreased most in twenty-five to forty-nine percent categories with a sixty-six percent decrease in time allotted for instruction. The reduction of science instructional time placed the efforts to make progress in science education at risk according to Klentchy and Molinea-De La Torre

(2004). The authors stated that school districts under pressure to increase performance on standardized tests reduce or eliminate science instruction. The reduction or elimination of science instructional time possessed the potential to create negative results on all content areas.

Romance and Vitale (2004) concurred, noting the compounding effect of not preparing students well for future courses in science. Without an understanding or prior knowledge of science students lacked proper preparation for high school courses, a major determinant in successful learning. When students lacked proper prior scientific knowledge, then teachers faced the problem of reducing the scope and depth of science courses in order to provide remedial instruction. The resulting remedial instruction focused on providing skills and prerequisite knowledge that students did not acquire in previous grades. Romance and Vitale suggested that the limited scope of learning opportunities resulted in a situation that causes a lowered ceiling on teaching and learning in the classroom. In effect, high schools experienced the negative consequences associated with the reduction or elimination of instructional time devoted to elementary science. Elementary students no longer interacted with rich, motivating science instruction and science related reading materials that were foundational for success in science at the middle and high school levels. Jorgenson and Vanosdall (2002) agreed contending that the reduction or elimination of class time devoted to science instruction possessed the potential for long-term impact on science education in America and, subsequently, on the medical, corporate, academic, and industrial sectors that relied on well-educated American science students.

Assuming that children possessed the ability to accelerate science learning in later grades contained a false assumption for three reasons according to Pratt (2007). First, the assumption disregarded the importance of catching children's attention when the students exhibited more openness, curiosity, and the natural disposition to ask questions about their world. Second, science learning possessed a cumulative effect in both process and content. Waiting too long inhibited a strong fluency in the language of science and provided a debilitating effect through a lack of basic understanding. Third, the lack of engaging and high quality science at the elementary level impoverished all students, and provided a difficult challenge for instructors at the middle and high school levels.

The study by McMurrer (2008) concerning the reduction of instructional time spent in the content area of science nationwide closely mirrored the curricula reforms at the elementary school where the author formerly taught. The Georgia's Choice Reform package involved increasing instructional time spent in the area of literacy and reduced the instructional time spent in science by one-half. The curricula change, a result of the implementation of NCLB, provided students far more instruction in reading and language arts than in science.

Willison (1996) suggested that various skills of measurement, manipulation of equipment, and observation allowed students to learn only in connection with hands-on experience. Some students learned best by simply doing activities. For some students the hands-on methodology provided a valid manner of learning and allowed input through a variety of senses not just visual or auditory. The recognition of Howard Gardner's (Gardner, 2005) multiple intelligences, specifically concerning bodily kinesthetic intelligence, made the case for hands-on learning in the subject of science stronger.

Others contended that increased literacy instruction in the content area, specifically science, again led to increased learning and improved achievement on standardized test scores. Morrow, Pressley, and Smith (1995) posited that learning science through authentic reading and writing experiences remained consistent with a variety of language arts models, including integrated language arts, whole language, language experience, and writing process approaches. Such integration provided students with exposure and practice with a variety of genres including science literature.

The purpose of Morrow, Pressley, and Smith's study (1995) determined the effects of an integrated literature based reading and writing program into literacy and science instruction at the third-grade level. The study also examined the effects of the program on attitudes toward science learning and achievement. The conclusion of the Morrow, Pressley, and Smith study indicated improvement in student achievement for reading, writing, and science learning due to the integration of literacy into science instruction.

In other research, Ketter and Jones (2003) conducted a four-year study in which the first two years involved a more traditional science instructional method and the last two years involved an inquiry instructional approach to science. The results of this four-year study did not indicate a gain in achievement in the physical science scores on the North Carolina standardized test for physical science.

Because of the emphasis on accountability and high-stakes testing local districts chose reading and language arts instruction over the subject of science. At the former school of the author, the Georgia's Choice curricular model resulted in a reduction in instructional time to twenty minutes for both science and social studies. Teachers chose how to alternate instruction in the two subjects in order to include the subjects in their daily instructional schedule.

In Florida, teachers report that principals occasionally requested that instructors stop teaching science in favor of concentrating on reading instruction for accountability reasons (Jacobson, 2004). Manning (2005) also reported more and more communication from teachers who stated that administrators request teachers omit science and social studies in favor of reading and mathematics instruction.

The National Center on Education and the Economy (NCEE) (1999) added clear performance standards to the National Research Council's call for a balanced approach to reading instruction. The standards offered a full range of skills, knowledge, and literacy habits that promote success for primary students in later schooling and life. The NCEE proposed that the standards allow students to learn both the print-sound code and the ability to comprehend and interpret reading from the beginning. The standards aided in tracking student progress by the students' ability to read benchmarked books of graduated levels of difficulty. In linking reading and writing the standards promoted creative spelling for students as an attempt to master phonics. In addition, the linking of reading and writing provided a voiced to students' writing through attendance to the language in books. The standards also brought an expectation for children to read and write in the genres of narratives, functional writing, reports, and literature. The NCEE standards additionally supplied benchmarks for daily practice of reading and writing as well as the use of conventional spelling and correct uses of punctuation, along with the careful choice of vocabulary, style, and syntax in writing.

The NCEE offered the standards in a packaged form titled America's Choice School Reform (2006). The Georgia State Department of Education chose America's Choice School Reform and renamed the reform package "Georgia's Choice" in 2001 (America's Choice-Georgia's Choice, 2009). The Georgia's Choice model expected third grade students to read a minimum of thirty chapter books during the course of the school year as well as listen to and discuss a least one chapter from a book read aloud every day. The model stipulated three hours of reading instruction on a daily basis and included Reader's Workshop, Writer's Workshop, a skills block, and group reading.

According to the America's Choice School Reform (National Center for Education and the Economy, 1999), third grade was a pivotal year in literacy development. Students lacking the confidence lost accuracy and fluency as well as new vocabulary and concepts. These literacy deficits possessed the potential to cause academic, social and emotional problems for students in the future. The third grade standards for reading included, reading standard one, the print-sound code; reading standard two, getting the meaning; and, reading standard three, reading habits.

The print-sound code standard taught the decoding of print-sound and included automaticity with the print-sound code across the entire span of language. Throughout third grade students learned about words, their roots, inflections, suffixes, prefixes, homophones and word families as a part of vocabulary growth.

Reading standard two, getting the meaning, had the components of accuracy, fluency, self-monitoring, and self-correcting strategies, and comprehension. By the end of third grade students possessed the ability to easily read words with irregularly spelled suffixes, use the cues of punctuation to guide in comprehension and reading fluently from increasingly complex texts. Additionally, students' used pacing and intonation to convey the meaning of clauses and phrase from sentences read aloud (National Center for Education and the Economy, 1999).

In reading standard three, the standards expected that third grade students read thirty books a year, independently or with assistance, and regularly participate in discussion about the reading with another student, group, or a teacher. In addition, the expectations required that students read and hear texts aloud from a variety of genres, read multiple books by the same author and identify differences and similarities among the readings, reread favorite books in order to gain a deeper understanding and knowledge of authors' craft, read the functional and instructional messages in the classroom including announcements, labels, menus, and invitations, listen to and discuss at least one chapter read every day, and voluntarily read to each other (National Center for Education and the Economy, 1999).

Reading standard three expected that students discuss books using comparisons and analogies to explain ideas, referring to knowledge built during the discussion, using accurate, accessible, and relevant information, restating the student's own ideas with clarity, asking other students questions that require the student to support claims or arguments, and indicating when ideas need further support and explanation (National Center for Education and the Economy, 1999).

The America's Choice School Reform model not only included the literacy component, but entailed mathematics and science as well. In *America's Choice School Design Science Handbook – Elementary School* the National Center on Education and the Economy (2003) published science curricula for elementary schools. The Science

Handbook attempted to integrate the role of literacy into science and vice versa. The authors explained that based on the America's Choice model demonstrating a deeper understanding of the content involved students' ability to explain the concept, observe the concept, and make predictions about the concept. Students also used the concept in both familiar and unfamiliar situations and represented the concepts in multiple manners including words, diagrams, graphs, and charts. While the authors saw the tangible evidence of the Readers and Writers Workshop, the evidence did not remain limited to language arts. A well designed Georgia's Choice science classroom involved science word walls and strategies for reading nonfiction. In addition, posted student authored reports and leveled libraries of nonfiction books by topic provided evidence of a literacy integrated science classroom. Students in quality literacy integrated science classrooms read about science not only during science time, but also during Reader's Workshop. Students wrote about science not only for science reports, but also during the Writer's Workshop. The use of mathematics to quantify results of science investigations further integrated subjects into the science classroom. According to the authors (National Center for Education and the Economy, 2003), science lived throughout the school day and in every classroom.

The increase in literacy instruction held the potential to aid reading in the science classroom when integrated properly. Increased accuracy, fluency, and comprehension aided students' in the reading of expository text for science as well as other subjects. Wellington and Osborne (2001) stated that the justification for making reading a key part of future science curriculum contained the factor of reading carefully, critically, and with skepticism as a vital component of scientific activity. The authors continued that like any activity, the skill of reading science develops only through coaching and practice.

Similarly, the reading component played a critical role in success of students in state mandated standardized tests. Many states used data from test scores to determine whether students advanced to the next grade level and as exit examinations for some courses. According to Greene and Melton (2007), whether the intended focus of a standardized test might include social studies, science, or writing, the test remained a reading test. The authors offered three fundamental beliefs about preparing students for testing. First, successful test takers were smart readers. Students successful in testing understood that test-taking strategies were also good reading strategies. Standardized reading tests were a specific genre and required general and genre specific reading strategies. Second, successful test takers were able to translate the unique language of the test. Standardized reading tests used formal language that was foreign to most students. Students were helpless on standardized reading tests if they failed to decipher test talk. Third, learning to be a successful test taker was engaging. Carefully planned units integrate test-taking skills into daily reader workshops.

Greene and Melton (2007) continued with the thought that reading was thinking and that in order to comprehend, strong readers predicted, made connections, asked questions, inferred, visualized, determined what is most important, noticed themes, critiqued, evaluated, synthesized, or do a plethora of types of thinking while reading. The authors contended that readers must think when reading words to be successful on standardized tests. To learn the strategies mentioned above students required opportunities to practice test-taking strategies over long periods of time.

Li (2006) contended that valid science tests included alignment with science standards and one that is not merely a reading test. Unlike mathematics, which contains its own universal language of symbols and numbers, most science subjects relied heavily on verbose descriptions and specialized vocabulary. According to Li most science tests remained strictly reading tests that do not adequately assess science standards.

America's Choice stated that standardized make up a separate genre with rules, tools, and a predictable organization. College admission offices, hiring committees, military organizations, educators, governments, and professional organizations used standardized tests to assess and categorize individuals based on the organizations' preferred assessment. According to America's Choice (National Center for Education and the Economy, 2003), the general public utilized standardized tests to determine the efficacy of schools.

America's Choice provided schools with a test taking curricular program that furnished students with aid in understanding the genre of standardized testing. The standardized test genre utilized predictable formats, patterns of organization, language, stress points in order to fulfill the purpose of the assessment which included testing the reader's accuracy and acuity (National Center for Education and Economy, 2003). America's Choice categorized standardized tests into four different types. First, norm referenced standardized tests compared the performance of each reader with that of other readers. Second, the criterion referenced standardized test compares the performance of a reader to clearly articulated criteria for success. Criterion referenced assessments tested whether students' knowledge and skill met established standards. Third, some standardized assessments penalized readers for guessing. Finally, some standardized assessment used machine scoring and relied on multiple choice probes into readers' thinking and understanding, while others relied on students' responses as windows into their thinking and understanding. The design of the test taking genre study potentially aided students in understanding the structure, rules, and formats of standardized testing.

Guthrie (2002) argued that spending time in preparing students for standardized tests increased achievement scores. Guthrie discussed five elements of successful test preparation with the first including guided instruction in reading and writing for both literary and nonfiction texts. The second element included explicit instruction on the strategies necessary for reading standardized test material. The third element required a substantial emphasis on engaged, independent reading for the purpose of learning. All reading tests, according to the author, required speed, fluency, and comprehension. A fourth element, included practice on the format of the test and according to Guthrie practice accounted for a ten percent difference in the success of students. When taking multiple choice tests students needed strategies for responding to the test questions, selecting alternatives, and allocating their time appropriately. The final and fifth element required strategies in motivation for reading and test taking. Motivational support included alleviating test anxieties, providing meaningful reasons for test success, enabling students to feel self-efficacy toward reading, and most importantly, fostering extensive amounts of reading throughout the school year.

The Georgia Criterion Referenced Competency Test

The Georgia Department of Education administered the Georgia Criterion Referenced Competency Test (CRCT) to all students in grades one through eight in the areas of reading, English/language arts and mathematics, science, and social studies. In addition, the state assessed students in third grade through eighth grade in science and social studies (The Georgia Department of Education, 2005).

McKenna and Staid (2003) stated that criterion-referenced tests are useful for mastery level or competency based assessment. The authors suggested that a curriculum that consisted of many specifically learned skills is probably well-served by criterion-referenced tests. Students differed in background knowledge and those differences affected their performance on reading tasks. Standardized measurements such as the criterion-referenced test dealt with the issue of background knowledge by utilizing many short passages. The Georgia CRCT utilized similar formats in assessing third grade students in both the Quality Core Curriculum (QCC) and the Georgia Performance Standards (GPS).

The Georgia Department of Education (2008) managed the development of the CRCT and adhered to the Standards for Educational and Psychological Testing as established by the American Educational Research Association, the American Psychological Association, and the National Council on Measurement in Education. The standards of the aforementioned organizations promoted sound and ethical use of tests and provided a basis for evaluating the quality of testing practices. The development process required the involvement of Georgia educators at every step. Development of the test items, completed by professional item writers, included the reviewing, revising, rejecting, and approving by committees of Georgia educators. The committee tested all new items by embedding the new questions in operational tests. The newly written items embedded in tests did not contribute to student scores and allowed evaluators to review items to determine their effectiveness before placing the items in operational assessments.

The key to success with any standardized assessment revolved around the issues of validity and reliability. While validity remained the most important consideration in the test development process, the Georgia Department of Education maintained that a test cannot maintain validity without a high degree of reliability (2008).

The CRCT measures how well students acquired the skills and knowledge described in Quality Core Curriculum (QCC) and the Georgia Performance Standards (GPS) as written by the Georgia Department of Education. The assessments yielded information on academic achievement at the student class, school, system, and state levels. Information assessed by the CRCT measured individual student strengths and weaknesses related to the instruction of the standards, and ascertained the quality of education in Georgia public schools (The Georgia Department of Education, 2005).

The Department of Education reported CRCT scores in terms of scale scores and performance levels. The results, reported by the State, allowed stakeholders to interpret assessment scores in a consistent manner. The codes provided the following meanings for the test: Does Not Meet (DNM), Meets (ME), and Exceeds Expectations (EE). Table 2.1 below indicates the scale scores and performance levels as reported.

Table 2.1 QCC and GPS Scale Scores and Performance Levels

	DNM	ME	EE
QCC scale score	Below 300	300-349	350 or Above
GPS scale	Below 800	800-849	850 or Above
Performance level	1	2	3

The evidence for the validity of the CRCT indicated how well the assessment instrument matched the intended curriculum. In addition, the score reported informed the various stakeholders including parents, students, and educators concerning the students' performance (Georgia Department of Education, 2008).

One of the two key components of the technical quality of a testing or measurement instrument involved reliability. Ary, Jacobs, and Razavieh (2002) discussed criterion referenced tests as assessments which determined an individual's status with respect to a well defined set of objectives. Reliability of the criterion referenced test then concerned how the consistency of the measurement estimates the individual's status. Cohen and Swerdlik (2002) defined reliability as the consistency of the measuring tool, adding that key components included the precision of the test measure and the extent of error presented in the measurement. McKenna and Staid (2003) referred to reliability the consistency of results or the general dependability of a test. A reliable test produced similar results under similar conditions. Reliability included the influence of factors such as the length of the test (the longer the test, the more reliable it is), the clarity of directions, and the objectivity of the scoring.

As a first index of instrument of reliability for the Georgia CRCT, Cronbach's alpha coefficient measured the internal consistency of reliability which indicated how well all the items in the assessment measured one single underlying ability. A reliability coefficient expressed the consistency of test scores as the ratio of true scores variance to observed test score variance. The alpha value represented the estimated average correlation between the possible split combinations of the test. Table 2.2 indicated the alpha coefficients for all elementary grades and subjects for the 2008 CRCT. The second statistical index utilized to describe test score reliability for the CRCT involves the standard error measurement (SEM). The SEM was an index of the random variability in test scores in raw score units (The Georgia Department of Education, 2008).

Table 2.2 Reliability Coefficients (Cronbach's Alpha) for Subject Area Test by Grade

Grade	Reading	English/Language Arts	Mathematics	Science	Social Studies
1	.88	.90	.91	NA	NA
2	.86	.90	.91	NA	NA
3	.89	.90	.93	.91	.92
4	.89	.90	.91	.92	.91
5	.86	.89	.92	.90	.92

The second of the two components of technical quality in assessment involved validity which began with the purpose of the assessment and continued through item writing and review. Cohen and Swerdlik (2002) maintained that the validity of a measurement suggests whether an assessment measures what the test purports to measure.

In Georgia after writing test items curriculum specialists and committees of Georgia educators reviewed each test item. Evaluation included overall quality and clarity, content coverage and appropriateness, alignment to the curriculum, and grade appropriate stimuli with an emphasis on higher order thinking skills. In addition, reviewers verified each item for one clear correct answer with appropriate, relevant, and reasonable distracters. The Georgia Department of Education required that the assessment contained no bias toward or against any particular group and representation for all Georgia students. The validity of the CRCT, supported by the alignment of the assessment to the curriculum, related specifically to standards in the Georgia curriculum for each subject area, which bolstered the content validity (The Georgia Department of Education, 2006).

Summary

In summary, a comprehensive and sustained program in reading instruction promoted academic success. In fact, a fully implemented reading curriculum promoted success across the content areas whether in mathematics, social studies, or science. An active reader used prior knowledge and text structures to construct meaning during the process of reading. In addition, active readers monitored comprehension throughout the reading process, and processed text after reading.

Students who understood the differences in text adjusted to differences while reading and monitored reading to account for differences. Using text structure to construct meaning included recognizing informational or expository text as well as narrative text. The ability to recognize and employ text structures from expository text such as cause and effect, comparison-contrast, sequence, description, and problem solution allowed for increased success in comprehension. Expository texts, as opposed to narrative texts, usually contained more unfamiliar words and concepts, fewer ideas related to the present and less information directly related to personal experience. The basic structural patterns of expository texts included description, sequence or procedure, enumeration, causation, problem/solution, and compare/contrast. Again, effective and explicit instruction in expository reading technique provided students with advantages in reading in the content areas of mathematics, social studies, and science.

Even with exemplary instruction in reading of expository texts, reading in the content area of science presented special challenges. Literacy skills in science played an important role since the accumulation and publication of knowledge exists primarily in text. Students lacking literacy skills remained unable to fully access the body of knowledge and data. The nature of reading skills in the content area of science meant that students possessed the need for both science and reading skills to achieve success. The importance of reading in science indicated the critical role that science teachers played in integrating literacy into the science curriculum. This critical need of reading for meaning required that science instructors teach reading and the methods for activating prior knowledge, vocabulary, and word attack skills.

Kinniburgh and Shaw (2009) noted the decreased time spent in instruction in science content as a reason that instruction in comprehension strategies not be the sole responsibility of the language arts teacher. Students taught comprehension in the primary grades might have difficulty transferring those comprehension skills to expository texts in the content areas. Because language arts and science had natural connections, the authors found it important to teach comprehension in science to promote understanding of the text. Incorporating comprehension strategies into science instruction provided students with skills to become successful at reading and comprehending concepts in a variety of texts. According to Kinniburgh and Shaw improved test scores were the result of increased training in comprehension strategies in content area reading.

The Georgia’s Choice science curriculum addressed the problem of decreased classroom instructional time for science by integrating reading into the science curriculum in the Georgia schools participating in the Georgia’s Choice school reform program. Through increased time spent in classroom instruction in literacy skills and knowledge students learned the reading proficiency necessary for success in the content area of science. In addition, students received instruction in assessment taking skills that prepared them for reading high-stakes measurements in multiple choice formats.

E. Wendy Saul (2004) maintained that students in the United States appeared fairly well adept at reading stories, but far less successful in reading expository or procedural text. The primary reading material for both science and social studies remained nonfiction or expository text. Saul suggested that, with the current emphasis on intensive reading instruction and improving reading and the realization that science topics often required additional instruction, schools address reading requirements and science deficiencies by introducing science related reading. Integrating science and reading instruction benefited both subjects in that students read more efficiently and comprehend science more successfully. In addition, integrating the two subjects possessed the potential to promote science reading beyond the classroom.

Jemison (2003) stated that effective science education built students' interest and curiosity in science, engineering, and technology fields and fostered the ability to digest and use information. The author added that it is during the elementary grades that students began to develop the basic skills and grounding that allowed them to become the technicians, engineers, and scientists of tomorrow. Elementary and secondary school also remained the greatest and most important educational exposure to science for the public.

Yore (2004) explained that in working with language and science the challenge still persisted of convincing other educators of the importance of language in science and the importance of language-oriented tasks in inquiry science instruction. The author asserted that along with hands-on activities, teaching communication and critical response skills, language oriented skills are crucial to science instruction. Yore suggested the following criteria as a guide for selecting language-oriented tasks for science inquiry instruction:

1. Keep science literacy central in all tasks infused into inquiry science instruction
2. Select language tasks that involved and promoted interactive-constructivist learning
3. Provided explicit instruction and scaffolding for support of language arts and abilities, then helped students build an improved understanding of the science ideas involved
4. Used authentic tasks, information sources, issues, and audiences in the language-oriented tasks embedded into the science inquiries
5. Spent time preparing students to debate, read, and write with preliminary activities; accessing various primary print and electronic information sources; refining problem focuses; and planning strategies
6. Revisited language-oriented tasks in sequential and developmental manner
7. Demonstrated the explicit value of language in science; let students see the teacher as a science-language user who valued the products of language-oriented tasks by processing the results in class and making the products available to students

The conceptual framework of this study, as stated in the introduction, was that teachers of both reading and science provided literacy rich environments in which students received increased time in instruction in reading, instructional strategies in reading, and exposure to literature including informational texts as a foundation to the reading and science curricula. Integrating academic factors that combined science vocabulary instruction, instruction in writing about science, exposure to quality expository text, hands-on science learning, integrating reading instruction into the science curriculum, and instruction in test taking skills comprised a strong science curriculum. These factors contributed to the outcomes of improved science knowledge, improved fluency and comprehension with expository texts, increased science vocabulary, and improved science test scores on high-stakes tests.

Freeman and Taylor (2006) stated that providing a quality and equitable education to all students as the goal of every educator. The authors included a goal for science education of teaching concepts through the missing components of today's science curriculum. Freeman and Taylor concluded that:

> This includes a manifestation of the joy of discovery, the excitement of learning information relative to life, and the innate inward fulfillment of problem solving. The goal of science education for the future is to be engaged in the process of learning and discovering science information by actually "doing" it in hands-on experimentation and inquiry learning. To effectively accomplish this goal, the integration of literacy strategies to increase comprehension is an essential component that will guide students into lifelong learning (p. 205).

Because of the nature and complexity of reading in the content area of science, reading successfully held particular importance. Introduction to new information in complex expository texts and an increase in new and crucial vocabulary increased the need for learning to read successfully in science.

Chapter 3

Methodology

This chapter explains the methods used to complete this study. The chapter contains a description of the research design of the study, the context of the study, the participants involved in the study, the assessment instrument from which the data were collected, procedures used in the research design, and how the data was analyzed in answering the research question.

The General Perspective

This research used quantitative methods in a causal comparative research design. Ary et al. (2002) and Fraenkel and Wallen (2000) describe causal comparative research as an attempt to establish a cause or effect that already exists between or among groups of individuals. Actually interpreting a cause however, is difficult because the researcher maintains no control over the variables in the study. The basic design of causal comparative research entailed selecting two comparison groups, one with the independent variable and one without the independent variable, or the control. In this study the independent variable included the group of Georgia elementary schools that chose to implement the Georgia's Choice Curriculum reform model. The CRCT science scores for third grade students in the 105 Georgia's Choice schools and the 105 randomly selected schools not using the Georgia's Choice curriculum made up the two comparison groups. Since both groups consisted of third grade students already enrolled in Georgia elementary schools, a lack of randomization occurred. The two groups were with the pretest –posttest design used with non-equivalent .control groups.

This study used the initial year of CRCT results, 2002, as the pretest, with the subsequent year of CRCT results for Georgia third grade students, 2004, as the posttest. The pattern continued with 2004 CRCT results used as the pretest and compared against 2005 CRCT results for both groups, then 2005 CRCT scores used and compared to 2006 CRCT results, and, finally, 2007 CRCT used as a pretest and compared to 2008 CRCT scores. According to Jackson (2008) the use of a pretest-posttest with an untreated comparison group such as the Non-Georgia's Choice schools in this study reduced the threat to validity.

This study sought to examine the effectiveness of reading instruction through Georgia's Choice curriculum on third grade science CRCT scores. The study examined the role of the intensive instruction of reading according to the Georgia's Choice curriculum model and the ability of third grade students to comprehend test questions on the science portion of the Georgia CRCT. The study compared the scores of students in Georgia's Choice schools and students from Non-Georgia's Choice randomly selected schools that did not have access to the Georgia's Choice curriculum. The independent variable of the Georgia's Choice curriculum was compared with the data from the dependent variable of student scores on the CRCT.

Participants

The first comparison group included third grade students in the 105 Georgia's Choice elementary schools who participated in the Georgia CRCT during the academic years of 2002, 2004, 2005, 2006, 2007 and 2008. The participants attended Georgia public elementary schools and represented a cross section of racial, ethnic, and socioeconomic groups of public school students in the State of Georgia. The participants also included students in gifted programs as well as students from special education programs. Additionally, the participants represented a variety of Counties from across the State providing a broad spectrum of geographical and cultural areas. As a result, participants in the study included students without regard to academic, racial, gender, or socioeconomic considerations. Additionally, all participants included students previously enrolled in Georgia elementary schools and were not manipulated in any manner prior to or during the study.

The second comparison group included students from 105 elementary schools without access to the Georgia's Choice curriculum. The schools were randomly selected using a random number generator from a list of schools in publicly reported lists of over 1,100 Georgia elementary schools administering the CRCT. Similarly, participants in this group included students previously enrolled in Georgia elementary schools and were not manipulated in any manner prior to or during the study

The researcher chose third grade students as participants in this study for two reasons. First, NCLB (United States Department of Education, 2001) selected third grade as the grade level at which all students have a reading level that is at or above what is considered a third grade reading level. Second, the Georgia Department of Education designated third grade as the first grade level in which passing the reading portion of the Georgia CRCT became a factor in the decision to promote or retain a student (Georgia Department of Education, 2005).

Instrument Used in Data Collection

The recording instrument was the Georgia Criterion Referenced Competency Test (CRCT). The results as scored, recorded, and reported by the Office of Standards, Instruction, and Assessment of the Georgia Department of Education was the sole source for data utilized in the study.

Criterion referenced test items measured the ability of the student against a set of instructional objectives. The primary concern involved utilizing a representative sample of items measuring the stated objectives to describe individual student performance in terms of specific knowledge and skills that students possess the ability to attain (Ary, Jacobs, Razavieh, 2002). The Georgia CRCT scores from across the State of Georgia presented a broad representative sample for student performance of students in the assessment areas of reading and science.

The first of two components of technical quality in assessment involved validity which began with the purpose of the assessment and continues through item writing and review. Cohen and Swerdlik (2002) maintained that the validity of a measurement suggested whether an assessment measures what the test purports to measure.

The second of the two key components of the technical quality of a testing or measurement instrument included reliability. Ary, Jacobs, and Razavieh (2002) discussed criterion referenced tests as assessments which determined an individual’s status with respect to a well defined set of objectives. Reliability of the criterion referenced test then concerned how the consistency of the measurement estimated the individual’s status. Cohen and Swerdlik (2002) defined reliability as the consistency of the measuring tool, adding that key components included the precision of the test measure and the extent of error presented in the measurement. McKenna and Staid (2003) referred to reliability the consistency of results or the general dependability of a test. A reliable test produced similar results under similar conditions. Reliability included the influence of factors such as the length of the test (the longer the test, the more reliable it is), the clarity of directions, and the objectivity of the scoring.

As a first index of instrument of reliability for the Georgia CRCT, Cronbach's alpha coefficient measured the internal consistency of reliability which indicated how well all the items in the assessment measure one single underlying ability. A reliability coefficient expressed the consistency of test scores as the ratio of true scores variance to observed test score variance. The alpha value represented the estimated average correlation between the possible split combinations of the test. Table 3.1 indicated the alpha coefficients for all elementary grades and subjects for the 2008 CRCT. The second statistical index utilized to describe test score reliability for the CRCT involves the standard error measurement (SEM). The SEM is an index of the random variability in test scores in raw score units (The Georgia Department of Education, 2008).

Table 3.1 Reliability Coefficients (Cronbach's Alpha) for Subject Area Test by Grade

Grade	Reading	English/Language Arts	Mathematics	Science	Social Studies
1	.88	.90	.91	NA	NA
2	.86	.90	.91	NA	NA
3	.89	.90	.93	.91	.92
4	.89	.90	.91	.92	.91
5	.86	.89	.92	.90	.92

Preliminary Procedures

In 2001 more than one hundred Georgia elementary schools elected to implement the Georgia's Choice curriculum model with the emphasis for state and local educators centered on improving reading achievement. Georgia elementary schools recognized the need to improve reading levels in order for all students to be reading on grade level by third grade as prescribed by NCLB. The pressure increased when with the implementation of the Georgia CRCT the next year, third grade students had to pass the reading portion of the assessment to attain promotion to fourth grade.

Prior to implementing this study, the researcher conducted a thorough review of literature. The literature review focused on the primary goals of reading instruction, the differences in text, the importance of reading in science, instructional reading methods important to science instruction, and the current Georgia's Choice science curriculum.

Data Collection

In 2001, Georgia law required the administration of the CRCT to all students in grades 1 through 8. Administration of the test included the subject areas of reading, English/language arts, and math. In grades 3 through 8 the CRCT included the content areas of science and social studies. Georgia designated the CRCT as the official assessment tool for federal accountability under the No Child Left Behind Act of 2001 (United States Department of Education, 2001). The CRCT measured student achievement and was reported to the federal government as a gauge of Adequate Yearly Progress (AYP) (Georgia Department of Education, 2005).

The author collected scores published by the Georgia Department of Education for third grade students from each school recording scores during the 2002, 2004, 2005, 2006, 2007, and 2008 CRCT assessments. The CRCT, not administered in 2003 for third grade students because of testing irregularities, meant that no scores were available for that year (Georgia Department of Education, 2005).

Design of the Study

In the study, the author compiled the reading and science mean scaled scores from the 105 Georgia's Choice schools included in the study as well as the reading and science mean scaled scores from 105 randomly selected elementary schools not choosing the Georgia's Choice curriculum model. Using an Analysis of Covariance to analyze the data for each year of the study determined if the difference of CRCT scores for the treatment group (Georgia's Choice schools) differed significantly from the CRCT scores of the untreated comparison group (Non-Georgia's Choice schools).

Table 3.2 represented the two comparison groups. Group one is comprised of the schools that chose the Georgia's Choice curriculum and received treatment while group two is comprised of Non-Georgia's Choice schools that did not receive treatment of any kind. The design of the study compared group one's CRCT scores for 2002 as a pretest to group two's CRCT scores for 2004 as a posttest. The pattern continued with the exception of the CRCT scores from 2006 as a pretest compared to 2007 as a posttest because of the change in the pass/fail scores from 300 to 800 in the year 2007.

Table 3.2 Representation of the Design for the Study

Group	Pretest	Treatment	Posttest
(1) Georgia's Choice Schools	Yes	Yes	Yes
(2) Non-Georgia's Choice Schools	Yes	No	Yes

Null Hypothesis

In comparing the science scores of third grade students who received instruction in the Georgia's Choice curriculum with third grade students who did not receive the Georgia's Choice curriculum the following null hypothesis was posed:

There will be no significant difference in the scores of third grade students with instruction in the Georgia's Choice curriculum and science scores of students who did not receive the Georgia's Choice curriculum.

Summary of the Methodology

The data collected in the research included the reading and science scaled scores from each third grade student in 105 Georgia's Choice Elementary Schools and 105 randomly selected elementary schools without the Georgia's Choice curriculum for the academic years of 2002, 2004, 2005, and 2006, 2007, and 2008. The data was analyzed for each year of the study using an analysis of covariance (ANCOVA) to determine if the difference between the means of the two comparison groups is significant.

The Johnson-Neyman statistical technique was used where the test for homogeneity of slopes was tested by an ANCOVA and rejected. According to Fraas and Newman (1997) the Johnson-Neyman statistical technique, was appropriate when the homogeneity of slopes was rejected. The Johnson-Neyman technique allowed the researcher to calculate the confidence bands for the regions of non-significance for scores of the pretests and posttests. The authors concurred that use of the Johnson-Neyman statistical calculation was appropriate for non-equivalent control group designs.

For the administration of the 2007 CRCT, the Georgia Department of Education (2005) modified the pass/fail score from 300 to 800. The modification rendered the scores from 2002 through 2006 incomparable. As a result, this researcher, made the 2007 CRCT scores the baseline data for a continued comparison for the 2008 CRCT scores. The result provided a continued comparison for the data over the course of this study.

Chapter 4

Research Findings

Research Question

This chapter presented findings of a study initiated to determine the relationship of Georgia’s Choice curriculum reform model on science scores on the Georgia CRCT. The analysis of the data was arranged to compare the pretest data from the 2002 science CRCT scores to scores from subsequent years through 2008 for both the 105 Georgia Choice Schools and 105 randomly selected Non-Georgia Choice Schools. The State Department of Education recorded no CRCT data for the year 2003 due to a decision to not test third grade students because of testing irregularities (Georgia Department of Education, 2005).

Under the Department of Education’s Quality Core Curriculum (QCC) Georgia maintained a pass/fail score of 300 for the core and content areas of mathematics, science, and social studies (Georgia Department of Education, 2005). In 2007 the Georgia Department of Education implemented the Georgia Performance Standards (GPS) and adjusted the pass/fail score to 800 for all core and content area subjects on the CRCT. As a result scores from the 2006 CRCT were not used as pretest scores to compare to 2007 as posttest scores.

The research question for the study asked if intensive reading instruction provided through the Georgia’s Choice curricular model had a significant positive impact on science scores for third grade students on the CRCT. The hypothesis was that third grade students in Georgia Choice Schools did not score significantly better on the science portion of the CRCT because of their exposure to the Georgia Choice curriculum.

Data Analysis

The researcher used Statistical Package for the Social Sciences® (SPSS) software, version 17.0 for Microsoft Windows®, to enter and process data for analysis. An analysis of covariance was conducted to determine means and standard deviations for continuous (interval/ratio) data. For this study, standard deviation measured the spread of values within the set of CRCT test scores. Data points close to the mean indicated that the standard deviation is close to zero.

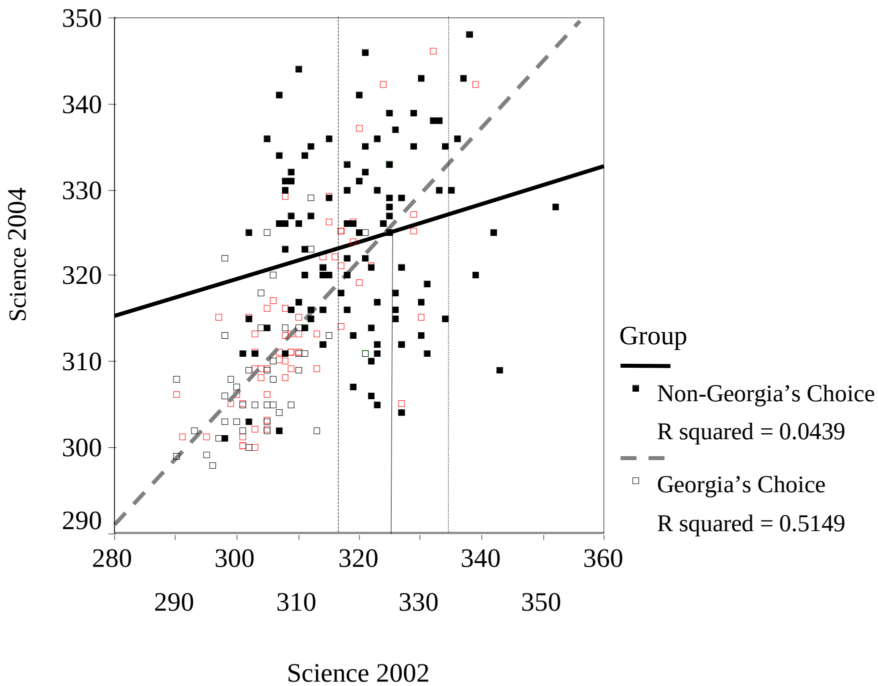
In testing the hypothesis the researcher used an analysis of covariance (ANCOVA) to determine if the mean of the distribution differed significantly for CRCT science scores for Georgia Choice Schools. An ANCOVA was used for the years 2002 through 2006 at the pass/fail score of 300 and for the years 2007 and 2008 at a pass/fail score of 800. Data analysis by an ANCOVA involved the academic years 2002 through 2008 for both sets of schools in the study. Data from 2003 were not used due to testing irregularities and data from 2006 and 2007 were not compared due to different pass/fail scores for those years.

Results

An ANCOVA performed for with 2002 as the pretest and 2004 as the posttest produced results that indicated interaction between the slopes or that the assumption of homogeneity for an ANCOVA was violated. According to White (2003), when slopes differed, regression elevations or slopes cannot be statistically compared using ANCOVA. The heterogeneous regression slopes required the use of the Johnson-Neyman technique to define regions of non-significance according to Preacher, Curran, and Bauer (2006).

The ANCOVA compared the 2002 CRCT science scores as the covariate and the 2004 CRCT science scores as the dependent variable. The grouping factors or variables were Georgia's Choice schools (group 1) and Non-Georgia's Choice schools (group 2). Figure 4.1 indicated the results of the test for homogeneity in the ANCOVA.

Figure 4.1 Scatterplot for 2002 Pretest Scores and 2004 Posttest Scores



The Johnson-Neyman technique used a formula to find the exact intersect point of the regression slopes designated by the solid vertical line in Figure 4.1. The intersect of the two slopes occurred at 323.73. The technique represented the range of science scores within which the simple slope of *y*, or 2002 CRCT science scores, differed significantly from *x*, the 2004 CRCT science scores. The calculation produced two values with one being the upper boundary of the region of non-significance and the other the lower boundary of the region of non-significance. The upper and lower boundaries of the region of non-significance, represented by the vertical dashed lines in Figure 4.1, occurred at 318.08 for the lower boundary and 334.88 for the upper boundary.

The researcher conducted a frequency table using Microsoft Windows Excel ® for the 2002 Georgia's Choice schools CRCT science scores as a pretest that indicated 12 percent of the 105 schools in the study scored in the confidence bands. The 2004 posttest CRCT scores for Non-Georgia's Choice schools indicated that 47 percent of the 105 schools in the study scored in the confidence bands. The range of scores for the confidence bands was 318.08 to 334.88.

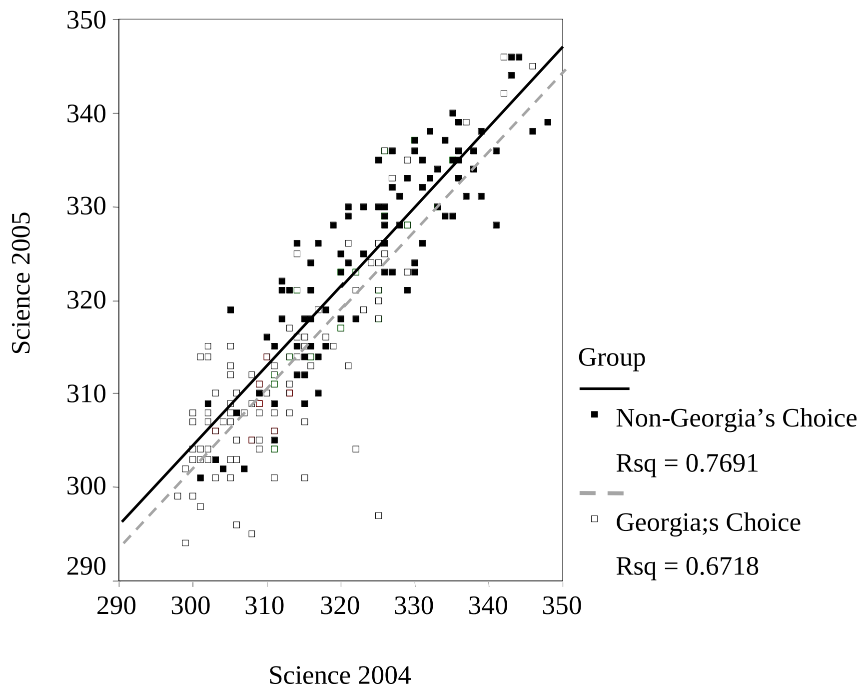
The researcher performed an ANCOVA that compared the treatment group of Georgia's Choice schools' science scores on the 2004 CRCT to the control group of Non-Georgia's Choice schools' science scores on the 2005 CRCT. The ANCOVA equated the nonequivalent groups by controlling for pre-existing differences in the pretest scores. The ANCOVA analyzed the 2004 science scores as the pretest and 2005 science scores at the posttest. Figure 4.2 represents scores indicated by the ANCOVA for the 2004-2005 data.

Table 3.2 Pretest and Posttest CRCT Science Scores for Georgia's Choice and Non-Georgia's Choice Schools

Group	*N*	Mean	*SD*	F	*p*
Georgia's Choice	105	312.35	10.42	8.47	.004
Non-Georgia's Choice	105	324.72	10.54	8.47	.004

After adjusting for the covariate, Science 2004, there was a significant difference between Georgia's Choice CRCT science scores and Non-Georgia's Choice science scores, *F* = 8.466, *p* = .004. The mean for the CRCT science scores for Non-Georgia's Choice schools (*M* = 324.62, *SD= 10.54*) was more than 12 points higher than the mean for Georgia's Choice CRCT science scores (*M* = 312.35, *SD* = 10.42). Figure 4.3 represented the scatterplot for both Georgia's Choice and Non-Georgia's schools for 2004 and 2005.

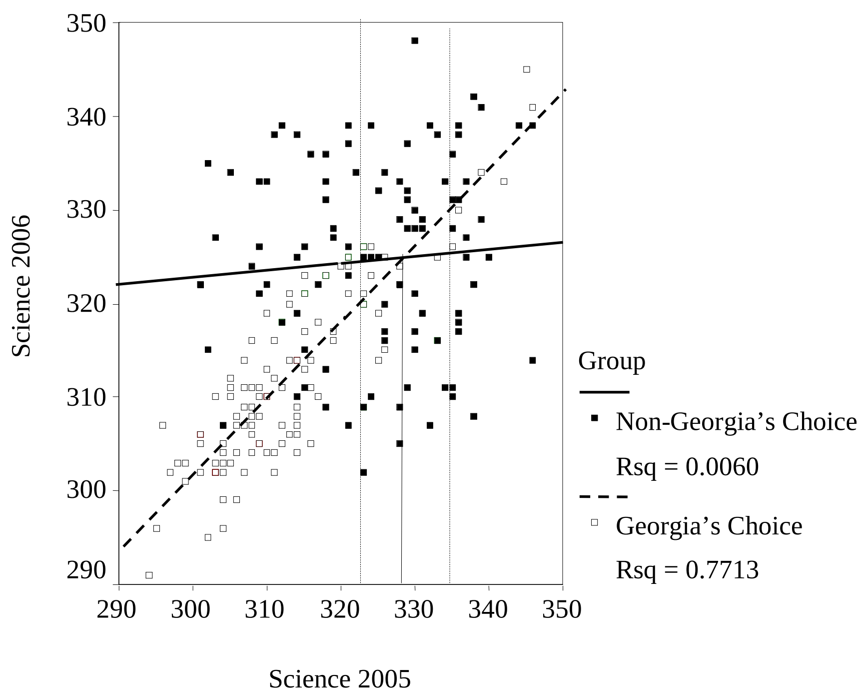
Figure 4.3 Scatterplot for 2004 Pretest Scores and 2005 Posttest Scores



An ANCOVA performed for with 2005 as the pretest and 2006 as the posttest produced results that indicated interaction between the slopes or that the assumption of homogeneity for an ANCOVA was violated. According to White (2003), when slopes differed, regression elevations or slopes cannot be statistically compared using ANCOVA. The heterogeneous regression slopes required the use of the Johnson-Neyman technique to define regions of significance according to Preacher, Curran, and Bauer (2006).

The ANCOVA compared the 2005 CRCT science scores as the covariate and the 2006 CRCT science scores as the dependent variable. The grouping factors or variables were Georgia's Choice schools (group 1) and Non-Georgia's Choice schools (group 2). The scatterplot in figure 4.4 indicated the results of the test for homogeneity in the ANCOVA.

Figure 4.4 Scatterplot for 2005 Pretest Scores and 2006 Posttest Scores



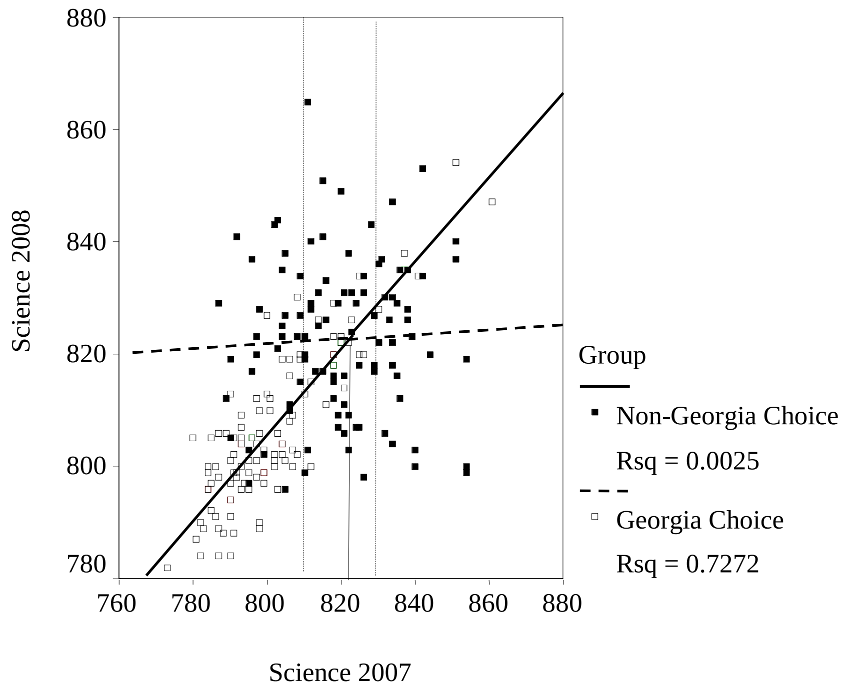
The Johnson-Neyman technique used a formula to find the exact intersect point of the regression slopes designated by the solid vertical line in Figure 4.4. The intersect of the two slopes occurred at 328.77. The technique represented the range of science scores within which the simple slope of *y*, or 2004 CRCT science scores, differed significantly from *x*, the 2005 CRCT science scores. The calculation produced two values with one being the upper boundary of the region of non-significance and the other the lower boundary of the region of non-significance. The upper and lower boundaries of the region of non-significance, represented by the vertical dashed lines in Figure 4.4, occurred at 324.92 for the lower boundary and 334.39 for the upper boundary.

The researcher conducted a frequency table using Microsoft Windows Excel® for the 2004 Georgia's Choice schools CRCT science scores as a pretest that indicated 7 percent of the 105 schools in the study had scores in the confidence bands. The 2005 posttest CRCT scores for Non-Georgia's Choice schools indicated that 38 percent of the 105 schools in the study had scores in the confidence bands. The range of scores for the confidence bands was 324.92 to 334.39.

An ANCOVA performed for with 2007 as the pretest and 2008 as the posttest produced results that indicated interaction between the slopes or that the assumption of homogeneity for an ANCOVA was violated. According to White (2003), when slopes differed, regression elevations or slopes cannot be statistically compared using ANCOVA. The heterogeneous regression slopes required the use of the Johnson-Neyman technique to define regions of significance according to Preacher, Curran, and Bauer (2006).

The ANCOVA compared the 2007 CRCT science scores as the covariate and the 2008 CRCT science scores as the dependent variable. The grouping factors or variables were Georgia's Choice schools (group 1) and Non-Georgia's Choice schools (group 2). The scatterplot in figure 4.1 indicated the results of the test for homogeneity in the ANCOVA.

Figure 4.5 Scatterplot for 2007 Pretest Scores and 2008 Posttest Scores



The Johnson-Neyman technique used a formula to find the exact intersect point of the regression slopes designated by the solid vertical line in Figure 4.5. The intersect of the two slopes occurred at 822.17. The technique represented the range of science scores within which the simple slope of *y*, or 2007 CRCT science scores, differed significantly from *x*, the 2008 CRCT science scores. The calculation produced two values with one being the upper boundary of the region of non-significance and the other the lower boundary of the region of non-significance. The upper and lower boundaries of the region of non-significance, represented by the vertical dashed lines in Figure 4.5, occurred at 816.91 for the lower boundary and 829.40 for the upper boundary.

The researcher conducted a frequency table using Microsoft Windows Excel ® for the 2007 Georgia's Choice schools CRCT science scores as a pretest that indicated 12 percent of the 105 schools in the study had scores in the confidence bands. The 2008 posttest CRCT scores for Non-Georgia's Choice schools indicated that 35 percent of the 105 schools in the study had scores in the confidence bands. The range of scores for the confidence bands was 816.91 to 829.40.

The results of the Johnson-Neyman statistics indicated that 12 percent of the scores for 2002 Georgia's Choice schools fell within the confidence bands for the 2002 – 2004 comparison. Of the Non-Georgia's Choice schools 47 percent of the scores for the 2004 scores fell within the confidence bands in the same comparison. The 2004 – 2005 ANCOVA the mean for the CRCT science scores for Non-Georgia's Choice schools (*M* = 324.62, *SD= 10.54*) was more than 12 points higher than the mean for Georgia's Choice CRCT science scores (*M* = 312.35, *SD* = 10.42). The 2005 – 2006 comparison indicated 7 percent of Georgia's Choice schools' scores and 38 percent of Non-Georgia's Choice schools' scores fell within the confidence bands. The final comparison of 2007 – 2008 indicated that the 12 percent of the Georgia's Choice schools' scores and 35 percent of the Non-Georgia's Choice schools' scores fell within the Johnson-Neyman confidence bands.

Based on the statistics the researcher failed to reject the null hypothesis that the Georgia's Choice curricular reform model would have significant impact on third grade science scores on the CRCT instrument. The Georgia's Choice curriculum did not have a significant impact on science scores for third grade students in Georgia's Choice elementary schools.

Chapter 5

Summary and Discussion

Thier (2002) stated that uniting literacy and science strengthened both disciplines and provided two important benefits to the curriculum. First, when literacy skills were linked to science content, students possessed personal, practical motivation to master language as a tool that aided in answering questions about the world around them. Second, a strong grasp of literacy skills produced a stronger grasp of science knowledge. This researcher attempted to provide further evidence through this study that linking science and literacy enhanced the achievement of reading skills in science and improved test scores on the Georgia Criterion Referenced Competency Test (CRCT). This chapter presented a review of the research, the methodology and the results. Additionally, the chapter included a discussion of the findings as well as recommendations for further research.

Review of the Problem

Reville (2007) referred to narrowing the curriculum as the attempt of school districts to achieve proficiency in core subjects at the expense of other subjects. The Georgia Department of Education chose to narrow the curriculum by focusing on literacy. The Georgia's Choice curriculum adopted by the Department of Education increased the time spent in literacy instruction to three hours and reduced the classroom instructional time for science and social studies to approximately 20 minutes for each on a daily basis. The only other decrease in the daily schedule appeared in the recess schedule which actually increased instructional time overall.

The purpose of this study was to examine the effectiveness of the Georgia's Choice reading curriculum on third grade science scores on the Georgia CRCT. An initial 105 Georgia elementary schools chose to adopt and continue a curriculum reform model from the National Center for Education and the Economy called America's Choice (NCEE, 2001). The Georgia Department of Education modified the curriculum and named it Georgia's Choice (Georgia's Choice – America's Choice, 2009).

This study examined the CRCT test scores of third grade students in 105 Georgia's Choice Elementary Schools and from 105 Georgia elementary schools not choosing the Georgia's Choice curricular model for the years 2002 through 2008. The examination continued with a comparison of reading and science scores from the CRCT to determine what effect, if any, increased reading instruction had on CRCT science scores over the same period.

Review of the Methodology

This quantitative research analyzed data collected from the CRCT. The assessment instrument, administered each spring during an April testing window tested the content areas of reading, English/language arts, mathematics, science, and social studies. Administration of the CRCT included students in grades one through eight. Passage of the third grade reading and math portions of the CRCT helped determine the retention or promotion of a student. Students not passing the initial assessment are given another opportunity for success during a subsequent re-administration of the assessment. The subjects included each third grade student administered the CRCT in 105 Georgia's Choice schools across Georgia. The selection process for participants entailed the participants' membership in a class of third grade students in one of the 105 Georgia's Choice elementary schools.

The study involved data from the CRCT for the academic years 2002, 2004, 2005, 2006, 2007, and 2008 and investigated performance in science scores after increased reading instruction. Each Georgia's Choice school experienced an increase in time allotted for reading instruction to three hours per day at the cost of decreasing the time allotted for science instruction to approximately twenty minutes per day. The map of schools in Appendix A represented the counties of school districts in the study and indicated the wide area of representation of schools across the State of Georgia.

The comparison of reading and science scores on the Georgia CRCT for the academic years 2002 through 2008 provided the opportunity for a causal comparative study. The study used quantitative methods to determine the impact the Georgia's Choice curriculum model on third grade science scores on the CRCT. The study referred to the implementation of the Georgia's Choice curriculum model in 105 Georgia elementary schools as the independent variable and the CRCT as the dependent variable. Schools not choosing the Georgia's Choice curriculum model retained the CRCT as a dependent variable in the study. Additionally, all participants included students previously enrolled in Georgia elementary schools and were not manipulated in any manner prior to or during the study. A t-test compared scores for the six years involved in the study and determined if a statistical significance existed between the means of the two comparison groups.

Summary of the Results

This study covered a six year span with the results of the 2002 CRCT scores from third grade students in 105 Georgia's Choice schools and 105 Non-Georgia Choice schools acting as baseline data. The research question asked if intensive reading instruction provided through the Georgia's Choice curricular model had a significant positive impact on science scores for third grade students on the CRCT.

The study used an analysis of covariance to determine if a significant difference occurred between the means of the two groups in the study. Because of testing irregularities in the third grade test results were not available for the 2003 CRCT. The first opportunity to compare results occurred with the administration of the 2004 CRCT.

The initial results from the 2004 third grade CRCT indicated significant gains from both the Georgia Choice schools and the Non-Georgia Choice schools. The increase in the means of the two groups indicated a gain of over four points in the mean from the 2002 CRCT results.

The 2005 analysis of covariance on the mean third grade science scores indicated a negligible gain for both groups. However, the 2006 results showed a decrease in gains for Georgia's Choice schools to below 2004 CRCT mean scores, while the Non-Georgia Choice schools indicated almost flat performance.

For the administration of the 2007 CRCT, the Georgia Department of Education (2005) modified the pass/fail score from 300 to 800. The modification rendered the scores from 2002 through 2006 incomparable. As a result, this researcher, made the 2007 CRCT scores the baseline data for a continued comparison for the 2008 CRCT scores. The result provided a continued comparison for the data over the course of this study. In comparing the 2008 mean scores to the 2007 mean scores both groups showed an increase in the means of science scores on the CRCT.

Discussion of the Results

The results of the Johnson-Neyman statistics indicated that 12 percent of the scores for 2002 Georgia's Choice schools fell within the confidence bands for the 2002 – 2004 comparison. Of the Non-Georgia's Choice schools 47 percent of the scores for the 2004 scores fell within the confidence bands in the same comparison. This thirty-five percent difference in the posttest scores of the Non-Georgia's Choice schools over the pretest scores of Georgia's Choice schools was considered considerable.

In the 2004 – 2005 ANCOVA the mean for the CRCT science scores for Non-Georgia's Choice schools (*M* = 324.62, *SD= 10.54*) was more than 12 points higher than the mean for Georgia's Choice CRCT science scores (*M* = 312.35, *SD* = 10.42). Again, the spread of over 10 points in the difference of the means between Non-Georgia's Choice and Georgia's Choice schools was significant.

The 2005 – 2006 comparison indicated 7 percent of Georgia's Choice schools' scores and 38 percent of Non-Georgia's Choice schools' scores fell within the Johnson-Neyman confidence bands. Thirty-two percent of Non-Georgia's Choice schools produced scores in the confidence bands as opposed to only 7 percent of Georgia's Choice schools. Once again the difference was significant.

The final comparison of 2007 – 2008 pretest and posttest scores indicated that the 12 percent of the Georgia's Choice schools' scores and 35 percent of the Non-Georgia's Choice schools' scores fell within the Johnson-Neyman confidence bands. While the Georgia's Choice schools improved slightly the difference in the two percentages remained at 23 percent. The Non-Georgia's Choice schools outperformed the Georgia's

Choice schools that had access to the Georgia's Choice reading program consistently in each year of the study.

As a result, the null hypothesis that the Georgia's Choice curricular reform model did not have significant impact on third grade science scores on the CRCT is accepted. According to the statistics the Georgia's Choice curricular reform model did not have a significant impact on science achievement for third grade students in Georgia's Choice elementary schools.

Limitations

As with any study, limitations existed that require consideration in the attempt to generalize the analysis to a broader area. For the Georgia elementary schools that chose to adopt the Georgia's Choice curriculum reform model several specific limitations affect the study. The first limitation embodied the degree to which each school actually implemented the model. The degree of implementation is the responsibility of each principal. At the elementary school where this author taught third grade the implementation of Georgia's Choice faced considerable challenge from the staff. The principal of the school voiced a strong vision for the direction the school should proceed academically and professionally. Many educators felt the decision, made without input of the staff, indicated a dramatic paradigm shift without adequate implementation time or professional staff development. Sixteen veteran teachers left the school in protest or in an effort to retain a more traditional model of teaching. As a result, the following school year began with educators in three distinct camps: Teachers full agreement with the implementation process, resistant teachers who acted late or did not act on the urge to transfer schools, or a group of brand new teachers with little or no awareness of the dramatic shift about to occur. While this process cannot be generalized for each of the 105 Georgia's Choice schools in the study, it does cause one to question the degree of implementation in each school.

The second limitation comprised the success or failure of the reform model in each school as a result of the emphasis placed on the implementation and the level of professional development provided by the individual school leadership. The Georgia Department of Education provided training for professional staff in the components of Georgia's Choice during the summer prior to the implementation, but many disagreed with the haste in which the training occurred. Several educators this author spoke with at various trainings voiced concerns that the implementation process seemed hurried for such a dramatic change in teaching methodology. The urgency with which the implementation happened caused question concerning the effectiveness of professional staff development. An elementary school with an inadequately trained staff possesses the potential for a reduced success rate in implementation.

A third limitation included the depth of professional development provided to teachers by the leadership of each school. The Georgia's Choice curriculum necessitates a considerable change in the traditional elementary teaching format. The changes include considerable adjustments in teaching styles and lesson plans as well as the inclusion of new assessments in areas of reading and writing. Much of the training provided by Georgia's Choice through the Georgia Department of Education centered on the philosophy behind the approach to teaching in the constructivist model. Training lacked emphasis on classroom delivery of methodology or the implementation of how to actually teach this model in the classroom. An additional problem occurred with the urgency of the implementation in that many failed to grasp an understanding of the big picture behind the process. Did the training provided by the Department of Education provide enough to sustain classroom teachers who left with questions or developed questions during the implementation process? A lack of training, or insufficient training, in instruction and assessments results in misdiagnoses of student reading and writing problems.

A fourth limitation entailed the individual teacher and the classroom library of each teacher. The study cannot ensure the quality of each third grade teacher for the students' in the 105 Georgia's Choice schools. The degree to which each teacher implemented the Georgia Choice curricular reform model affects the students in each classroom. The Georgia's Choice model called for a literacy rich classroom but provided no financial resources for teachers to purchase additional classroom library materials. Georgia's Choice asked that students have the opportunity to read a variety of books according to their individual level. For a classroom of students to have the opportunity to choose books to read on their level required a considerable number of books in the classroom. The classroom teacher also received little or no training in leveling books for their classroom libraries. As a result, the study cannot ensure the adequacy of individual classroom libraries, the accuracy of the leveling process, or the extent to which each student received exposure to a literacy rich environment.

Student transiency, a fifth limitation, is another issue in some schools and within this study. There can be no guarantee that every student taking the CRCT receives the same instructional strategies because of transiency. The Georgia Department of Education requires that every student enrolled in a Georgia public school take the CRCT if the student enrolls before the first day of administration of the test. This means that students transferring from non-Georgia's Choice schools, from out of state schools, and home schools take the CRCT without the instructional strategies provided in the Georgia's Choice reform model. This study makes no accommodation for third grade students receiving less than a full Georgia's Choice instructional program.

A sixth limitation is the researcher cannot control for changes the Georgia Department of Education makes in the content of questions over the length of the study. While the validity and reliability of the overall CRCT remains high, the researcher cannot control the correlation of questions on the CRCT to content taught during the length of the school year.

Finally, a seventh limitation occurred when the Georgia Department of Education altered the pass/fail score from a score of 300 to a score of 800 for the 2007 CRCT. While the author assumes this had no affect on the academic achievement of students involved in the study, there is no control over the affect this had on pass/fail rates for the years 2007 and 2008.

Recommendations for Additional Research

Suggestions for additional research include the following:

1. Conduct a study to compare the results of the same students on the Iowa Test of Basic Skills (ITBS) over the same period of time.
2. Conduct a study of CRCT science scores with disaggregated socioeconomic, racial, and ethnic groups.
3. Conduct a study of CRCT science scores using different grade levels or in comparing grade levels.

4. Conduct a study of CRCT science scores with respect to the effectiveness of Georgia's Choice on mathematics scores on the CRCT.
5. Conduct a qualitative study of the effectiveness of the Georgia's Choice curriculum reform model using data gathered from students, parents, teachers, and administrators.
6. Conduct a study on the effectiveness of implementation of the Georgia's Choice curriculum reform across grade levels.

Conclusion

The results of the study indicated that while the Georgia's Choice curricular reform model did increase science scores on the CRCT for third grade students, increases were relatively flat after the initial implementation. In addition, while scores improved overall, there were periods with very little improvement, and in 2006 scores actually decreased. Over the same period third grade science scores on the CRCT for Non-Georgia Choice schools improved steadily. The research indicated that the Georgia's Choice curricular reform model did little to improve science scores on the CRCT in any appreciable manner.

As the stakes for standardized testing have continued to increase, school districts, administrators, and teachers continue to pour human and financial resources into improvement of, not only science scores, but standardized test scores in general. While curriculum reform models may hold merit for increasing test scores in some school districts, most models are not designed as a one size fits all solution to the standardized test dilemma. Alternatives include increased professional development to ensure teacher knowledge in content area subjects and academic performance standards, consistent benchmark or formative assessments to drive instruction in a prescriptive manner, focusing on key subject matter, sharing best practices among teachers, and increasing efforts in gathering and disseminating assessment data to improve instruction of performance standards.

All standardized tests are essentially reading assessments that evaluate reading ability and comprehension. The fact that Georgia's Choice did not return sustained positive results may be evidence that sacrificing instructional time in one subject area for another may not return the desired outcomes.

Kinniburgh and Shaw (2009) noted the decreased time spent in instruction in science content as a reason that instruction in comprehension strategies not be the sole responsibility of the language arts teacher. Students taught comprehension in the primary grades might have difficulty transferring those comprehension skills to expository texts in the content areas. Because language arts and science have natural connections, the authors found it important to teach comprehension in science to promote understanding of the text. Incorporating comprehension strategies into science instruction provided students with skills to become successful at reading and comprehending concepts in a variety of texts. According to Kinniburgh and Shaw improved test scores are the result of increased training in comprehension strategies in content area reading.

Science instruction cannot be left to middle and secondary schools. It is of utmost importance that elementary schools increase efforts in the area of science reading and instruction if science knowledge and scores are to increase.

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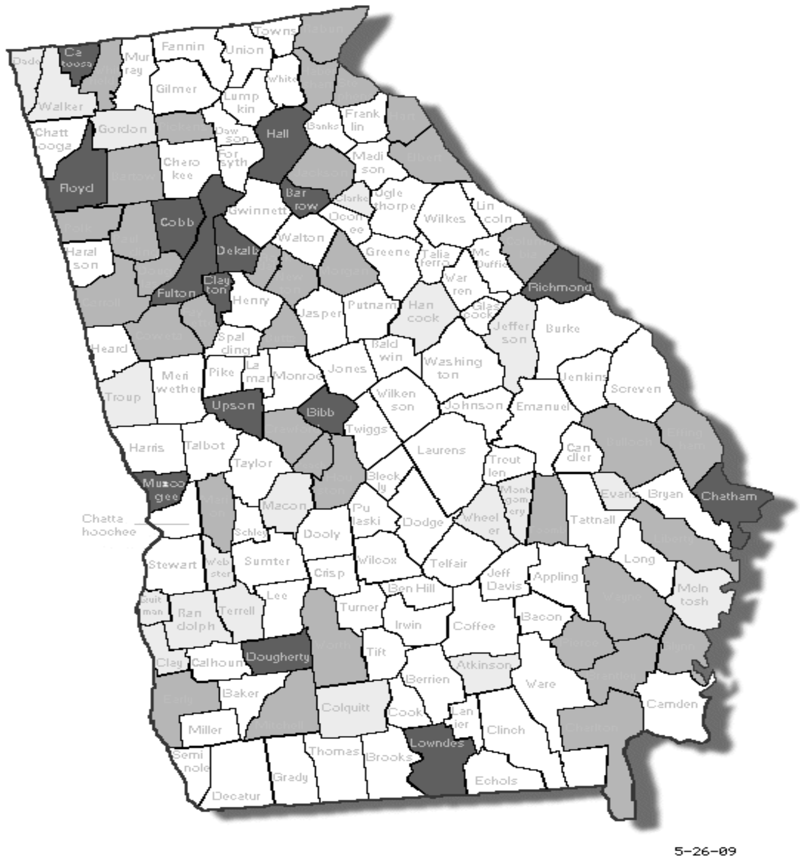
Appendix A

Map of Georgia Counties Included in the Study



Map Key:

- Georgia’s Choice Counties
- Non-Georgia’s Choice Counties
- Georgia’s Choice and Non-Georgia’s Choice Counties