WHAT IMPACT WILL TEACHING VOCABULARY AND COMPREHENSION STRATEGIES IN SEVENTH GRADE SCIENCE HAVE ON HIGH STAKES TEST SCORES?

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ABSTRACT

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This study was designed to examine the importance of continuing reading instruction throughout middle school and its effects on high stakes tests. The specific question for this investigation was, “What impact will teaching vocabulary and comprehension strategies in seventh grade science have on high stakes science achievement test scores?” The purpose of this investigation was to determine whether there was improvement of test scores after these strategies have been embedded in instruction.

Using a pre-test/post-test quasi-experimental design, questions from a state, high-stakes test were collected and used to develop both the pre-test and post-test. The questions were obtained from the eighth grade Ohio Achievement Test practice test, released by the Ohio Department of Education for the purpose of classroom practice. Questions were also collected from Study Island, a web-based assessment that includes opportunities for instruction and practice. All information was based on state standards and identified by indicators.

The students completed a pre and post-test covering science content information. After the pre-test, students continued in their daily classroom learning while vocabulary and comprehension strategies were embedded in instruction. After a five-week unit, the students completed a post-test identical to the pre-test; however, the goal was for the scores to be higher due to the new knowledge of vocabulary needed to read the questions as well as comprehension strategies to understand what the questions were asking. Quasi-experimental statistics were used to analyze the data collected. Significance was set at the $\alpha < .05$ level.
ACKNOWLEDGEMENTS

This thesis was written for all who struggle to show what they know due to their roadblock in reading.

I cannot thank my husband, Spencer, enough for his continued support during this stressful, but extremely important time in my life.

I would like to dedicate this to two very special little girls, Tatum and Pressli, who have heard, “don’t touch that pile,” and “wait a minute, I’m working right now” more times than they should have. I promise there will now be endless time to play!

I would like to thank my mom, Kelly and my dad, Roger MacDonald for instilling this strength and dedication in me at a very young age, when quitting was not an option.

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CHAPTER I. INTRODUCTION

If you can read this, thank a teacher.

~ Anonymous Teacher ~

As a middle school science teacher, with a passion for reading, I try every day to engage students in the vast world of scientific knowing, through hands-on learning, but that does not happen without the initial instruction and the use of text. However, because the students will be required to pass a high-stakes test to prove achievement and accountability, it is necessary that they are successful in transferring all of their acquired knowledge onto a bubble sheet, in addition to short answer and extended response questions.

As much as I love reading, and appreciate the importance of its many components in the classroom, such as fluency, vocabulary, and comprehension, I believe that it is necessary for all content teachers to recognize these values, to best prepare our students for success on achievement tests. If students struggle to read the question, can’t understand what the question is asking, or is unable to decipher the meaning of the answer choices, it becomes difficult to measure their success in a given content area.

My first year of teaching, in addition to my science classes, I was given a remedial reading class for a small group of students. Most of the students enrolled in this class had not passed the sixth grade Ohio Achievement Test in reading. It was through teaching this class that I realized these students needed much more than just improved test scores. They struggled in many areas of reading, including, but not limited to fluency, vocabulary, comprehension, and motivation.

With my goal being to help these students to pass the achievement test and hopefully foster a love for reading along the way, I decided to tap into their interests and focus on
vocabulary and comprehension, two skills that I believe would benefit the students in all of their content classes.

According to Biancarosa and Snow (2006):

When instructional principles are embedded in content, subject-area teachers provide or reinforce instruction in skills and strategies that are particularly effective in their subject areas. This instruction should be coordinated with the language arts teachers, literacy coaches, and other subject–area teachers. The idea is not that content-area teachers should become reading and writing teachers, but rather that they should emphasize the reading and writing practices that are specific to their subjects, so students are encouraged to read and write like historians, scientists, mathematicians, and other subject-area experts. Additionally, it is important that all subject matter teachers use teaching aides and devices that will help at-risk students better understand and remember the content they are teaching. The use of such tools as graphic organizers, prompted outlines, structured reviews, guided discussions, and other instructional tactics that will modify and enhance the curriculum content in ways that promote its understanding and mastery have been shown to greatly enhance student performance—for all students in academically diverse classes, not just students who are struggling. (p.15).

Statement of the Problem

According to Whipple (1925), the importance of vocabulary knowledge to subject matter comprehension has been recognized since the 1920s. Understanding that this issue has been noticed since the 1920s and still exists today, I decided to further examine this relationship. Approximately six years ago, teachers were introduced to the government mandated, No Child Left Behind Act. This narrow path was carved out of the landscape by the kind of high-stakes
accountability that is based on inexpensive, standardized tests and comes with an extremely narrow focus on low-level knowledge and skills (McKim, 2007). McKim argues:

NCLB fails to address the needs of the whole child and reduces the guiding purpose of public education from the development of effective and contributing citizens to an unending quest for higher scores on tests that cannot assess what we value most in a democratic society—things like critical thinking, problem solving, effective and persuasive communication, cooperation, perseverance, caring, respect, and appreciation for diversity. (p. 298)

It is the job of educators in this country to stand and deliver appropriate material that will be of the greatest benefit to students. However, content area teachers are often so focused on getting through the required standards for which children are going to be held accountable, that they lose sight of the foundation sometimes assumed to exist by middle school: the ability to understand what teachers are asking them to do. Alvermann (2001), states that adolescents respond to the literacy demands of their subject area classes when they have appropriate background knowledge and strategies for reading a variety of texts.

Research Questions

As a department chair, I sift through piles of achievement test scores at the beginning of every school year. We try to have as many interventions as possible in place for struggling students before they ever walk into the classroom. As a team of content area teachers, we have many common goals, but our number one goal is to see success for every student. We look for improvement every year for every child in our classrooms. As a seventh grade teacher, I look at sixth grade scores first. At the sixth grade level, in the state of Ohio, the students only take achievement tests in reading and math. My team and I first look at students who didn’t pass one
or more areas of the test. We then go back and look at their fifth grade scores, where they are assessed in math, reading, science and social studies. If their reading scores are low, they usually struggle on the science and social studies tests also. I then look at the reading scores even more closely. I check the different areas of reading. Generally, I find that two of the lowest areas are Acquisition of Vocabulary and Literary Text. I also look to see if their scores have improved or regressed since the fifth grade. I want to know if there is a correlation between their content knowledge and their reading levels. This preparation work, as well as some of my findings, have led me to ask, what impact will teaching vocabulary and comprehension strategies in seventh grade science have on high stakes science achievement test scores? The purpose of this investigation was to determine whether there was improvement of test scores after these strategies were embedded in instruction.

Rationale

Tierney and Shanahan (1991) believe, “Effective teachers look for ways to integrate reading and writing as often as possible because they know that each process reinforces the other and can lead to improved comprehension and retention of subject area content” (p. 11). Vocabulary is a principle contributor to comprehension, fluency, and achievement. Vocabulary development is both an outcome of comprehension and a precursor to it, with word meanings making up as much as 70-80% of comprehension (Nagy & Scott, 2000; Pressley, 2002). Finding ways to use reading and writing in the science classroom with a focus on the understanding of vocabulary to better comprehend the material should increase student achievement on the standardized tests.
Definition of Terms

There are terms that will reoccur throughout this study. For the purpose of clarification, the following terms have been defined for the reader to increase understanding.

1. **Word Walls:** “working bulletin boards,” a chart with a theme or focus determined by the teacher (or students). These charts of words are posted around the room and used as a way of studying word patterns and word relationships. (Crawley & Merritt, 2009, p. 64)

2. **Word Relationships:** Words may have different relationships to each other that students should be aware of to understand differences in meaning. Understanding these differences in meaning helps students to use the dictionary and comprehend material they read (Crawley & Mountain, 1995).

3. **Guided Reading Procedures:** organizational structures or plans for teaching reading that provide specific steps to help students activate prior knowledge, establish background, engage in purposeful silent or oral reading, and extend learning (Crawley & Merritt, 2009, p. 182)

4. **High Stakes Testing:** a means for assessing student outcomes and measuring school improvement, (Jones, Katsiyannis, Ryan, & Zhang, 2007), an example would be the Ohio Achievement Test (OAT). It should also be noted that high-stakes testing can have different meanings in different states or countries.

5. **Acquisition of Vocabulary:** According to the Ohio Academic Content Standards, it is the application of knowledge of words (origin, parts, relationships, and meanings) to acquire specialized vocabulary that aids comprehension.
6. **No Child Left Behind:** — *Accountability for Results:* Creates strong standards in each state for what every child should know and learn in reading and math in grades 3-8. Student progress and achievement will be measured for every child, every year.

7. **Action Research:** any systematic inquiry conducted by teachers, administrators, or others with a vested interest in the teaching and learning process or environment for the purpose of gathering information about how their particular schools operate, how they teach and how they learn (Mertler, 2006).

8. **Short Cycle Assessment:** It is a formative assessment given periodically, designed to help the teacher to shape or form instruction (Lang, Stanley & Moore, 2008)

**Limitations**

There were clearly identified limitations for this study. First, there were many variables that could not be controlled that may have influenced the post test scores on the given questions. For example, post-scores could possibly increase due to information presented in other classes. Also, a five-week treatment period may not be a sufficient amount of time to have a significant impact on the outcome. In addition, the time of year in which this study took place could be factored by weather and or interruptions in the school day. Lastly, while the science questions did not separate scores of vocabulary and comprehension, these areas too, could improve on other areas of the test, such as reading.
CHAPTER II. REVIEW OF LITERATURE

"Americans are taking as many as 600 million standardized tests each year in schools, colleges, and universities, and the workplace."

Peter Sacks

Although many politicians argue that standardized testing will guarantee that poor and minority students receive a quality education, teachers are reporting that testing pressures are affecting the quality of their instruction and their professional beliefs about reading and learning to read (Hoffman, Assaf, & Paris, 2001; Pennington, 2004). In an effort to raise students’ test scores, teachers are responding by using more systematic, low-level, drill-and-skill building instruction (Pennington). Teachers are becoming less responsive and adaptive to students’ literacy needs and are focusing more on skills management based on test objectives (Flores & Clark, 2003) because of increased concerns about passing the high-stakes tests. The consequences of high-stakes testing are being felt by classroom teachers and reading specialists alike, both of whom are engaged in the daily realities of literacy instruction and assume the heaviest burdens of testing pressures (Smith & Fey, 2000).

This chapter will explore the history and relevance of vocabulary and comprehension strategies in the content area classroom as well as to look at the benefits that these two components will have on all subject areas. In turn, the enhancement of these reading strategies should increase the students’ abilities to better comprehend the content in their subject areas, as well as the ability to read and answer questions, thus improving high-stakes test scores.

History of Vocabulary

Some content area teachers may argue that reading instruction and strategies are already taught by the reading specialist and do not need to be taught in the content areas. Research has
shown that reading is not an “isolated skill” and cannot be removed from the classroom (Frederick, 1972; Moss, 2005). It is for these reasons that classroom teachers need to not only understand the values in all teachers being a teacher of reading, but also have the ability to incorporate these strategies into their content teaching.

Greenwood (2004) argues, “There is a great divide between what we know about vocabulary instruction and what we (often, still) do” (p. 28). Many teachers know they need to do a better job teaching vocabulary to students who find reading difficult (Thompkins & Blanchfield, 2004). Teachers also know that one of the challenges of struggling middle school readers is their limited vocabulary and knowledge of the world (Broaddus & Ivey, 2002). While teaching vocabulary well in every curriculum area is only one aspect of developing engaged and successful readers, it is a key aspect (Bromley, 2007). Students with large vocabularies understand text better and score higher on achievement tests than students with small vocabularies (Stahl & Fairbanks, 1986).

Vocabulary as an Instructional Practice

Broad word knowledge enables students to communicate in ways that are precise, powerful, persuasive, and interesting because words are tools for analyzing, inferring evaluating and reasoning (Vacca, Vacca, Gove, Burkey, Lenhart, & McKeon, 2005). Understanding these levels of thinking is required to answer questions on high-stakes tests such as the Ohio Achievement Test. To answer questions that require these levels, the students must be able to understand what is being asked of them. According to Bromley (2007), the following recommendations have been made to improve these abilities.

- Read literature aloud to students, stopping to talk about words they may not know. Share Trelease’s (2001) notion with students that the best SAT preparation
course in the world is to hear literature read aloud because the richer the words student hear, the richer the words will be that they can read and give back when they speak and write.

- Encourage students to ask about words they don’t know.
- Engage students’ prior knowledge and related experiences before teaching new words to introduce a chapter or content area selection. (p. 529-531)

Bromley (2007) states that 70% of the most frequently used words have multiple meanings. For example, *hand* can have many meanings (e.g., to give someone something, applause, a way of measuring a horse’s height, cards dealt to someone playing a card game, or the part of the anatomy at the end of the wrist). Words such as *foot, ball,* and *java* also possess multiple meanings. Context often helps unlock the meaning of words, but when it doesn’t help, students have a purpose for using the glossary, dictionary, or thesaurus. Using these references can expand vocabularies and encourage curiosity about words. The following examples are ways to show students how to properly identify multiple meanings and identify context clues, as stated by Bromley:

- Use a fiction or nonfiction selection to teach students how context can give clues to a word’s meaning in several ways. Show that many words have multiple meanings and explicitly teach them how to use context and references to help unlock appropriate meanings.

- Show students how to use context to figure out new words by reading to the end of a sentence or paragraph, reading a caption, analyzing a picture or graphic, or looking at a footnote.
According to Bromley (2007), meanings of 60% of multisyllabic words can be inferred by analyzing word parts. Students also need a mindset to alert them to this (Nagy & Scott, 2000). Knowing the meaning of a root, prefix, or suffix often gives clues to what a word means. This is especially true in science because it contains many multisyllabic terms. Knowing just a few roots makes it much easier to identify several other words that contain these roots. One example of this would be biology; *bio* represents living, and *ology* pertains to the study of a topic.

Bromley (2007) also states that direct instruction in vocabulary influences comprehension more than any other factor. Although wide reading can build word knowledge, students need thoughtful and systematic instruction in key vocabulary as well (Blachowicz & Fisher, 2004; Nagy, 1988; Watts-Taffe, 2002). Instruction that engages students in the meanings of new words and their letter, sound, and spelling patterns promotes more effective word learning than just analyzing context (Juel & Deffes, 2004). As students learn new words, they can use them to learn other new words and build independent word learning strategies (Baumann & Kame’enui, 1991). One way to incorporate this idea, as stated by Bromley is by making connections with other words whenever possible because it helps to build from the known to the new. For example, when teaching the word *counterrevolutionary*, it should be related to *revolt*, *revolution*, *act*, and *counteract* to build on what students may already know.

Bromley (2007), also explains that teaching fewer words well is more effective than teaching several words in a cursory way. Science, math, and social studies material contain many conceptually dense terms, and most need instruction in this technical vocabulary (Vacca et al., 2005). While it may be tempting to introduce the entire list of new vocabulary from a chapter in a content text, it is more effective to teach fewer words well rather than several words less well.
(Robb, 2000). Few teachers realize that they can occasionally teach vocabulary during or at the end of a lesson (Watts, 1995).

Good comprehension also depends on an extensive vocabulary, for above-word-level comprehension cannot occur if individual words are not understood. The most salient comprehension processes of good readers involve comprehension above the word level; however, good readers derive the meaning of whole text by engaging the text before they read it, while they read it, and after a first reading is completed (Levin & Pressley, 1981). Before reading, good readers often skim a text and make predictions about it based on their prior knowledge. As the good comprehender reads, he or she reads selectively, reading some parts carefully (Pressley, 2006).

History of Comprehension

Reading comprehension has a long and rich history. There is much that we can say about both the nature of reading comprehension as a process and about effective reading comprehension instruction. Most of what we know has been learned since 1975 (Duke & Pearson, 2006). Reading comprehension strategy instruction has been a major research topic for more than 20 years. The idea behind this approach to instruction is that reading comprehension can be improved by teaching students to use specific cognitive strategies or to reason strategically when they encounter barriers to comprehension when reading. However, to be effective, such instruction must ensure that the content is presented and students read the texts in ways that emphasize deep understanding and critical thinking, and that implies some attention to strategies.
Comprehension as Instructional Practice

The fact that content and strategies are fundamentally intertwined makes this a difficult issue to study, but the question is important. Certainly content plays a larger role in comprehension than is suggested. In fact, it may well turn out that the long-term contribution of our recent strategy research, including the work on preparing teachers to teach strategies, will not be to endorse comprehension strategies as an independent topic of instruction. Rather, the strategies found to be successful may be incorporated into curriculum areas such as social studies and science (Williams, 2006).

Strategies needed for success in high-stakes reading comprehension tests are well established. Schwartz’s (1988) research supports the importance of the following: (a) using background knowledge, (b) searching to locate information, (c) summarizing, (d) self-monitoring, (e) self-questioning, (f) concept mapping, and (g) self-explanation. Good readers are known to use these strategies when necessary and poor readers rarely use them. Furthermore, these strategies can be taught and instruction in them will improve high-stakes reading comprehension test performance. The direct instruction recommended includes (a) teacher modeling of the strategies, (b) explanation of when and how to use them, (c) repeated opportunities for guided practice, and (d) extended independent reading.

A variety of innovative teachers and researchers have shown that long-term engaged reading can be increased with integrated instruction. When students are provided opportunities to connect reading and writing activities to integrated language arts, their engaged reading increases and reading achievement improves (Morrow, Pressley, Smith, & Smith, 1997). Further, when reading and writing are also linked to content learning in social studies and science, engaged reading is likely to be fostered (Guthrie, 2006).
American youth need strong literacy skills to succeed in school and in life. Yet approximately eight million young people between fourth and twelfth grade struggle to read at grade level. Very few of these older struggling readers need help to read the words on a page; their most common problem is that they are not able to comprehend what they read (Biancarosa, & Snow, 2006).

After an extensive summary of research on comprehension, Pressley (as cited in Crawley & Merritt, 2009) wrote that comprehension is not isolated; it is multidimensional. Pressley recommends teaching decoding skills, developing sight words, teaching the use of semantic context cues, teaching vocabulary, encouraging extensive reading, encouraging students to ask themselves “why” questions about the text, and teaching students to use comprehension strategies.

In another extensive review of research on comprehension, Duke and Pearson (as stated in Crawley & Merritt, 2009) wrote that approaches to teaching informational text structure are quite varied and range from the use of graphic organizers (such as concept maps, charts, and graphs) to summaries. Duke and Pearson also concluded, “almost any approach to teaching the structure of informational text improves both comprehension and recall of key text information” (p. 217). They also concluded that research supports the use of comprehension strategies that teach readers to make predictions, activate prior knowledge, think aloud, use text structure, use visual displays of text (e.g., diagrams, flow charts, semantic maps), summarize, and generate and respond to questions.
History of Reading in the Content Area

From the early 1900s through the 1960s, the predominant paradigm for content area reading was skills based. Reading scholars and researchers recognized the relationships between reading and learning and essentially pursued two lines of inquiry through descriptive, correlational, and experimental research: (a) the identification of reading and study skills associated with each of the content areas, and (b) the effects of various instructional variables on the acquisition of reading and study skills and learning in the content areas (Vacca, 2006).

According to Vacca (2006), Gray conducted one of the first studies to identify reading and study skills by content areas. Gray’s work prompted other reading researchers to analyze the skills needed to read effectively in content areas. According to Vacca, McCallister (1930) used qualitative research methods, including observation and interviews, to identify the types of reading skills and activities in various content areas. He reported that students enrolled in junior high subjects had to perform numerous kinds of reading activities depending on the nature of the subject matter and the teaching strategies appropriate to the particular subject area.

Other researchers compared students’ performance on general tests of reading with performance on content-specific achievement tests. Artley (1944), for example, studied the relationship between general reading comprehension and reading comprehension factors specific to social studies. He found that “the ability to read generally is related to the ability to read social studies, but an absence of a near perfect correlation indicated a high degree of specificity in the factors associated with reading comprehension in a content area such as social studies” (Farstrup & Samuels, 2002, p. 189). For the most part, investigators concluded that there are skills common to different subject areas, but some of these skills hold special relationships to achievement in each of the subject areas.
Content area reading in middle and high school can make a difference in the literate lives of adolescents. William S. Gray, preeminent among first generation reading educators and researchers, often is credited with having fashioned the movement toward reading and studying in content subjects. Gray articulated the relationship between reading and learning that remains today the underlying rationale for content area reading instruction. Not only is Gray credited with having forged the beginning of content area reading, but he is also associated with what has become an often used, often confused mantra in education: “Every teacher is a teacher of reading” (Vacca, 2006, p. 186).

Vacca (2006) also states that a credible knowledge base, grounded in theory and research on the relationships between reading and learning, supports the visible, and invisible dimensions of content area reading instruction. The visible aspects of content area reading emphasize the explicit development of reading strategies that enable students to think and learn within texts (Pressley, 2000). According to Vacca, “Strategy instruction in content area is visible in the sense that teachers engage in explicit instructional routines to develop students’ metacognition of reading strategies and the self-regulated use of these strategies to comprehend and learn from text” (p. 184).

Vacca (2006) further explains, “Just as metaphysical concepts of soul are invisible to physical concepts of body, so should the use of reading strategies be an invisible dynamic underlying subject matter learning” (p. 184). As crucial as strategy instruction may be to adolescents’ literacy development, an equally important dimension of content area reading is its invisibility across the curriculum (Vacca). Content area reading is a matter of good teaching. When the invisible aspects of content area reading are operating in the classroom, the teacher is
able to integrate reading and subject matter learning in seamless fashion, using language and literacy to scaffold students’ learning (Vacca).

According to Vacca (2006), a functional concept of content area reading became popular in the 1970s. Because functional instruction in content areas integrates that application of comprehension strategies and content acquisition, content area teachers will not find that they are sacrificing an inordinate amount of time to the teaching of reading.

Teachers make content area reading invisible through the design of well-planned content literacy lessons. Often these lessons are referred to as the teacher’s instructional framework, (Vacca & Vacca, 1999). Essentially there are three points in an instructional framework at which students can use reading strategies for comprehension: (a) before reading, (b) during reading, and (c) after reading text assignments.

Content area teachers scaffold before reading experiences using a variety of cognitive and metacognitive strategies, including encouraging students to analyze the reading task that is ahead of them by asking questions such as, “What is my primary purpose for reading the text assignment?” “Should I try to remember details or read for the main ideas only?” “How much time will I spend on the reading?” “What do I already know about the topic?”, and “What will I need to find out more about?” (Vacca, 2006).

Vacca (2006) also states that the visible and invisible dimensions of content area reading can make a difference in the school lives of adolescents. Showing students how to use reading strategies and language processes to learn in the content classroom does not require specialized training, nor does the development of reading strategies diminish the content area teacher’s role as a subject matter specialist. To the extent that texts are an integral part of content studies,
teachers have a direct and functional role to play in adolescents’ literacy development. On a practical day-to-day basis, teachers need to be successful in academic subjects (Vacca).

Preparing Students for High-Stakes Tests

In the past decade, tests in reading have become a high priority for teachers, administrators, and students. Attempting to improve student achievement, schools and districts have placed an emphasis on accountability. Schools and teachers are expected to show that their students are achieving well on tests in reading, math, and content areas. In this environment of school improvement through accountability, testing is a “high-stakes” part of teaching and schooling.

The most prominent use of high-stakes tests is improvement of instruction. In 1998, 43% of states in the United States reported using assessment to improve instruction. The tests in these assessment programs may be standardized tests or performance assessments. In some instances, schools scoring low on a high-stakes test are subject to “takeover” by the state department of education. The school loses its freedom and flexibility in decision-making.

Tests used for high-stakes purposes vary widely. In some cases, traditional standardized tests are used. Frequently, tests such as the *Iowa Test of Basic Skills* or comprehensive achievement tests are employed. Often these include a high proportion of multiple-choice items. Traditional items, such as small passages with brief questions and four alternatives are used. Subtests in the intermediate grades often include vocabulary, word attack skills and comprehension.

Administrators favor these tests because they are easily administered and can be scored by a machine. Multiple-choice reading tests have the advantage of high reliability. However, many educators question the validity of multiple-choice tests. We rarely confront multiple-choice
items in the real world and thus reading experts increasingly prefer the use of “naturalistic” items (Guthrie, 2006).

Challenges in the Middle School

Middle school teachers face many challenges as they help students transition from elementary school to new and often larger schools with different teachers, more schoolwork, more emphasis on grades and for some students, more of the same problems that plagued them throughout their earlier school years, which include problems with doing homework, following directions, and reading. These challenges are significant because they impede student learning and successful school performance. They also increase the instructional demands placed on the teachers in an age of high-stakes testing and accountability.

Perhaps the most challenges, however, are those experienced in the area of literacy. Students’ over-all academic success is comprised by the lack of well-developed reading and literacy skills” (Alvermann & Phelps, 1998, p. 195). It comes as no surprise that even the best readers struggle at times. However, the difference between good readers and poor ones is that when good readers struggle with text, they employ a number of strategies that allow them to master the troubling area (Vacca & Vacca, 2002). The same is not true for struggling readers. They may need to be taught explicit literacy strategies to help them make sense of text (Kozen, Murray, & Windell, 2006).

Kozen, Murray, and Windell (2006) also state that, in middle school, instruction focuses on acquisition and proficiency of subject matter rather than acquisition and proficiency in reading. Students are expected to read to learn, rather than learn to read (Chall, 1983). They are responsible for teaching subject matter in a timely, effective manner (Alvermann & Moore, 1984; Moore 1996). Teachers rely on students’ ability to read for meaning and understanding,
and they assume that students will use textbooks to assist them in learning course content.

Unfortunately, if students’ reading skills are deficient, teachers rely on a common and critical tool for instruction and learning that is lacking. So the question then is, “How can middle school teachers assist students in mastering content area knowledge and, at the same time, address the diverse reading skills students bring into their classrooms?”

Summary

Upon the review of literature, it is clear that the necessity to continue the instruction of reading at the middle school level, through the content classes exists. There are many unanswered questions that need to be researched, and there are many suggestions to be explored. With all of this available information, ensuring, or at least, improving middle school students ability to better read and therefore comprehend what is being asked of them on high stakes assessments could be successful, through the implementation of these ideas.
CHAPTER III. METHODS AND PROCEDURES

The purpose of this study was to examine the impact of vocabulary and comprehension instruction on science achievement among seventh grade students. The sample of students were introduced to a variety of vocabulary and comprehension strategies to be used in the science classroom. Students were assessed through the use of pre- and post-test scores. This chapter will discuss the methods and procedures used for this study.

Methods

Research Design

The action research design model for this study followed that as recommended by Mertler (2006) for quasi-experimental educational research. Quasi-experimental pre-test post-test design is the closest relative to true experimental designs. The only difference is that there is no random assignment of participants to groups. The literature review suggests that there are a number of strategies that classroom teachers can incorporate invisibly, through good lesson planning and teaching. This study used these strategies throughout its entirety.

Participants

The study was conducted in a junior high building that houses three seventh grade science classrooms in a northwest Ohio school district. This junior high embraced the teaming concept, where each team of four content teachers, math, science, language arts, and social studies shared a group of approximately 70 students throughout the day. All 70 students shared the same content teacher at different times throughout their day. The school district community included a university, a rural area and small industries throughout the city.

Most of the students were assigned randomly, using a computer program, to the team prior to the start of the school year. An exception to this was that the particular team involved in
this study was the “at-risk” team. This team did not have any students who were on an Individualized Education Plan (I.E.P.), due to the lack of an intervention specialist. This team did however, have four children who were on a 504 plan. There were 23 students who were identified at-risk, also. At-risk is a term used within this district to describe students who may require interventions that can be met by the classroom teacher in the general education classroom. This team did have a part-time tutor who provided three periods of tutoring each day, for students who were struggling academically. This class appeared similar to a resource room that provides assistance to struggling students in their four core classes; math, science, language arts or social studies. This class offered pre-teaching and re-teaching of the concepts being covered in the core classes. This class was also used as an intervention for students who required additional time and assistance.

Students and parents were given permission slips with a description of the study that would take place in the classroom. If there were any parents who did not wish for their children to participate, the scores of those students were not included in the data collected by the researcher. It was common practice in this class for the students to take a pre- and post-test at the beginning and end of each unit. Therefore, all students took each test, but only students who had parental permission and provided self permission had their scores included in this study.

Instrumentation

Prior to beginning the study, but after obtaining permission from all participants, a pre-test was administered. The researcher pulled sample questions from the eighth grade science section of the Ohio Achievement Test (OAT) that were released by the Ohio Department of Education as well as Study Island. Although the researcher conducted this study in a seventh grade classroom, there was not a science section on the OAT given in the seventh grade. The
science test was given in the eighth grade and covered the Ohio Academic Content Standards as taught in grades five through eight. Therefore, the researcher only pulled the released questions that covered the Ohio Academic Content Standards as taught in fifth, sixth, and thus far in the seventh grade school year. This precaution was taken to eliminate variables such as content teaching that took place between the pre- and post-portion of the study. The researcher incorporated questions from both banks due to the number of questions needed. The Ohio Achievement Test had very few questions that had already been covered in seventh grade science. Therefore, questions were used from both resources. This allowed the researcher to develop a bank of questions, which included short answer, extended response and multiple choice, which should be able to be completed within a 42-minute class period.

Procedures

This study started at the beginning of the fourth nine weeks of the district’s school year, April 14, 2009. The first step was to receive permission from all requested participants (see Appendix A), approximately 70 students. In addition to consent, the letter to parents (see Appendix B) and students also informed them of the reasons and goals for the study.

The students were not removed from their classroom at all throughout this study. All portions of the study were conducted in the classroom through content teaching. Science content standards, as required by the state of Ohio, were not compromised throughout this study.

Upon selecting the questions to be used in the pre- and post-test (see Appendix C), the researcher identified any vocabulary words in the directions, questions and or answer choices that could be difficult for the level of readers in the classroom (see Appendix D). Reading levels of the students in this classroom were determined throughout the course of the year using DRA scores and sixth grade Ohio Achievement reading scores. Upon identification of these words, the
The researcher created a list and strategically placed each word in the lessons to be taught over the next five weeks. This area of the lesson plan was highlighted to ensure identification (see Appendix E-G).

The researcher incorporated a variety of vocabulary and comprehension strategies throughout the science curriculum. According to Vacca (2006) showing students how to use reading strategies and language processes to learn in the content classroom does not require specialized training, nor does the development of reading strategies diminish the content area teacher’s role as a subject matter specialist.

Upon receiving all necessary approval, only one week was given for the return of the permission slips; all other students’ scores were not reported. The researcher administered the chosen questions from the OAT and Study Island. The questions were scored and data were put into an Excel spreadsheet. This spreadsheet was used to further analyze this data using quasi-experimental statistics.

Next, the researcher began incorporating the vocabulary and comprehension strategies over a five-week period. Strategies were evaluated through the use of short cycle assessments within the classroom procedures throughout the study. Short cycle assessments are quick and easy to administer in the classroom. One example would be to give the students directions that included a vocabulary word, as identified in the pre- and post-test questions, and pause to ask the students to explain to their classmates what the meaning of the word(s) is. Another example would be to give the students three vocabulary words being covered in the unit on a note card. The students would then be asked to flip the card over and give as many meanings as they can think of relating to the vocabulary word (i.e. Thermal – heat, clothing to be worn sledding,
energy). All strategies were written right into the lesson plan as provided by the researcher and a collection was kept throughout the entire study.

At the end of the fourth quarter, on May 22, a post assessment was given. The students completed the same set of questions they were given at the beginning of the study. The researcher scored the post-test upon completion and an analysis of the results was conducted.

Data Collection

The researcher gathered the data from the pre- and post-tests. Pre-tests, as well as post-tests, consisted of previously covered science material. During the study, science instruction integrated vocabulary and comprehension strategies. One such strategy that was implemented often was questioning strategies. Since the test is comprised of multiple styles of questions, the researcher used these strategies to familiarize the students with the questioning styles that they would experience.

Morgan and Richardson (2003) state, “Durkin (1979) found that teachers rely on questioning more than any other comprehension technique. When it works, it works very well. Questions can help teachers to know whether students understand text and can guide readers to consider many aspects of material” (p. 184). It was also discussed that “a teacher who requires students to close their books and recite information before they have a chance to assimilate that information is testing a product rather than assisting the process of constructing meaning” (Morgan & Richardson, p. 185). Since none of the questions that appeared on the Ohio Achievement Test came literally from the classroom discussions and labs, the researcher used this idea to best prepare students to understand and apply classroom content to state testing. McMurray, Laffey, and Morgan (1979) found that students skipped over unfamiliar words when they had had no strategy for learning vocabulary. Hynd and associates (1995) report that students
tend to skip over text that does not confirm their prior knowledge, unless their attention is
directed specifically to it. Teachers need to assist students in understanding words that clarify
text for the reader” (Morgan & Richardson, p. 256).

Upon collecting the data, the goal was to show an increase in scores between the pre-
and post-test scores based on the focus of vocabulary and comprehension used to answer the
questions. The post-test covered the same concepts as the pre-test and there was not a focus on
science vocabulary, but vocabulary and comprehension of reading the questions in general (i.e.
analyze, which is a command word commonly in the directions of an achievement test). The
researcher included both sets of data in an Excel spreadsheet using the Microsoft Word program.
To best conceal the students’ identity, numbers were assigned to each participant. Participants
were assigned one number so that the pre-test scores could be compared to the post-test scores.

Data Analysis

The researcher used two tables to organize the pre- and post-test scores. Data were then
entered into the Stat Crunch program to be analyzed using a t- Test of Related Samples (paired).
The two sets of data were used to determine whether there was a significant difference in the
scores after the reading strategies had been incorporated into the science classroom.

Summary

The researcher conducted this study to investigate the use of reading strategies, mainly
vocabulary and comprehension in the science classroom, as well as a tool to measure the impact
of the strategies on high-stakes assessments.

The researcher documented each strategy used within each lesson plan and included a
daily reflection. The researcher also documented the amount of time spent in the content
classroom to incorporate each strategy. This information was used to support the idea of
“invisibility” in the content classroom. There should be no content time lost to utilize the comprehension and vocabulary strategies.

The researcher also collected and included copies of any index cards, a list of the words (identified from the test) and/or any other materials given to the students during this study. If the strategies were incorporated through conversation, the dialogue will be added into the lesson plan. This study was also reported to the administration as a means of evaluation for reading in the content area.
CHAPTER IV. DATA ANALYSIS AND DISCUSSION OF RESULTS

According to Alliance for Excellent Education:

When Reading First was launched five years ago, many policymakers believed that if students could master the basics of literacy in the first few years of school, that would be sufficient to carry them successfully through the middle and high school years. Increasingly, though, research has made it clear that students need ongoing support in order to handle the more difficult kinds of reading and writing they must do in the upper grades. For example, teachers must continue to work with students to help them read fluently, to expand their vocabularies, and to make sense of the complex and increasingly specialized materials they encounter in the academic content areas. Furthermore, the most recent review of the research on secondary literacy instruction—commissioned by the U.S. Department of Education—strongly reiterates and expands upon the findings of Reading Next and the subsequent reports (Torgesen et al, 2007). It concludes that in grades four through twelve, literacy instruction should address as least six key areas of concern: reading fluency; vocabulary knowledge; content knowledge; higher-level reasoning and thinking skills; reading comprehension strategies; and student motivation and engagement, (pp. 1-2)

This study focused on the impact of embedding vocabulary and comprehension strategies into the [science] content classroom on the performance of high-stakes science achievement tests. The researcher implemented these strategies into the classroom to answer the question: What impact will teaching vocabulary and comprehension strategies in seventh grade science have on high stakes test scores?
Data Analysis

The researcher designed a test made up of 27 questions; 25 multiple choice, one extended response, and one short answer. The total test was worth 31 points; multiple choice questions were worth one point each, the extended response was worth four points and the short answer was worth two points. All questions were pulled from either Study Island, a web based assessment that focuses on Ohio Academic Content Standards, and released practice test questions from the eighth grade Ohio Achievement Test. The researcher used an answer key from Study Island and The Ohio Achievement Test to accurately grade the pre- and post-tests. This test was given to help determine the impact of vocabulary and comprehension strategies in the seventh grade science classroom on the scores of high stakes assessments.

Table 1 presents the frequencies and percents for the pre- and post-test scores. The pre- and post-test was administered to 69 seventh grade students and the results of 63 participants were reported. Scores were used only from students whose parents returned permission forms.

The frequency tables show the number of times the data value occurs for the pre- and post-tests, with the lowest score of 8 occurring one time and the highest score of 29 occurring twice. The total value of the test was a 31 (see Table 1).

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The t-test of related samples, indicated that, the researcher should reject the null hypothesis and conclude that reading instruction did have a significant impact on science achievement scores, t(62)=6.00, p<.0001.

Table 2 is a summary of the statistics assembled using the Stat Crunch program. This table was used to calculate the effect size. The effect size shows the size of the change that took place between the pre-test and the post-test. The paired t-Test shows that the pre- and post-test mean changed from 20 to 22, which was more likely due to intervention as opposed to sampling error. The researcher calculated the effect size by subtracting the mean of the pre-test by the mean of the post-test and dividing by the standard deviation of the pre-test which equaled 0.48.

Table 2
Summary Statistics

<table>
<thead>
<tr>
<th>Summary Statistics</th>
<th>n</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>63</td>
<td>20.19</td>
<td>4.80</td>
</tr>
<tr>
<td>Post</td>
<td>63</td>
<td>22.51</td>
<td>4.48</td>
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Discussion of Results

What impact will teaching vocabulary and comprehension strategies in seventh grade science have on high stakes test scores? Of the 63 students who participated in the study, only 14 students performed lower on the post-test than they did on the pre-test. However, the students whose scores dropped only ranged from a one- to a three-point drop. On the other hand, the 49 students who improved their test scores ranged anywhere from a one- to a nine-point difference. Overall, there were 143 more points scored on the post-test than there were on the pre-test. Based
on these data and the Stat Crunch results, there were improvements made between the pre- and post-test scores.

Summary

Bromley (2007) states, “The goal of vocabulary instruction should be to build students’ independent word learning strategies that can empower them for lifelong learning. This requires teachers who are passionate about words and language, who immerse their students in language, and who provide direct instruction that is thoughtful, intentional, and varied” (p. 536). When students struggle to understand the vocabulary of the questions written on the test of the ability to comprehend what the question is asking, it is difficult to measure what they truly know about the science.

This study was designed to show the impact of the vocabulary and comprehension strategies on seventh grade students. According to the results, it appears that the instruction at this level is beneficial. Clearly, the findings indicate that with continued vocabulary and comprehension strategies, the students will show significant improvement in their test scores.
CHAPTER V. SUMMARY, CONCLUSION, AND RECOMMENDATIONS

There are students who struggle to read everyday for many reasons. In the content classroom, it is important for students to not only read assignments and tests, but also to understand the vocabulary used and the ability to comprehend the material presented. Alvermann (2001) states:

The expectation that effective literacy instruction should address the demands that various subject area classes place on adolescents is fueled by the perceived need to develop students’ abilities to comprehend and think critically about multiple forms of text related to the school curriculum. Tied to this perception of academic literacy is the research finding that comprehension is indeed a complex process-one that should not be left to chance for it’s development. (p. 9)

For students to prove what they know in the content area on a high stakes assessment, they must be able to understand what it is that the questions are asking.

This chapter provides a summary and the conclusions of a study involving comprehension and vocabulary strategies implemented in the seventh grade science classroom. Also, the results of this study as well as recommendations for further research on this topic will be included. Additionally, a final summary will be included.

Summary

Alvermann (2001) writes:

In an extensive review of how instruction influences students’ reading engagement and academic performance, Guthrie and Wigfield (2000) concluded that various instructional practices, while important, do not directly impact student outcomes (e.g., time spent reading independently, achievement on standardized tests, performance assessments, and
beliefs about reading). Instead, the level of student engagement (including its sustainability over time) is the mediating factor, or avenue, through which classroom instruction influences student outcomes. Guthrie and Wigfield’s conception of the engagement model of reading calls for instruction that fosters: student motivation (including self-efficacy and goal setting); strategy use (e.g., using prior knowledge, self-monitoring for breaks in comprehension, and analyzing new vocabulary); growth in conceptual knowledge (reading trade books to supplement textbook information, viewing videos, and hands-on experiences); and social interaction (e.g., collaborating with peers on a science project, and discussing as Internet search with the teacher). (p. 7).

While many of these suggestions were implemented over the course of the study, the vocabulary and comprehension strategies were the subject of focus for the results. These strategies were all highlighted in the lesson plans located in Appendix E, F, and G.

This study incorporated a variety of vocabulary and comprehension strategies over a six-week period of time in a seventh grade science classroom. The researcher identified vocabulary words from the pretest that was designed and incorporated them into daily lessons utilizing a number of questioning strategies to develop comprehension of these words in text. According to Padak and Rasinski (2000):

Exemplary vocabulary instruction is not unidimensional. Certainly, it focuses on developing students’ breadth of word knowledge, but it also works to increase students’ depth of word knowledge as well. Just because a word is understood one way or in one context does not mean that the student has a full understanding of the word. Good vocabulary instruction both develops the richness of already known words and also introduces new words. (p. 131).
The goal of the researcher was to administer a pre-test, analyze difficult vocabulary, implement embedded vocabulary and comprehension instruction in the science classroom, and observe an increase in post-test scores. The statistical results of this study showed there was an increase in post-test scores from pre-test scores after embedded vocabulary and comprehension instruction. The pre-test data were collected and observed by the researcher. The researcher then collected vocabulary terms from the test and embedded them within the science content standards currently being taught. There was no attention drawn to the selected words. Comprehension strategies were then implemented through questioning strategies within current lessons. Six weeks later when the post-test was administered there was a significant increase in scores. There were several students whose scores dropped, but overall, the scores improved. Inferential statistics revealed a significant increase in science achievement due to the treatment of reading strategies embedded in the content instruction.

Conclusions

As a result of the study, it can be concluded that teaching vocabulary strategies can enhance students’ comprehension of passages.

It appears that multiple vocabulary and comprehension strategies in the content [science] classroom may be effective. This supports the research as stated in chapter two that, teachers also know that one of the challenges of struggling middle school readers is their limited vocabulary and knowledge of the world (Broaddus & Ivey, 2002). While teaching vocabulary well in every curriculum area is only one aspect of developing engaged and successful readers, it is a key aspect (Bromley, 2007). Students with large vocabularies understand text better and score higher on achievement tests than students with small vocabularies (Stahl & Fairbanks, 1986).
It also seems as though embedded strategies are effective as we observed an increase in post-test scores from pre-test scores. This claim is supported by the idea that content plays a larger role in comprehension than is suggested. In fact, it may well turn out that the long-term contribution of our recent strategy research, including the work on preparing teachers to teach strategies, will not be to endorse comprehension strategies as an independent topic of instruction. Rather, the strategies found to be successful may be incorporated into curriculum areas such as social studies and science (Williams, 2006).

Strategies needed for success in high-stakes reading comprehension tests are well established. Schwartz’s (1988) research supports the importance of the following: (a) using background knowledge, (b) searching to locate information, (c) summarizing, (d) self-monitoring, (e) self-questioning, (f) concept mapping, and (g) self-explanation. Good readers are known to use these strategies when necessary and poor readers rarely use them. Furthermore, these strategies can be taught and instruction in them will improve high-stakes reading comprehension test performance. The direct instruction recommended includes (a) teacher modeling of the strategies, (b) explanation of when and how to use them, (c) repeated opportunities for guided practice, and (d) extended independent reading. Understanding this concept helps to describes the necessity of developing lessons with multiple strategies in order to be effective for most students.

**Recommendations**

The researcher implemented this study in a seventh grade science classroom to specifically see if there would be an impact on high stakes test scores after embedding vocabulary and comprehension strategies in the instruction. There are many ways that this data could have been used; however, the researcher only examined the overall group scores. The
researcher pre- and post-tested all students on this seventh grade team. Of the 69 students, scores were reported for 63 participants. These students were not grouped in any particular manner. For further study, the students could be grouped in a variety of ways. For example, the researcher could have examined the difference in scores for boys versus girls. There are many studies that analyze the differences in reading levels, as well as an interest in science, where boys and girls are concerned.

Another way that the researcher could analyze data would be to break down the students’ scores by class period. In the future, this could greatly benefit the classroom teacher in terms of differentiating instruction. Benjamin (2000) adds:

Differentiated Instruction is a broad term that refers to a variety of classroom practices that accommodate differences in students’ learning styles, interests, prior knowledge, socialization needs, and comfort zones. On the secondary level, it involves a balance between the content and competencies expected on the mandated assessments and various pedagogical options to maximize durable learning. The standards tell us what the students need to know and to be able to do. Differentiated Instruction practices help to get students there, while at the same time teaching the how to learn in a meaningful way.

(p.1)

The participants in this study were divided into four class periods. These data could be analyzed and separated by class scores. The class with the highest initial scores could receive higher level thinking questions, more difficult vocabulary or enrichment activities to benefit the specific learners. The lowest scoring class could focus on fewer strategies or class goals could become more individualized.
One more way to further use this data would be to break down the overall abilities of the individual students. On this team there are several students on 504 plans, one student on an Individualized Education Plan (IEP), two students with an open multi-factored evaluation (MFE), and two ELL students. Students with these accommodations require differentiated lessons on a daily basis, so the researcher could use these scores to develop more individualized goals for these students.

Since all students are required to take the Ohio Achievement Test, the more closely related the instruction is to each student could potentially be of greater benefit. The researcher could implement this study at the beginning or middle of the school year to best prepare the students for success on the high stakes tests.

Summary

Focusing on the implementation of vocabulary and comprehension strategies in the content classroom to better prepare students for high stakes tests, this study describes the potential benefits of student’s scores. The treatment included a variety of vocabulary and comprehension strategies to four seventh grade science classes. The objectives of the strategies were based on current research and literature as well as the high stakes assessment used in this state. According to these data, embedding these strategies in the content classroom, it appears that there will be a positive impact on test scores. The data show an increase in student achievement when comparing pre-test scores to post-test scores.

This study provides classroom teachers with the statistical evidence that implementing these strategies into their content classrooms could increase student achievement on high stakes test in their particular subject areas. As more and more content teachers embrace their
responsibility to also be a teacher of reading, the sooner we could potentially congratulate our students on the high stakes tests.
REFERENCES

*Academic content standards: K-12 Science.* (2001). Columbus, OH: Ohio Department of Education


*Journal of Reading Behavior, 27*, 399-424.


Appendix A

Student Consent Form
Dear Students,

As many of you know, I am working on completing my Masters of Education in reading at Bowling Green State University. I am conducting a study, involving you, for my thesis. I will be looking at standardized test scores among seventh graders. I will be using reading and vocabulary strategies in the science classroom. Your participation in this study is voluntary, and you may choose later that you no longer want to participate. I will understand and respect your decision whether you choose to participate or not. I will not be upset with you if you choose not to participate.

During our genetics unit, I will use a lot of vocabulary, so these strategies should help you to better understand the lessons and homework. The way that work is done in the classroom will not change and you will not have any extra work by choosing to participate.

At the beginning of the unit, you will take a pre-test over information that we have already learned. I am not going to give you the answers right after the test. Instead, we will continue with the genetics unit and I will work with some of the words that were in the questions. You will take the same test again at the end of the unit. There will be no new information on the test. This will hopefully just help you to better understand what the questions are asking. I will compare your scores to see if once we discussed the meanings of these words, you will have scored higher. All students will complete this activity as a part of our classroom activities. However, your scores on the pre and post tests will not affect your classroom grade. You are not taking any risks by participating in this study. By signing this form you are allowing me to include your score in my data.

I will not use your name on any of the information that I use in my thesis, I will replace your name with a number. All of your information will be kept confidential. This means that no one will be able to tell who received what score. If you have any questions as we are working on this, please ask me. I would be glad to explain it to you. You may also contact the Human Subjects Research Board at (419) 372-7716 or you may email them at hsr@bgsu.edu.

Thank you all, I am looking forward to working with all of you.

Mrs. Krupp

I have been informed of the study that Mrs. Krupp is working on, and I agree to participate.

_________________________________  __________________________________
Student’s Name                      Student Signature
Appendix B

Parent Consent Form
Dear Parent/Guardians & Students,

As many of your children know, in addition to being their science teacher, I am also a graduate student at Bowling Green State University. I am currently working on my masters of Education in reading and am conducting a study for my thesis. My study will look at the ability to increase standardized test scores by incorporating vocabulary and comprehension into the content classroom.

After spring break, our next unit will be on genetics. While the students seem to be excited about the topic, the curriculum is difficult. My study should enhance their learning experience. I will be using vocabulary and comprehension strategies throughout the unit. None of your child’s science content will be compromised. I will be looking at a variety of ways to teach your child to better read, understand and in turn, answer questions.

At the beginning of the unit, your child will take a pre-test over content previously learned. We will not go over these tests, I will simply examine and record the data, your child’s name will not appear on any of the materials released, a number will be assigned. This will include questions from fifth, sixth and seventh grade content learned thus far. We will then continue science class as usual. However, I will be embedding vocabulary and comprehension strategies right in their daily lessons. We will work our way through the genetics unit using these strategies. At the end of the unit, I will give the students the same test they previously took. My goal is that as we work through our current unit, focusing on the vocabulary and comprehension of the questions, the student’s will improve their scores on material they had already learned, by learning how to answer the questions. My intention is to increase/improve their ability to show what they know, by understanding what the questions are asking. All students will participate in the regular classroom activities, however, if you do not wish for me to include their results you do not need to return this form. I am very excited about the findings as I truly believe that all students are capable of improvement!

All information obtained from this study will be kept confidential. Student’s names will not be included in any of the material that I submit. I encourage you to review the progress taking place in the classroom. You can contact me or my university supervisor.

If you have any questions regarding the study, please contact me at kkrupp@bgcs.k12.oh.us or my university advisor, Cindy Hendricks, Bowling Green State University, at cindyg@bgnet.bgsu.edu. You may also contact the Human Subjects Review Board, Bowling Green State University, at hsrb@bgnet.bgsu.edu if you have any questions or concerns regarding the rights as a participant. Thank you in advance for your cooperation, and as always, I look forward to working with your child.

Mrs. Kristi Krupp

I am aware of my child’s participation in “Embedded Vocabulary and Comprehension Strategies” and I give my consent for the use of their results in this study.

__________________________   _________________________
Student’s Name     Parent/Guardian Signature

_______________________
Student Signature
Appendix C

Pre/Post-Test
1. The reproductive success of an organism depends in part on the ability of the organism to survive.

How does the physical appearance of these organisms help them survive?

A. Their physical appearance helps them find a habitat.
B. Their physical appearance helps them resist parasites.
C. Their physical appearance helps them avoid predators.
D. Their physical appearance helps them defend a territory.
Vanessa is conducting an experiment to see how exposure to different types and amounts of light affects the growth of plants. Her results are shown in the data table below.

<table>
<thead>
<tr>
<th>Light Source</th>
<th>Type of Plant</th>
<th>Growth (centimeters)</th>
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<tbody>
<tr>
<td>Sunlight</td>
<td>Pea Plant</td>
<td>1.09375</td>
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<tr>
<td>Partial Sunlight</td>
<td>Daffodil</td>
<td>0.81250</td>
</tr>
<tr>
<td>Artificial Light</td>
<td>Lima Bean Plant</td>
<td>0.78125</td>
</tr>
<tr>
<td>No Light</td>
<td>Sunflower</td>
<td>0.18750</td>
</tr>
</tbody>
</table>

Did Vanessa make an error in the design of her experiment?

- A. Yes; there are too many variables in her experiment.
- B. Yes; plants cannot grow in artificial light.
- C. No; Vanessa designed her experiment correctly.
- D. Yes; Vanessa should have measured with customary units.

An eighth-grade class wants to identify a representative sample of the crawling and flying insects living in the schoolyard. The students build and set five traps like the one shown below. They place the traps in the listed locations at the end of the school day and check them the following morning to see what they have caught.

Two variables in this investigation are location of trap and size of jar.

In your Answer Document, explain how each of these variables could affect the conclusions of the investigation.

Explain why the students' collecting procedures will not allow them to collect representatives of all insects living in the schoolyard.

Describe one way the students could change their collecting procedures to correct for this weakness. (4 points)
3. Which of the following safety precautions should always be followed when mixing chemicals?
   A. Chemicals should never be mixed
   B. Wear safety goggles
   C. Always heat the chemicals before mixing
   D. Stir chemicals with finger before mixing

4. Paula likes to study herbs that can be used for cooking, so she decided to bring some herb specimens into the lab one day. She studied the herbs under the microscope. What should Paula do with the herb specimens she used in the lab?
   A. Paula should put the herb specimens with the stored chemicals
   B. Paula should give the herbs to any live laboratory animal to eat
   C. Paula should take the herb specimens home and cook with them
   D. Paula should put the herb specimens in the lab's waste receptacle

5. Nancy needs to do a scientific investigation for her class. She is interested in pottery, plants, and basketball. Which of the following questions would be suitable for use in a scientific investigation?
   A. What length of time is best to use for the firing of pottery to make it strong?
   B. How many needles grow on the giant redwoods in California?
   C. What color of carnation flowers do people find most attractive?
   D. What is the most number of points ever scored in a professional basketball game?

6. Juan wants to see how air expands when it is heated. He has a balloon, a heat lamp, a spring scale, and a meter stick. Which is the best procedure to follow for the experiment?
   A. Inflate the balloon, heat the balloon using the heat lamp, and measure the weight of balloon with a spring scale
   B. Inflate the balloon, measure the width of the balloon, heat the balloon using the heat lamp, and then measure the width again
   C. Use the spring scale to measure the weight of the balloon before and after it is blown up.
   D. Measure the weight of the deflated balloon, inflate the balloon, heat the balloon with the heat lamp, then measure the inflated balloon's width
7. Dan wants to test the effects of different amounts of antibiotic on bacteria. While setting up his experiment he makes sure to use the same type of antibiotic, the same type of bacteria, and the same type of incubator for each trial. Which phrase below best describes this part of the experiment?
   A. Collecting data
   B. Forming a hypothesis
   C. Setting up constants
   D. Analyzing results

8. A toothpaste company developed a new product. On the package, they printed the claim, "5 out of 5 dentists recommend this product!"

   Should a customer trust this statement?
   A. Yes; advertising can always be trusted
   B. Yes; 5 out of 5 dentists means that every dentist recommends the product.
   C. No; they didn't explain the word "recommend."
   D. No; they might have only asked 5 dentists

9. Recently over 400 American companies have agreed to join the EPA’s Green Light’s program and replace their old light bulbs with new, more energy-efficient light bulbs. The new light bulbs cost approximately 30% more than the old light bulbs. What is the most likely reason the companies agreed to make the replacement?
   A. The new light bulb has a modern, high-tech appearance that suits the companies’ images.
   B. The companies are using the new light bulbs because all new technologies are better than older versions of the same technology.
   C. The new light bulbs may initially cost more, but they will lower the companies’ energy costs in the long run.
   D. The companies are trying to improve their public image by making environmentally friendly choices.

10. Cell phones have become an extremely popular technology in the United States. What does the popularity of cell phones most likely indicate about the attitudes of Americans?
    A. Americans want the freedom to communicate at any time from any location
    B. Americans readily accept all new forms of technology no matter the price
C. Americans prefer to communicate with each other face to face
D. Americans value their privacy more than any other group of people in the world

11. Airbags are protection devices that can save lives in the event of a collision. However, airbags can also be a danger. Which of the following are related to the dangers of airbags?
   A. The extremely rapid inflation of airbags
   B. Being positioned incorrectly in the seat when an airbag inflates
   C. Not wearing a seatbelt when an airbag inflates
   D. All of these

12. American pharmaceutical companies invest around $40 billion a year to research new drug technologies. What does this indicate about the values of Americans?
   A. Americans do not value any type of technological innovations
   B. Americans do not value technologies that require them to be physically active
   C. Americans value technologies that are expensive to develop
   D. Americans value technologies that can improve their health

13. In the state of Tennessee, electricity customers are given the option of joining in the Green Power Switch program. This program takes advantage of new forms of technology that use renewable resources in order to produce electricity. In order to join the program, customers must pay $4 more for 150 kW-h of electricity.

   Currently, about 54,000 households in Tennessee have joined the program. What do you think is the primary motivation of the households that join the Green Power Switch program?
   A. The people that have signed up for the program are scientists who could earn money should the technology prove to be successful.
   B. Keeping the environment clean is more important to these households than spending a few extra dollars.
   C. Most of the people who have signed up for the program do not understand that their participation is making their electric bill go up.
   D. The income per capita in Tennessee is higher than in other state, thus people there do not mind spending extra money on cutting-edge technology.

14. Most automobiles are powered by fossil fuels. When a fossil fuel is burned, pollutants are released into the air. Over time, this can damage the environment and
may alter climates around the world. Considering the damage done to the environment, what do you think is the most likely reason people continue to use automobiles?
A. Burning fossil fuels releases oxygen into the air, which is necessary for people to breathe.
B. People do not care about the health of the environment
C. Environmental problems do not affect people in any way
D. The use of automobiles is necessary for the running of the economy

15. The ancient Egyptians believed that it was necessary to preserve the body after death so that it could be used in the afterlife. Which of the following was a scientific advance that was made as a result of the Egyptian practice of mummification?
A. A better understanding of the human psyche
B. A better understanding of the afterlife
C. A better understanding of human anatomy
D. A better understanding of microorganisms

16. The primary purpose of an exoskeleton is to...
A. Allow movement
B. Circulate oxygen
C. Provide protection
D. Digest food

17. Which of the following structures provides a physical barrier of protection between the inside and outside of the body?
A. Bone
B. Skin
C. Muscle
D. Blood vessel

18. ___________ can be found on the anterior end of an earthworm
A. The anus
B. The mouth
C. The gizzard
D. The crop

19. The factor that is changed throughout an experiment is called the _________.
A. Constant
B. Hypothesis
C. Apparatus
D. Variable

20. Denise wants to find out how the steepness of a hill’s slope affects the amount of soil that erodes from it. She will use soil, a long pan, and several 4-inch-tall wooden blocks to build a model hillside. She will use a watering can to simulate rainfall. In her experiment, which factor should be Denise’s variable?
A. The number of blocks holding up the end of the pan
B. The location she uses to test her model
C. The type of soil with which she fills the pan
D. The amount of water she pours on the model hillside

21. Autism is a disability that results from a disorder in the central nervous system. It has been speculated that the increasing number of cases of autism in recent years is due to the increase in the number of vaccinations given to young children. What might be another possible explanation for this phenomenon?
A. The increase in autism is due to an increase in television watching
B. The increase in autism is due to the decline of public education
C. There are now better diagnostic tests available for autism
D. The increase in immunizations is the only possible cause for autism

22. Why is it important to accurately report procedures and results from an experiment?
A. So that others can admire your work
B. So that others can change the variables in the experiment
C. So that others can repeat the experiment to see if they get similar results
D. So that others can disprove the results of the experiment

23. Which of the following will most likely happen if a grassy meadow becomes overpopulated with deer?
A. The meadow will produce more grass to compensate for the increase in deer population.
B. The deer will not be able to reproduce since there are already too many deer
C. The deer will ration and share the available grass
D. The deer will quickly strip the meadow of all edible plants

24. Why would ten scientists all conduct the same experiment?
A. To collect more data
B. To prevent bias
C. To validate the results of the experiment
D. All of these

25. The paleontologist examined 10 sites in all. She made detailed drawings of these sites and removed sample fossils. She labeled the sample fossils with the site number, location and layer in which the fossil was found. The paleontologist returned to the lab and discovered that some of the fossil samples were missing labels.

In the space below, describe two different ways the lack of labels for those samples will affect the interpretation of the data.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

Examine the graph below.

![Average Annual Precipitation Graph]

The first water-repellant raincoat was invented in 1823. Using the information on the graph, a citizen of which of the following nations most likely invented the raincoat?

- A. Greece
- B. Scotland
- C. Morocco
- D. Mongolia

Data adapted from: http://www.nationmaster.com/graph/geo_pre-geography-precipitation
Appendix D

List of Vocabulary
vocabulary words selected from pre/post-test by researcher

1. precautions
2. herbs
3. receptacle
4. suitable
5. antibiotic
6. incubator
7. suits (multiple meanings)
8. images
9. initially
10. indicate/indicator/indication
11. collision
12. rapid
13. pharmaceutical
14. invest/investment/investor
15. innovations
16. primary motivation
17. per capita
18. cutting-edge
19. alter
20. anterior/posterior
21. speculated
22. phenomenon
23. diagnostic
24. immunizations
25. compensate/compensation
26. ration
27. prevent bias
28. validate-validity
29. paleontologist
30. interpretation
31. customary
32. analyze
33. describe
34. support
35. infer
36. explain
37. apply/application
38. simulate
Appendix E

Lesson Plan 1
Lesson Plan for Mrs. Krupp

Subject: Life Science Date: Monday, April 13

Objective: The students will continue to develop their understanding of the principles of heredity, biological evolution and the diversity and interdependence of life.

Procedure: What is DNA?

? “Who can tell me what DNA stands for?”

Explain to students that every “word” in the DNA language is made up of 4 letters, which represent the 4 nitrogen bases:

A – Adenine
T – Thymine
G – Guanine
C - Cytosine

Use the ATCG (nitrogen bases) to pair up three letter “words”

*point out to the students that my example is part of my explanation, because it is an example that supports my lesson*

Put students in their lab groups and put desks into pods – pass out a bag of “nitrogen bases” to each lab group

Give the students a few minutes to create as many three letter words as possible

Ask: “How many words did you make, could you have made more?”

These are all words in the DNA language, but, DNA is read in sentences

The sentence is referred to as a triplet—the triplets are made of three, three letter words. *can you think of any other ways the word triplet or triple is used?*

EX: TTT
    GAA
    TAC

Take nine of those letters and make a row

EX: A
    T
    T
    C

Understand that A ALWAYS pairs with T, and C ALWAYS pairs with G

Now, a single strand of DNA becomes a double helix

About 1,000 pairs wind and coil to store themselves inside the nucleus

The storage unit is a chromosome *When are some other times we use the word unit and what is meant by storage unit?

Every cell in the human body is made up of the exact same 46 chromosomes

In order for a cell to divide (and make two) ~ Mitosis the chromosomes have to reproduce

When the cell is ready to divide, the enzyme unzips the DNA molecule (teacher will visually represent this with a class model)

Because the nitrogen bases are available in the cell, they instantly pair

You now have mirror images of the DNA molecule *(What is an image? - check
Now that 1 cell can divide into 2 cells with the exact same genetic information… “Uh-oh A accidentally paired with A – AA (teacher will model) We now have a genetic mutation!” What is a mutation? Can anyone give me an example?

*Review*A genetic mutation is when there is something wrong with the way the nitrogen bases pair. Remember A has to pair with T and C has to pair with G, so when the bases are paired incorrectly, there can be a defect. An example could be something as simple as being double jointed to as severe as Down’s Syndrome.
Appendix F

Lesson Plan 2
Lesson Plan for Mrs. Krupp

Subject: Life Science Date: Tuesday, April 14

Objective: Describe that in sexual reproduction an egg and sperm unite and some traits come from each parent, so the offspring is never identical to either of its parents. Use graphs, tables, and charts to study physical phenomena and infer mathematical relationships between variables & variability.

Procedures: Quickly review the vocabulary from yesterday’s lesson (i.e. explain, support, triplet, unit, image, nitrogen base) Introduce Mendel/probability/punnett squares

- Explain the definition of each word – Ask students if they are familiar with any of these words.
- Have students get their Cells & Heredity books from their lab drawers
- Have the students quickly partner up with someone sitting close by
- Tell each group to take out a half sheet of paper, explain that we will be making predictions. Ask the students for examples in the real world that predictions are made (i.e. weather) Discuss the difference between a guess and an inference (i.e. inferences are based on observations)
- Tell each group to predict how many times the coin will land heads up vs. tails up if they were to do a coin toss 20 times.
- Students will test their hypothesis by tossing their coin 20 times and record their results
- Combine and graph the class data and discuss the results

- Have the students analyze the class graph
- Ask students what it means to alter something? (i.e. alter clothing)
- Were there any conditions that could have altered the data?
- Discuss the idea of 50/50. Each toss is an independent occurrence, previous tosses cannot predict future outcomes?
- Have the students open their Cells & heredity books to page 76. We will use guided reading to read this chapter

Pre-reading strategy – Can anyone tell me how the coin tosses we just did might relate to this chapter?
- Continue reading while pausing at the end of each section to discuss what the students have read.

Assessment: Exit ticket question – Understanding that each time two parent organisms pass their traits there is a 0%, 25%, 50%, 75% or 100% chance that the offspring will inherit that particular trait (i.e. hair color)

* An exit ticket is a pre-cut half sheet of paper (shaped like a movie ticket) that the students use to answer a question shown on the smart board during the last five minutes of class. Responses should model an Ohio Achievement short answer/extended response and include three to five sentences.
Appendix G

Lesson Plan 3
Lesson Plan for Mrs. Krupp

Subject: Life Science  Date: Monday, April 21

Objectives: Students will review genetics vocabulary
Students will apply knowledge of probability to use punnett squares to determine the phenotype of an offspring
Students will recognize that likenesses between parent and offspring (e.g., eye color, flower color) are inherited. Other likenesses, such as table manners are learned.

Procedures: Use vocabulary analogies as a short cycle assessment to assess vocabulary knowledge – pass out pre-printed analogies and give students approx 3-5 minutes to complete.
1. Male sex cells are to sperm as female sex cells are to ________________.
2. Evolutionary Theory is to Charles Darwin as Genetics are to ________________.
3. Genotype is to genetic code as Phenotype is to ________________.
4. TT is to Homozygous Dominance as Tt is to ________________.
5. Two parent organisms are to sexual reproduction as a one parent organism is to ________________.

Punnett Squares: Teacher will say, “Alright, so far we have learned a lot about dominant and recessive alleles, and whether they are homozygous, heterozygous or even a hybrid. We have also looked at the role that probability plays as an indicator for phenotype. Who can tell me what an indicator is? We can speculate an outcome based on the phenotypes of the parents, but we can make a much more accurate prediction using a punnett square. What do I mean by that statement?”

“Soon, we will be starting our Dragon Lab, and as “parents” you will be responsible for hypothesizing about the traits that your offspring will inherit.” Remember that you will want to pick the traits, such as fire-breather, that are most suitable for success in their environment, but that is not always the case, fire-breathing is actually recessive, how will this impact your initial decision and how can your offspring compensate? Wait for student’s responses (to check for understanding) and give a class example.

Teacher will pass out a sheet with eight punnett squares. There will also be a class demo on the wall using chart paper (all punnett squares will be drawn prior to the start of class). Fill in punnett squares for the remainder of class.
Appendix H

Word Wall Words
Word Wall Words!

As we answer questions, and think! What am I being asked to do?

<table>
<thead>
<tr>
<th>Analyze</th>
<th>Describe</th>
<th>Define</th>
<th>Infer</th>
<th>Explain</th>
<th>List</th>
</tr>
</thead>
<tbody>
<tr>
<td>Break down the information, and look at each part</td>
<td>Use details to support your answer, give examples</td>
<td>Tell exactly what the word or words mean</td>
<td>Make an educated guess based on observations</td>
<td>Use examples and supporting details to provide an explanation</td>
<td>Make a bullet point list to answer the question • • •</td>
</tr>
</tbody>
</table>