An Evaluation of Physical Activity on the Reading Achievement of Middle School Students

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AN EVALUATION OF PHYSICAL ACTIVITY ON THE READING ACHIEVEMENT
OF MIDDLE SCHOOL STUDENTS

By
Christina N. Phillips

An Applied Dissertation Submitted to the Lynn School of Education in Partial
Fulfillment of the Requirements for the Degree of Doctor of Education

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ABSTRACT

CHRISTINA PHILLIPS: An Evaluation of Physical Activity on the Reading Achievement of Middle School Students

This study analyzed the relationship between reading achievement and the use of Exergames as an intervention, to investigate the areas in which physical activity can improve reading achievement among struggling readers, and to understand the amount of minutes and levels of intensity of physically active adolescents that supports reading achievement. The need for an innovative reading intervention has become more urgent because of the lack of improved reading achievement in the United States. In addition, students should not lose access to physical activity in an attempt to increase reading achievement. Using a quasi-experimental, pretest-posttest, nonequivalent group design, this study attempted to measure the effect of Exergames between a control and treatment group.

Participants were assessed at the beginning and the end of the 6-week intervention. The findings from a Pearson chi-square test indicated no common difference between the groups, such as race/ethnicity, educational status, and gender. The results from the postassessment indicated no common difference between the control and treatment group. However, results showed that in some areas the control group academically outperformed the treatment group. The research resulted in several recommendations for improvement with the data collection method as well as the suggestion for a longer-term study. The proposed recommendations may provide insight on how well-trained reading specialists impact reading achievement among struggling readers in middle school and not the time allotted for instruction.
AN EVALUATION OF PHYSICAL ACTIVITY ON THE READING ACHIEVEMENT
OF MIDDLE SCHOOL STUDENTS

Phillips, Christina N., Ed.D.
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DEDICATION

I dedicate my dissertation work to my parents, who have been there for me from day one. Thank you for all of your love, support, and encouragement. I will always appreciate all you have done for all of your children and grandchildren.

This is a tribute to the both of you. You have been our best cheerleaders.
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CHAPTER I
INTRODUCTION

Purpose of the Study

The available instructional methods for teachers of reading neglect to take into consideration research that shows the positive effect of brain stimulation, brought about by technology that induces physical activity, on achievement in reading. Regular participation in physical activity, through the use of video games, may produce a positive impact on the developmental outcomes of students (Best, 2010; Russell & Newton, 2008). To implement effective instructional interventions, it is critical to understand the intensity levels, duration, and frequency of physical activity required to increase academic achievement (Best 2010; Rocha, 2007; Tompkins, Hopkins, Goddard, & Brock, 2012; Walberg & Paik, 2000). Children should participate in moderate to vigorous physical activity for 60 minutes a day (Tompkins, et al., 2012). Thus, the purpose of the study is to investigate the effects of physical activity through the use of Exergames on reading achievement of middle-school students.

Research Questions

The following research questions will guide this study:

1. Does integrating physical activity into the reading curriculum improve overall reading achievement, as comprised of vocabulary, informational text, and literary analysis?

2. Does integrating physical activity into the reading curriculum improve reading achievement as it pertains to levels of complexity?
3. Does integrating physical activity into the reading curriculum improve reading achievement as it pertains to type of text?

**Background of the Problem**

Successful reading education is critical to the educational needs and goals of society (Becker, McElvany, & Kortenbruck, 2010; Freire, 2010) and successful reading education must address the reading needs of every student (Sensenig, 2011). As early as fourth grade, educators see the cumulative effects of low reading proficiency (Kelley & Decker, 2009). Students who have this fourth-grade reading slump are unable to meet grade-level expectations (Kelley & Decker, 2009). Without remediation, struggling readers continue to experience difficulties in both middle and high school (Vaughn et al., 2011). Due to repeated academic failures in reading during the early grades, struggling middle school students often experience a lack of motivation to achieve in reading or in any subject matter that requires proficient reading skills (Blanton, Wood, & Taylor 2007; Mucherah & Yoder, 2008).

The importance of improving reading achievement should not be underestimated (Stanley & Stanley, 2011). Reading is the foundational skill for all academic subject areas (Marchand-Martella, Martella, Modderman, Petersen, & Pan, 2013; Melekoglu, 2011). Reading proficiency at the end of elementary school is a predictor for academic success at the secondary level and beyond (Melekoglu, 2011). Learning to read includes learning to comprehend material (Allington, 2009; Chall, 1983a; Dion, Brodeur, Gosselin, Campeau, & Fuchs, 2010; Marchand-Martella et al., 2013). Without the skills necessary to comprehend reading material, students are prone to fail in other subject
areas, perform poorly on high-stakes assessments, and drop out of school (Allington, 2010; Stanley & Stanley, 2011).

Often, ineffective reading instruction and misplaced reading interventions contribute to reading difficulties among struggling readers (Allington, 2010; Dion et al., 2010). As students transition between elementary, middle, and high school, the complexity of reading tasks increases by grade level (Indrisano & Chall, 1995). Reading comprehension becomes increasingly dependent on skills beyond word recognition as students progress through each grade level (Sesma, Mahone, Levine, Eason, & Cutting, 2009). Once struggling readers enter high school, the inability to comprehend reading material is a problem, possibly threatening a student’s ability to obtain a high school diploma (Alger, 2009; Allington, 2010).

To improve reading achievement, policy makers and practitioners must agree on the most effective reading strategies and interventions at each grade level (Dion et al., 2010). As measured by many high-stakes assessments, critical elements to improving reading achievement include effective reading instruction at all grade levels and appropriate reading interventions to support struggling readers and eventually diminish their number (Alger, 2009; Allington, 2010; Dion et al., 2010). Yet, as educators work to improve reading achievement based on high-stakes testing, most instruction reflects test-taking strategies and not how the brain learns new information (Blanton et al., 2007; Willingham, 2009).

The cognitive processes necessary for goal-oriented and organized behavior, commonly referred to as executive functions, are critical to reading comprehension.
Successful reading comprehension depends on the use of cognitive skills within the executive function domain (Sesma et al., 2009). Such cognitive functions include the student’s ability to use higher-level skills, which include working memory, planning, organizing, and monitoring (Sesma et al., 2009). Thus, reading interventions should take into account the way the brain processes text and stores information in working memory (Bohn-Gettler & Rapp, 2011; Cutting, Materek, Cole, Levine, & Mahone, 2009; Eason, Goldberg, Young, Geist, & Cutting, 2012). Text requires the reader to make both predictions and inferences by recalling previous knowledge to connect the information in the text (Eason et al., 2012). Readers effectively engaged in reading are cognitively connected to the text (Bohn-Gettler & Rapp, 2011). The use of such higher-level skills during reading suggests a link to the executive function, though the majority of studies focusing on reading comprehension do not connect specific reading skills to executive function (Cutting et al., 2009).

A lack of certain cognitive skills can lead to difficulties in reading comprehension (Allington, 2010). When secondary students read increasingly difficult text to learn new information, the ability to read and understand words quickly and accurately is critical. Cognitive skills within the executive function domain support such tasks (Sesma et al., 2009). For example, less cohesive text requires the reader to make both predictions and inferences and to recall previous knowledge to connect the information in the text (Cutting et al., 2009; Eason et al., 2012). During a reading task of less cohesive text, college students with low working memory have difficulty making predictions and inferences about what will happen next (Linderholm, Cong, & Zhao, 2008).
Many struggling adolescent and adult readers have difficulty reading and comprehending basic materials as well completing simple tasks, such as following written directions at home and at work or reading menus in restaurants (Greenberg, Pae, Morris, Calhoon, & Nanda, 2009). The ability to read is also considered a workforce skill and, as such, students' reading achievement affects the types of jobs for which they are qualified (Aper, 2010). A workforce that lacks employees with skills that rely on reading proficiency can impede a country's economic growth and social development (Legters & Balfanz, 2010; Organisation for Economic Co-operation and Development [OCED], 2010a). High cognitive skills are essential to a country's economic growth and social development (OCED, 2010b).

Reading is a mandatory skill for both academic success and adult responsibilities (Hagaman & Reid, 2008) and the ability, or lack thereof, to read has far-reaching implications. Students' reading achievement affects not only their academic success but also graduation rates, college readiness, the opportunity to enroll at colleges and universities (Legters & Balfanz, 2010; Zhao, 2009), and occupational opportunities (Cutting et al., 2009). In the United States, business leaders, government officials, and the nation's citizens agree that education should produce functional workers and citizens (Aper, 2010). The ability to read promotes the development of intellectually, socially, and physically sound citizens (Ediger, 2012).

As with literacy problems, the lack of physical activity among students continues to present problems for a growing society (Russell & Newton, 2008). Over the past 3 decades, the number of physically active students in the United States has decreased
Fitness and physical activity have been shown to increase academic achievement among students (Wittberg, Northrup, & Cottrell, 2012). Research shows that students are becoming progressively unfit due to an increasingly sedentary lifestyle facilitated by technology, for example, video games, television, and an increased use of motorized transportation (Best, 2010; Biddle, 2011; Hillman, Erickson, & Kramer, 2008). In addition to missed opportunities for increased academic achievement, decreases in physical activity are related to increases in serious long-term health risks, such as diabetes, high blood pressure, and obesity (Cordes, Miller, & Almon, 2004; Laurson, Brown, Cullen, & Dennis, 2008; Laurson, Eisenmann, & Moore, 2008). Such comorbidities are likely to contribute to low academic achievement as the result of teasing, avoiding physical education classes, health complications requiring medical attention, and skipping school (Puhl & Luedicke, 2012).

The significant increase in obesity rates among children and adolescents stems from a less physically active lifestyle (Green, Riley, & Hargrove, 2012). Less activity among children and adolescents living in the United States poses a serious threat to communities around the nation (Green et al., 2012; Laurson, Eisenmann, et al., 2008). Green et al. (2012) have reported that more than 23 million children and adolescents living in the United States meet the criteria for being obese or overweight. Some students from low socioeconomic backgrounds suffer from childhood obesity. Such children are at a greater risk for truancy, school failure, substance abuse, and violent or unhealthy behavior (Green et al., 2012).
Taking a more positive perspective regarding physical activity, childhood obesity will decrease with the possibility of an increase in academic achievement, as children maintain a more physically active lifestyle during the day (Green et al., 2012; Laurson, Eisenmann, et al., 2008; Russell & Newton, 2008). The literature also links physical activity with improvements in cognition that, in turn, are related to increased academic achievement (Best, 2010; Donnelly & Lambourne, 2011; Hillman et al., 2008). In light of this research, the potential benefits from regular use of technology beyond entertainment purposes may have widespread implications for the field of education. For example, the use of physical activity through interactive video games may improve student engagement throughout the school day (Russell & Newton, 2008).

Russell and Newton (2008) have indicated that physical activity through visually stimulating environments such as video games requiring the body to become physically active, increases self-efficacy and that self-efficacy among adolescents has been linked to higher levels of student achievement. Regular participation in physical activity, through the use of such video games, may produce a positive impact on the developmental outcomes of students (Best, 2010; Russell & Newton, 2008). Exergames are a type of video game in which the user must engage in vigorous physical movement by using the entire body (Best, 2010). The use of Exergames during the school day may improve student engagement and increase academic achievement (Best, 2010; Russell & Newton, 2008).

Similarly, Tomporowski, Davis, Miller, and Naglieri (2008), as well as Ploughman (2008), argued that aerobic exercise has a significant effect on cognitive
performance. This supports the use of physical activity to improve the performance of executive functions (Best, 2010). Students who engage in some form of physical activity during the school day exhibit excellent fine motor skills and fitness as well as better academic performance and a better attitude toward school (Jensen, 2005; Wittberg et al., 2012). Overall, through physical activity, students may begin to improve academically, and as a result, begin to practice a healthier lifestyle, which reduces long-term health risks (Wittberg et al., 2012).

Edwards, Mauch, and Winkelman (2011) conducted a review of the literature on the relationship between exercise and academic achievement. They found that quasi-experimental interventions in which additional time was allotted for physical activity did not reduce student achievement in the classroom or on standardized test scores. Students who engage in daily physical activity not only perform academically better but also have a better attitude towards school (Best, 2010; Coe, Pivarnik, Womack, Reeves, & Malina, 2006; Silverman, 1993).

Providing students with adequate levels of physical intensity is challenging (Donnelly & Lambourne, 2011). Thus, to successfully incorporate vigorous physical activity into an academic setting, educators should consult with knowledgeable practitioners in the field of physical activity, specifically physical education specialists. Physical educators receive training to ensure students have exposure to the most effective techniques and behavioral aspects of physical activity (Russell & Newton, 2008; Wong & Louie, 2002).
As a strategy to provide more time for instruction in tested subjects such as reading, schools continue to decrease the time for both physical education and physical activity (Coe et al., 2006). No clear evidence supports the need for an increase in academic time through the reduction of physical activity (Coe et al., 2006). As an intervention for improving academic achievement, research supports the need for active student engagement during classroom instruction, rather than a reduction in certain classes (Rocha, 2007). An increase of more time for subject areas such as reading and math do not guarantee student mastery (Walberg & Paik, 2000). Improving the quality of instruction and the level of student engagement during allocated instructional time is a necessary component to improve student achievement (Silva, 2007).

During instruction, less engaged students may be less motivated to perform an academic task such as reading (Kelly & Decker, 2009). Less engaged student learners will have varying academic needs (Kelly & Decker, 2009; Rocha, 2007; Walberg & Paik, 2000). As a means to improve student achievement, teachers should have access to multiple instructional strategies, which promote active student engagement (Rocha, 2007; Walberg & Paik, 2000); for example, including additional academic time for programs that involve physical activity, may provide students with more engaging learning opportunities (Rocha, 2007).

Depriving students of engaging educational experiences, which include physical activity, may cause more harm to students (Rocha, 2007). Reducing the curriculum in order to place a greater emphasis on core subjects may not be the best reform strategy for all students (Rocha, 2007). Engaging students in more physically active education
supports skills for successful adults living in a global society (Rocha, 2007). As demonstrated by the California Department of Education, a lack of physical activity among students may be linked to students performing lower during high-stakes testing (O’Hanlon, 2007). Regular participation in physical activity may produce a positive impact on academic outcomes measured by standardized and high-stakes testing (Coe et al., 2006; O’Hanlon, 2007). The California Department of Education found that students participating in 10 minutes of aerobics (physical activity) before a standardized test outperformed 25% of the other students tested (O’Hanlon, 2007).

The National Assessment of Educational Progress (NAEP) measures both reading and mathematics achievement across the United States. At a local level, in 2011, the percentage of fourth-grade students in the state of Florida who performed at or above the NAEP proficiency level was 35%, which is less than the average of 36% of fourth-grade students who performed at or above the NAEP proficiency level in 2009. Similar to the results for fourth-grade students in the state of Florida, the percentage of eighth graders who performed at or above the NAEP proficiency level was 73%, which also is less than the average of 76% for eighth-grade students who performed at or above the NAEP proficiency level in 2009 (National Center for Education Statistics [NCES], 2010).

At the middle school selected for this study, in 2010, 50% of the sixth-grade student population scored below the Florida state reading proficiency level on the Florida Comprehensive Assessment Test (FCAT). Under Section §1003.455 of Florida Statute Title XLVIII (Fla. Stat., 2010), once students fall significantly below reading proficiency levels, they must be provided with additional instructional time through mandatory
remedial reading courses (Allington, 2009). This is accomplished, however, by losing access to the required physical education classes. An alternative to reducing physical education during the school day would be to integrate physical activity into the academic setting (Donnelly & Lambourne, 2011).

**Definition of Terms**

*Cognitive processes* include four types of mental processing: executive function, controlled processing, visiospatial processing, and speed processing (Tomporowski et al., 2008).

*English language learners (ELLS)* are students who are classified as students who are in the process of learning English and placed in the English as Second Language (ESOL) program. ELL students vary in literacy levels from level 1 to level 4. Once students are classified as level 4, students begin exiting the program. Literacy levels, as defined by the Palm Beach County School District 2008-2011 Plan for Services to English Language Learners (Appendix A), are as follows: (a) level 1: the student has limited ability to read and write in any language; (b) level 2: the student, within limits, is able to read and write in at least one language; (c) level 3: the student is able to read and write extensively in English; and (d) level 4: the student is able to read and write in English. Based on Section §1003.56 of the 2010 Florida Statute on public education, once students meet the eligibility requirements they are allowed additional time and alternate testing locations when taking an assessment (School District of Palm Beach County [SDPBC], 2011).
Exceptional student education (ESE) is designed to meet the unique learning needs of exception students, as defined below (Bureau of Exceptional Education and Student Services [BESS], 2011).

Exceptional students are those who are classified as having learning disabilities or are able to perform at superior academic levels, for example, gifted (Bureau of Exceptional Education and Student Services [BESS], 2011). For the purpose of this study, exceptional students are those who have learning disabilities.

Executive function is a set of cognitive processes that allow for controlled, goal-directed cognition and behavior (Best, 2010).

Exergames are video games that require the user to engage in vigorous physical movement while using the entire body (Best, 2010).

Expository texts are documents that concern factual informational on the structure, function, and/or sequence of events as related to subjects and topics that are taught (Medina & Pilonieta, 2006).

Functional literacy is the ability to use both printed and written information to achieve an individual goal in addition to developing one’s knowledge and potential (Baer, Kutner, & Sabatini, 2009).

Integrated curriculum involves two or more content areas being taught together (Opitz, 2011).

Narrative texts are documents that provide a description of a number of events in sequential order, in which one event is related to one another through temporal and causal relationships. Narrative texts include at least one protagonist, for example, a character
who follows certain actions to reach a goal or solve a problem (Medina & Pilonieta, 2006).

Physical activity is skeletal muscle activity in which the use of energy may cause an increase in metabolic rate, which may continue after the termination of observable movement (Armstrong, 1998).

Sedentary activity is behavior that involves sitting or lying (Biddle, 2011).

Significance of the Study

There is limited research on the required levels of intensity for physical activity through the use of Exergames necessary to affect reading achievement in adolescent readers, and, as such, this is an area worthy of investigation. Specifically, regular participation in physical activity using Exergames may produce a positive impact on the cognitive process that is important for reading success in students (Best, 2010). The results from this study will provide teachers of reading critical information regarding instructional strategies for struggling adolescent readers. Reading proficiency levels continue to show minimal gains in many states, including Florida (NCES, 2010). Struggling readers involved in physical activity receive an increase in cognitive benefits related to the executive function (Best, 2010). Brain research continues to indicate that physical activity provides the brain with the additional oxygen, which it needs to increase the connections among the neurons (Jensen, 2005; Wolfe, 2001). During the school day, student engagement in physical activity leads to higher academic achievement and better attitudes toward school (Jensen, 2005; Russell & Newton, 2008).
Delimitations and Limitations

Due to time constraints, the research will be conducted over a 6-week period. Six weeks will not provide the researcher with sufficient time to see whether the effect, if any, of physical activity on reading achievement will last over time. Thus, future research would benefit from a longer time frame.

Due to the study being delimited to middle school students, who are between the ages of 11 and 13, from two level-1 intensive reading classes, the results may not be generalizable to students of other grade levels, ages, or types of reading classes. Thus, future research should use a more diverse sample.

Due to class sizes and scheduling demands of the school, the research will be conducted on a small sample of 22 students, which also limits the generalizability of the findings. Thus, future research should use a larger sample.

Due to the instructional requirements of the Florida Department of Education, the reading instruction received by both the treatment and nontreatment groups will be conducted by the researcher; it is, therefore, unavoidable that in this study certain level of subjectivity may be present. In future studies, to avoid the possibility of this subjectivity, someone other than the researcher should administer the reading instruction or the reading intervention if possible.

Due to the researcher’s role as the teacher completing the intervention, the level of teacher motivation and preparation time outside of the regular school day may be significantly overestimated or underestimated in some areas.
Due to participants’ access to the X-box Kinect and their personal experience with it, participants may play the X-box Kinect games beyond the regular school day; therefore, participants may become discouraged with, lose interest in, or become bored with the intervention. Also because participants may play the X-box Kinect games beyond the regular school day, practicing the activities may cause skewed variations in heart rate responses.

Due to high-stakes testing in cores subjects such as reading, participants may attend reading tutorial services funded by grants beyond the regular school day. These services provide additional support from certified reading teachers to students struggling with reading achievement.

Due to human error, there may be calculation variations in participants’ target heart rate zones. The estimation of target heart rate zone may be an underestimate or overestimate of intensity for some students.

**Assumptions**

1. All students in the treatment group will want to participate in the physical activity sessions.

2. Students will not be transferred between the treatment group and the nontreatment group.

**Organization of the Study**

This chapter provided an introduction to and an overview of the dissertation proposal. The chapter concludes with a discussion of limitations and delimitations. Chapter II provides the review of the literature and theoretical framework of the study.
Chapter III presents the methodology, including the research design, the target population and sampling plan, instrumentation, procedures, methodological limitations, and the data analysis plan.
CHAPTER II
LITERATURE REVIEW

This chapter presents a review of the literature relevant to reading achievement, levels of text complexity, the Florida Comprehensive Assessment Test (FCAT), and physical activity. Included in the review are discussions of teacher quality, executive function, the heart rate and target heart zone, reading instruction, integrated curriculum, brain research, technology, and physical activity to provide the foundation of the proposed study.

Reading Achievement

As the American public continues to express concern over reading achievement, the reading education of students in the United States remains a priority for public policy agendas (Sensenig, 2011). Improving reading achievement as measured by both international and national assessments for all students remains a priority for the United States (NCES, 2010; National Commission on Excellence in Education, 1983; U.S. Department of Education [U.S. DOE], 2011). According to the No Child Left Behind law (NCLB), by 2014 all children were to be at grade level by the end of the third grade (Sensenig, 2011). As early as 2004, results from the Nation’s Report Card showed that after the implementation of NCLB, an achievement gap in reading still existed in educational systems, not only on an international level but also at national and state levels across the United States (Alger, 2009).

International reading achievement. Every 3 years, the Programme for International Student Assessment (PISA) collects international reading data on 15-year-
old students (OCED, 2010a). The assessment includes questions that require each student to apply reading strategies acquired in the school setting to nonschool environments. Each student must make a variety of cognitive-based decisions that require them to make use of not only reading but also mathematical and scientific knowledge from school-based settings and relevant experiences (OCED, 2010b). The United States consistently ranks average or below average in the majority of subject areas tested internationally (Rotberg, 2010). In 2009, when compared against other countries, the United States ranked 17th in reading scores from the Programme for International Student Assessment (PISA) report. The report showed that only 30% of 15-year-old boys and girls in the United States performed at or above reading proficiency level 4 (OCED, 2010a). According to PISA, 15-year-olds who achieve a level 4 or higher are proficient readers, capable of reading difficult texts (OCED, 2010b).

PISA assessment results in reading correlate with a country's economic and social growth. Consequently, countries with the highest percentage of students who read at proficient levels reflect a successful education system (OCED, 2010b). Absent from the PISA results are the detailed curricula, mandates, and time used for educational practices in the high-performing school systems.

**National reading achievement.** In the United States, federal programs have been implemented with a goal of increasing reading achievement among students at every grade level (Allington, 2009). Literacy programs once adopted as part of the No Child Left Behind Act of 2001 included such programs as Early Reading First, Reading First, and Striving Readers (U.S. DOE, 2002). Early Reading First programs emphasized the
development of early childhood centers designed to expose students to effective learning environments before they entered elementary school (U. S. DOE, 2002). To ensure that students read well by the end of third grade, the federal government supported Reading First Programs, which emphasized research based on teaching methods for early reading instruction (Meier, Noguera, & Cobb; 2007). For struggling readers enrolled in Title I middle schools and high schools, the federal government funded the program called Striving Readers, which focused on reading interventions specifically designed for adolescents reading significantly below grade level (“Striving Readers,” 2009; U. S. DOE, n.d.), with a goal of raising reading achievement among struggling readers. Title I schools receive additional funding from the federal government to support schools in meeting the education goals of low-income students (U. S. DOE, n.d.). After the implementation of such programs, Brozo (as cited in Marchand-Martella et al., 2013) found that 1.2 million students continued to drop out of school with reading skills that are below basic (p. 161).

Educational stakeholders search for ways to reduce the number of underperforming students in core subjects (Jeynes, 2007; Stanley & Stanley, 2011; Zhao, 2009). To ensure that both equity and a quality education exist within the U.S. public education system, the federal government continues to monitor, modify, and implement educational reforms to address the academic weaknesses of the United States (Zhao, 2009). In 2001, The No Child Left Behind Act (NCLB) began to require teachers to ensure that every student made academic progress in core subject areas (Stanley & Stanley, 2011). But even with the implementation of multiple educational mandates, the
lack of reading achievement among students at every academic level has existed in the United States for many years (Allington, 2009; Forgione, 1998; Lacour & Tissington, 2011; McQuillan, 1998 Valencia & Buly, 2004). Even after the passage of federally funded education laws, such as the Reading Excellence Act of 1998, the NCLB Act of 2001, and the Individuals with Disabilities Education Act of 2004, achievement among struggling readers in the United States continued to lack significant improvement (Allington, 2009).

In 2009, a nationally representative sample size of 213,000 fourth graders and 168,000 eighth graders participated in the National Assessment of Educational Progress (NAEP) in reading (NCES, 2010). The NAEP measures reading proficiency levels for students in the fourth, eighth, and twelfth grades, using three achievement levels: basic, proficient, and advanced. Students who achieve at the basic level demonstrate partial mastery of knowledge and skills. Proficient students demonstrate a strong understanding of challenging material, and students who demonstrate advanced levels exceed expectations set by the NAEP (2010).

As measured by the NAEP (U. S. DOE, 2010) in 1992, 62% of fourth graders were at or above proficiency levels; in 2009, 67% of fourth graders read at or above proficiency levels. In 2011, the average fourth-grade reading score reflected the same fourth-grade reading average of 67% from 2009 (U. S. DOE, 2010). In addition, the NAEP assessment did not find a significant increase between the national average reading score of eighth graders between 1992 and 2011. In 1992, the average eighth-grade reading score was 69%. However, in both 1992 and 2009, the average national
reading score for eighth-grade students was 75%, an increase of only 5% points from 1992 (U.S. DOE, 2010). The results of the NAEP assessment for both fourth- and eighth-grade students consistently show how reading achievement in the United States has lacked significant improvement. Test results such as the NAEP project nationwide images of deficits in reading achievement at all grade levels.

**Florida’s national reading achievement.** The NAEP addresses, by state, both reading and mathematics test scores across the United States. In Florida, in 2011, the average percentage of fourth-grade students who performed at or above the NAEP proficiency level was 35%, which was one percentage point less than the average of 36% of fourth-grade students who performed at or above the NAEP proficiency level in 2009. Similarly, the percentage of eighth graders who performed at or above the NAEP proficiency level in Florida in 2011 was 73%, which also is less than the average of 76% of eighth-grade students who performed at or above the NAEP proficiency level in 2009 (U.S. DOE, 2010).

The percentages of fourth-grade and eighth-grade students in the state of Florida who read at or above proficiency level as measured by the NAEP have shown no significant difference from 2004 to 2009 (U.S. DOE, 2010). According to Rotberg (2010), the results from statewide assessments should show progress toward the achievement of the state’s set proficiency standards. Deficits in reading achievement among students enrolled in kindergarten through 12th grade project images of achievement gaps long observed both across Florida as well as nationwide (Greenleaf & Hinchman, 2009). Closing the achievement gap and improving student achievement in
reading at both the national and state levels remains a priority for the United States (National Commission on Excellence in Education, 1983; U.S. DOE, 2010)

**Florida's state reading achievement.** The Florida Comprehensive Achievement Test (FCAT), a state-mandated assessment, was first administered to students statewide in both reading and mathematics in 1998. The FCAT in reading was designed to measure student achievement of the Sunshine State Standards in basic reading skills at each grade level, starting with the third grade. Beginning in 2011, the FCAT 2.0 in reading measured the student achievement of the standards, now called the Next Generation Sunshine State Standards, in basic reading skills and literature at each grade level, beginning in the third grade. The reading skills and understanding of literature assessed on the FCAT 2.0 increase in difficulty by grade level (Florida Department of Education [FLDOE], 2012c).

The FCAT 2.0 uses five student achievement levels to measure the reading proficiency for each student. Students rated at level 1 experience *minimal* success with grade-level content; classification of the student’s test performance is significantly below grade level (FLDOE, 2012c). Students at level 2 experience *limited* success with grade level content; therefore, the student’s test performance is below grade level (FLDOE, 2012c). At level 3, students experience *partial* success, or a satisfactory level of success, with grade level content; therefore, the student’s test performance meets the minimum requirements for grade level performance (FLDOE, 2012c). Students at level 4 demonstrate an above-satisfactory level of success, and students at level 5 demonstrate a mastery of the most challenging content of the Next Generation Sunshine State Standards.
(FLDOE, 2012c). The minimum goal for all students who take the FCAT is a level 3. Only students who achieve at levels 4 or 5 are considered on grade level (Appendix B).

In 2001, 51% of sixth-grade students demonstrated above-satisfactory levels on the reading FCAT. Similar to the national and state level NAEP results, by 2012, the FCAT showed minimal gains. The number of sixth-grade students who read at level 3 or above increased by 8% on the FCAT reading test. In 2001, 37% of 10th-grade students demonstrated proficiency (level 3 or above) as measured by the FCAT. By 2012, 10th-grade proficiency levels increased by 13%, which raised the statewide percentage for 10th-grade students who read at satisfactory levels or above to 50% (FLDOE, 2012).

As a result of NCLB, high-stakes testing at both the national and state levels dominates methods for measuring reading achievement among students (Ediger, 2012). At the state level, if assessments continuously indicate that students’ needs are not being adequately addressed, each state’s department of education has the authority to implement changes that better address the needs of students in both testing policies and teacher- and student-based curriculums, as long as the new assessments and curriculums continue to address the federal guidelines (Rotberg, 2010). In efforts to reduce the number of struggling readers across the United States, some states have reduced initial classroom instructional time for low-performing students, in order to provide time for small group and one-to-one direct instructional remediation for struggling readers (Greenleaf & Hinchman, 2009). Preparing students for success beyond effective test-taking strategies begins with the implementation of classroom instructional practices, which reflect the learning needs of students (Zhao, 2009).
Impact of Struggling Readers

Education policies must implement classroom instruction and instructional practices to provide students methods for success beyond high-stakes, test-taking strategies (Zhao, 2009). Beginning in the primary grades, the cost to educate struggling readers puts an increasing financial burden on the education system every school year. Each struggling reader requires additional support (Allington, 2009; Cappella & Weinstein, 2001; Slavin, Lake, Davis, & Madden, 2010). Struggling readers, at all grade levels unable to achieve average reading success, must be exposed to alternative reading interventions, which may include hiring reading specialists and purchasing additional reading programs. As struggling readers at any grade level receive additional support in reading instruction, any student still unable to achieve average reading success must receive additional and often more costly reading interventions (Allington, 2009).

Over 1 million teenagers between the ages of 16 and 19 are not enrolled in school or have not attained a high school diploma (Curran & Reyna, 2010; Legters & Balfanz, 2010). In turn, high school dropouts experience higher unemployment rates, a greater number of incarcerations, poorer health conditions, and a greater need for social services (Legters & Balfanz, 2010). Students dropping out of high school are more likely to cost the government millions of dollars. There is an increasing concern that, as adults, high school dropouts also experience higher unemployment rates, more incarcerations, lower socioeconomic status, the need for more social services and poorer health conditions (Legters & Balfanz, 2010). One method to lowering the high school dropout rate is by ensuring that high school students have adequate reading skills before graduating from
high school. Due to the inconsistent and varied methods in the reported data at the state level, current dropout rates among high school students are likely underestimated (Greene & Winters, 2006; Legters & Balfanz, 2010). The dropout rate among high school students subsequently affects the number of students eligible to enroll and earn degrees from institutions of higher education (Knesting, 2008).

As high school graduates exit high school in preparation for college and universities, many high school graduates are not prepared to enter college with the necessary reading skills to be successful in higher education (Rosenfeld, 2005). Some higher education institutions contribute the increase of students in need of remedial courses to the declining conditions and instructional practices in school districts educating students in grades K-12 (Rose, 2012). More than 35% of students who enter colleges and universities need remediation courses before beginning standard college and university courses (Handel & Williams, 2011; Rose, 2012). Customarily, remedial courses do not earn students transferable credits toward requirements for graduation (Handel & Williams, 2011).

Those students required to enroll in remedial courses also experience lower graduation rates. Students significantly underprepared for college coursework will need to spend more than the usual 4 years of attendance at a higher education institution (Rose, 2012). The majority of college students entering college who are unable to complete a program within six years never graduate from a college or university. Only 35% of students who enter a 4-year degree program will graduate within four years and fewer than 60% of them will graduate within six years (Tabarrok, 2012). In 2009, the dropout
rate among college and university students was, as a result, the United States had the highest dropout rate among colleges and universities compared to all other industrialized countries (Tabarrok, 2012). Without the assistance of remedial reading courses, more than 35% of high school graduates would enter colleges and universities without the basic reading and writing skills necessary to successfully attend and graduate from institutions of higher education (Fitzhugh, 2011; Handel & Williams, 2011; Rose, 2012).

In the United States, business leaders, government officials, and the nation’s citizens agreed that education should produce functional workers and citizens (Aper, 2010). Reading achievement affects the number of people who enter the workforce with the necessary skills that employers seek in our global workforce (Biancarosa, 2012; Sabatini, Shore, Holtzman, & Scarborough, 2011; Schoeff, 2007). Further, an essential understanding of reading education is that people should be able to read well enough to function in everyday life (Biancarosa, 2012; Farr, 1977; Freire, 2010). National Governors’ Association (2005) found that 40% of students who graduate from high school lack the reading skills sought by employers. Freire and Macedo (1987) showed that illiterate individuals generally experienced failure in schools and in other environments.

Both adolescent and adult struggling readers have a difficult time in performing everyday tasks, such as reading a television guide or completing official documents (Bohn-Gettler & Rapp, 2011). When people are unable to read well, a greater number of social services are needed, which results in greater financial strain on government programs (Marchand-Martella et al., 2013). As adolescents become literate and
productive members of society, graduate from high school, successfully enter and
graduate from colleges and universities, and obtain success employment, the United
States may save the nation billions of dollars (Marchand-Martella et al., 2013).

Profile of a Struggling Reader

Students enter each grade level with a vast range of academic and social abilities; thus, each student does not enter classroom settings equally prepared for academic success (Allington, 2009; Willingham, 2009). Before schooling begins and throughout the schooling process, students experience different levels of parental support and academic preparation methods (Willingham, 2009). As kindergarteners enter formal school settings, their socioeconomic status, prior knowledge, vocabulary, and reading ability will vary. For example, before entering kindergarten, some students have experienced over 1,000 read-alouds, which includes exposure to different vocabulary words, while other students entering kindergarten have listened to fewer than ten stories read aloud (Allington, 2009). Research (Allington, 2009; Allington, 2010) also has indicated that some students enter kindergarten after attending a preschool program, while others enter kindergarten without any formal education (Allington, 2009). Students entering kindergarten from low socioeconomic backgrounds are at a higher risk for becoming struggling readers (Dion et al., 2010).

As early as kindergarten, many readers' struggling stems from the lack of quality instruction provided in elementary classrooms (Allington, 2009; Dion et al., 2010). The lack of quality reading instruction leaves older struggling readers with more complex reading deficiencies, such as comprehending increasing complex text (Allington, 2009;
Marchand-Martella et al., 2013; Vaughn et al., 2011). Longitudinal research (Allington, 2009; O’Connor & Jenkins 1999) shows that when kindergarten students have limited knowledge of letter names, those same students have limited word recognition by the end of first grade (Allington, 2009; Dion et al., 2010).

For most struggling readers, word recognition continues to be limited beyond first grade; thus, many struggling readers may be identified as early as kindergarten. In efforts to reduce the overall number of struggling readers, such research leads researchers to argue that explicit and purposeful reading instruction and interventions should begin as early as kindergarten, leaving some reading experts to speculate that an important element for improving grade level reading achievement is the timing of instruction in the early grades (Alger, 2009; Dion et al., 2010).

Traditional reading instruction and curriculums do not adequately address the reading needs of each struggling reader in the elementary grades (Greenleaf & Hinchman, 2009). Early reading interventions help prevent some younger students from becoming struggling readers (Allington, 2009; Dion et al., 2010). Yet, early interventions have not resulted in the overall improved reading achievement of older struggling readers identified as such before exiting elementary school (Allington, 2009; Marchand-Martella et al., 2013). Seventy percent of readers who receive reading intervention in elementary school require intense reading remediation in middle school and high school (Marchand-Martella et al., 2013).

Students not meeting grade level expectations in elementary school are likely to continue to fall behind throughout their academic careers as reading material becomes
more complex (Allington, 2009; Greenleaf & Hinchman, 2009; Willingham, 2009). In the early elementary grades (K-3), most struggling readers are less than a year behind their achieving grade-level peers. By fourth grade, many struggling readers are more than one year behind their grade level peers (Allington, 2009). Results from the NAEP show minimal improvements for fourth-grade readers performing below grade level (Kelley & Decker, 2009). After fourth grade, the achievement gap between most struggling readers entering middle school and their grade level peers is more than three years (Allington, 2009).

When students leave third grade, they must have the skills necessary to begin reading to learn new information (Allington, 2009). Many struggling readers entering fourth grade have not received adequate reading instruction or reading interventions to support the comprehension of increasingly difficult grade-level text (Allington, 2009; Blanton et al., 2007; Greenleaf & Hinchman, 2009). Beginning in the fourth grade, many struggling readers begin a pattern of academic failure that continues through middle school and high school (Blanton et al., 2007; Vaughn et al., 2011). Correcting reading deficiencies in struggling readers beyond elementary school is more difficult for both the reader and the teacher (Allington, 2009).

**Secondary level.** Eliminating reading difficulties, which lead to academic failure among struggling readers enrolled in elementary school, is essential to the academic success and future of students entering middle school (Vaughn et al., 2011). As struggling readers enter middle school, the possibility of academic success is reduced (Slavin et al., 2010). To ensure reading success among students who enter sixth grade,
however, education policies must prevent reading failure and provide adequate reading interventions at the elementary level (Helf & Cooke, 2011). Studies of older struggling readers (Allington, 2009) show little success with current interventions that focus on improving reading achievement. For states and school districts to consider students to be on-grade-level readers in middle school, students must perform at proficiency levels on state and national assessments (Marchand-Martella et al., 2013). As students enter middle school, based on standardized assessments, students identified as struggling readers are placed in remedial reading classes, which can decrease their motivation to learn (Donaldson & Halsey, 2007).

A struggling reader’s motivation to read continues to decrease as the reader progresses through each grade level and his or her academic needs are not addressed. Once struggling readers reach third or fourth grade, most of them stop reading outside of class (Allington, 2009). On the other hand, an increase in student motivation provides struggling students with opportunities to perform at the optimal learning levels (Allington, 2009; Marchand-Martella et al., 2013). Struggling readers in middle school often lack motivation; this may limit their ability to learn and implement effective reading strategies necessary to become successful readers (Marchand-Martella et al., 2013).

Research shows that reading comprehension is an extensive problem for struggling readers in both the middle and high school settings (Hagaman & Reid, 2008). Students in middle school and beyond must be prepared to comprehend a variety of genres and different text complexity levels when they enter new grade levels (Marchand-
Martella et al., 2013). In addition to lacking motivation, struggling middle school and high school readers lack the skills they need to develop strategies to decode multisyllabic words. The ability to decode multisyllabic words is essential to successfully comprehending both expository and narrative text (Marchand-Martella et al., 2013).

Many reading interventions in middle school are ineffective for struggling readers because the instruction focuses on foundational skills, such as basic word recognition and the decoding of one-syllable words (Hagaman & Reid, 2008) and does not extend to the level of complexity of students’ reading. Struggling adolescent readers have broad and complex reading difficulties that involve vocabulary as well as understanding and making meaning of new texts (Vaughn et al., 2011). These struggling readers have limited sight word recognition and decoding skills, and, when they transition to sixth grade, they have difficulty with reading text to learn subject matter (Biancarosa, 2012).

Struggling readers at every grade level typically have difficulty applying prior knowledge to written text and monitoring their own reading comprehension during reading; they also have limited vocabularies (Blanton et al., 2007; Marchand-Martella et al., 2013; Shapiro & Riley, 1989; Vaughn et al., 2011). The struggling reader has difficulty using a variety of reading strategies (Blanton et al., 2007; Shapiro & Riley, 1989). According to Chall’s (1983b) *Stages of Reading Development*, the ability to read is a mix between complex abilities and skills that change as the reader progress through school. During the school day, struggling readers need additional reading lessons provided by reading experts designed to meet their specific needs (Allington, 2009).
Legters and Balfanz (2010) noted that by sixth grade, many unsuccessful students experience limited academic success, low attendance rates, and frequent occurrences of inappropriate behavior, making it possible to identify future dropouts as early as sixth grade. Their research also has shown that a relationship exists between classroom instruction, reading achievement, and graduation rates. Students who experience little success in school and receive low test scores are more likely than successful students who score at least average on high-stakes assessments to drop out of school (Christle, Jolivette, & Nelson, 2007).

**No Child Left Behind**

Before the NCLB Act in 2001, several scientists and educators felt that the world of education was not ready for the field of scientific brain research (Wolfe, 2001). But according to the federal guidelines outlined by NCLB, classrooms based on scientific research are essential to reducing the number of struggling readers in classrooms across the United States (Allington, 2009). To ensure school districts across the nations use the best scientific research available, NCLB restricted the use of federal funding to instructional programs and interventions deemed effective by scientific research (Allington, 2009). As part of NCLB, programs such as Early Reading First, Reading First, and Striving Readers served as some of the first federally funded initiatives to prioritize classroom instruction for struggling readers at all grade levels supported by scientific research (Allington, 2009).

Implementation of the NCLB Act was designed to reduce the achievement gap between students from different socioeconomic status, race, and gender (Berliner, 2011).
Through NCLB, the federal government guarantees that every student who enters a public school classroom will receive quality instruction, delivered by highly qualified teachers with education credentials set by both the federal and state governments (U. S. DOE, 2005). For example, in the state of Florida, as a result of NCLB, the need for teachers with Florida state reading certifications and reading endorsements increased to meet federal demands for highly qualified teachers. Accordingly, the FLDOE expected to find teachers with the necessary skills to detect early reading problems and provide the appropriate interventions for improved reading instruction for all students (Florida Center for Reading Research [FCRR], 2007). According to the FLDOE certification department, there are over 8,000 teachers with reading certification credentials and 23,711 teachers with reading endorsement certifications in the state of Florida (FLDOE, 2012a). Since the initial implementation of NCLB, across the state of Florida, the reported number of teachers per year who receive reading endorsements increased from 500 to well over 1,000 (Florida Center for Reading Research, 2007).

Nationwide, from federal and state mandates included as part of NCLB, education systems have been required to monitor the implementation of programs designed to meet the needs of all students, specifically including struggling readers (Allington, 2009; Stanley & Stanley, 2011). Teachers and administrators must ensure classroom assessments measure state standards (Berliner, 2011; Supon, 2008; Willingham, 2009). Both teachers and administrators must continually examine these results (Supon, 2008). The results from these classroom assessments drive instructional practices for teachers...
working to achieve mandatory proficiency levels on high-stakes assessments mandated by the state (David, 2011; Supon, 2008).

NCLB demanded that all education systems across the United States implement instruction that would increase the achievement of all students (Allington, 2009; Willingham, 2009). To ensure that states meet the federal guideline, the requirements of NCLB provided for high-stakes testing to hold states and teachers accountable for student progress and the lack thereof (Berliner, 2013; Willingham, 2009). As schools across the United States prepared for high-stakes testing, classes that include physical activity, such as physical education, continued to be reduced during the school day (You, 2011).

Before NCLB, some school administrators viewed physical education as an unnecessary interruption to core academic instruction (Berliner, 2011; Sallis et al., 1999). Then, with the increasing demands of statewide assessment, many states began to reduce the time for physical activity in the school setting in order to provide more time for academic subjects, such as reading (Berliner, 2011; Collier, 2011). According to Coe et al. (2006), there is no clear evidence to support the strategy of more academic time and less physical activity to improve academic achievement. In fact, research has demonstrated that students who participate in at least ten minutes of appropriate aerobics before a standardized test performed 25% better than did their peers who did not exercise before the test (O'Hanlon, 2007).

In response to the national implementation of NCLB, schools and teachers began to align classroom curriculums with the demands of high-stakes testing (Blanton et al., 2007). The majority of state tests consist of only multiple-choice questions (Willingham,
2009). By matching classroom instruction to test-taking strategies, teachers who design their reading instruction only around high-stakes testing fail to instruct readers in thinking skills used for comprehending increasingly difficult text (Blanton et al., 2007). Yet every year thousands of students fail these high-stakes tests (Allington, 2009; Valencia & Buly, 2004).

As reading teachers face pressure to meet high-stakes testing standards and state mandates, reading instruction has increasingly come to rely on commercial products (Blanton et al., 2007). Educational tools, which have teacher guides and supportive materials, are designed for easy implementation (Vaughn et al., 2011). Many commercial products include scripted teacher dialogue and repetitious exercise with limited use of challenging texts (Blanton et al., 2007; Vaughn et al., 2011). Such products, however, may not be designed to reduce the number of struggling readers or meet the needs of struggling readers (Blanton et al., 2007).

**Approach to Reading Instruction**

Effective reading instruction must extend beyond teaching struggling readers how to answer questions for standardized assessments (Biancarosa, 2012; Blanton et al., 2007). Reading instruction for struggling readers should recognize the cognitive differences among readers (Blanton et al., 2007). The most effective reading instruction for all readers addresses comprehension and word-recognition strategies (Vaughn et al., 2011). Teaching students to read successfully depends on the effectiveness of the reading instruction (Allington, 2009).
To ensure an increase in both the number of effective teachers in each state and student achievement in core subject areas, national mandates require teachers to meet new teacher qualifications at the federal, state, and local levels (U.S. DOE, 2005). These teacher qualification mandates guarantee quality classroom instruction for all students receiving instruction in core academic subject areas at every grade level. Through NCLB, all teachers teaching core subjects such as math and reading must meet standards set by federal, state, and local educational authorities, which classify core subject-area teachers as highly qualified (Marchand-Martella et al., 2013). Highly qualified teachers are responsible for creating educational environments that match every student's academic interests and needs (Marchand-Martella et al., 2013). Yet, over the course of 12 years, most students will receive instruction from only three highly qualified teachers with effective teaching strategies: one in elementary school, one in middle school, and one during high school (Allington, 2009).

**Role of the teacher.** Increasing student achievement requires the delivery of instruction by effective teachers meeting high standards, who will ensure academic success among all students at every grade level (Lemke, Thomsen, Wayne, & Birman, 2012). Effective teachers not only meet high qualifications but also have extensive pedagogical content knowledge about the subject taught (Loughran, Berry, & Mulhall, 2006; Yilmaz, 2011; You, 2011). During classroom instruction, effective teachers use strategies to promote both academic and social success among all students (Azzam, 2007; Wiske, Franz, & Breit, 2005). As such, improving student achievement depends on
effective reading instruction in which teachers of reading meet the instructional needs of each student (Allington, 2009).

To be an effective teacher of reading, a teacher must understand the vital role of acquiring reading skills in the acquisition of knowledge for readers (Helf & Cooke, 2011; You, 2011). In most formal classrooms settings, reading success depends on the ability to comprehend a variety of written materials (Hagaman & Reid, 2008; Lesaux & Kieffer, 2010). As a reader begins to successfully comprehend reading material, he or she is able to meet the requirements of a complex, technological society with the possibility of upward social mobility (Comings, Garner, & Smith, 2000).

Teachers of reading have a critical role in improving reading achievement among struggling readers in classrooms across the United States (Biancarosa, 2012; Helf & Cooke, 2011). Every year, at accelerated rates, teachers of reading must produce increased levels of reading achievement among struggling readers (Allington, 2009). Effective reading teachers have extensive subject area knowledge, supported by effective teaching strategies that provide quality instruction, which improves achievement among all students, including struggling readers (Allington, 2009; Helf & Cooke, 2011).

According to Allington (2009), in a 2004 randomized field trial design developed by Nye, Konstantopoulos, and Hedges, these researchers found the most important variable to improving any student’s reading achievement is the effectiveness of the teacher. As such, research shows that students’ reading rates increase when teachers receive effective training and adequate support in reading instruction (McCombes-Tolis & Feinn, 2008).
Effective teachers of reading instruction should be experts in specific areas of both reading content and instructional delivery (Helf & Cooke, 2011). Teachers of reading instruction with expertise in reading support effective reading teachers with the skills needed to present students with customized instructional support in areas such as phonics and the decoding of multisyllabic words (Ediger, 2012). Teachers of reading instruction with expert teaching skills also provide effective reading teachers with the knowledge to determine specific areas of difficulty for struggling readers (Shapiro & Riley, 1989). As such, effective reading teachers are able to match each struggling reader with reading material aligned with the reader’s current achievement level (Ediger, 2012).

Effective reading teachers understand the purpose of reading instruction (Allington, 2009; Shapiro & Riley, 1989). Learning to read involves acquiring decoding skills in addition to developing vocabulary and learning reading comprehension (Comings et al., 2000). During reading instruction, effective reading teachers expose students to strategies that teach students to recognize words, decode unfamiliar words, learn new vocabulary, and comprehend material. Comprehension strategies include finding the main idea and summarizing information (Small & Arnone, 2011). Effective reading teachers understand that overemphasizing one view of the reading process during instruction may hinder a reader and even produce a struggling reader (Allington, 2009; Shapiro & Riley, 1989).

**Developing readers.** Effective reading teachers’ instruction results in the reader’s ability to integrate multiple cognitive processes during reading (Christopher et al., 2012). As reading instruction reflects an increase in text complexity, the demands on
a reader’s cognitive ability increase (Christopher, et al., 2012). Effective teachers provide students with instruction that supports the development of the cognitive skill structures necessary for reading and comprehending new material (Blanton et al., 2007; Christopher et al., 2012). Reading requires students to use cognitive processing, also known as the executive function, which relies on orthography, phonological meaning, and context (Adams, 1990).

As it relates to reading, the executive function focuses on the individual’s ability to understand, retrieve, and learn new information (Pass & Sweller, 2011). The executive function is a set of cognitive processes that allow for controlled, goal-directed cognition and behavior (Best, 2011). During reading, skilled readers intentionally select cognitive skills and strategies reliant on executive functions (Allington, 2009). For example, the ability to retain and quickly manipulate and process visual information during reading is critical for reading comprehension (Christopher et al., 2012).

Effective functions include working memory and processes allowing for self-regulation (Alves, Gualano, Takao, Morine, & Takito, 2012; Best, 2010). Working memory is one of several executive functions needed for the comprehension of reading material (Eason et al., 2012); the ability to use it is critical to successful reading comprehension (Christopher et al., 2012). By retaining and manipulating information in the working memory, the brain is able to quickly process visual information. For a reader, more working memory is required when comprehending a story, as compared to processing visual information. To formulate a coherent story, the reader must be able to match, manipulate, and attach the meaning to each word (Christopher et al., 2012).
Learning to read is a very difficult process because reading is not a skill that occurs naturally in the brain (Sensenig, 2011). Effective instruction depends on the implementation of the best theoretical perspective, which represents the learning that is expected to take place (Schunk, 1991). Cognitive learning theories explain the way in which the brain processes and memorizes information and take into consideration how the learner experiences the material. More importantly, these theories are used to provide an understanding of the learning that takes place as a result of executive functions, such as the working memory (Schunk, 1991).

Cognitive theories have been applied to self-regulatory skills, self-determination, and moral development (Schunk, 1991). During reading instruction, the use of self-regulation and self-monitoring is essential to improving reading instruction among struggling readers in middle school (Hagaman & Reid, 2008). When readers successfully comprehend the material read, they are able to read the majority of words in text using such skills as self-regulatory and self-determination skills made possible by the executive functions (Allington, 2009; Christopher et al., 2012). Flexibility within the executive function allows each student to read and comprehend complex narrative and content-area text with ease, subsequently achieving academic success (Marchand-Martella et al., 2013).

**Purpose of instruction.** Achieving academic success with struggling readers requires teachers to use explicit instruction so that students may learn how to successfully implement effective reading strategies (Marchand-Martella et al., 2013). Research documents the benefits of using explicit instructional practices when teaching struggling
readers (Archer & Hughes, 2011). Explicit instruction during reading is essential to improving reading achievement among struggling readers. For example, explicitly teaching multisyllabic chunking is an appropriate instructional tool for struggling readers in middle school. Explicitly teaching struggling readers how to recognize irregular words, suffixes, and roots is an essential skill for supporting struggling readers (Marchand-Martella et al., 2013).

Once students experience consistent and continuous effective reading instruction, the majority of students eventually become successful readers (Allington; 2009). The ability to read efficiently helps readers learn new complex words, which help the readers comprehend new text (Christopher et al., 2012). Such readers are able to read and demonstrate understanding when reading more dense content-area text (Marchand-Martella et al., 2013). Research suggests the need for strategy instruction during reading instruction at the middle and high school levels. Such strategy instruction should include the use of self-monitoring, self-regulation, and goal setting to improve reading comprehension (Hagaman & Reid, 2008).

**Improving Adolescent Reading Achievement**

Improving adolescent reading achievement is dependent on teachers creating educational environments that match every student's academic needs (Marchand-Martella et al., 2013; Willingham, 2009). To meet the educational demands of every student during classroom instruction, social interactions among adolescent struggling readers will help develop the cognitive structures vital to reading comprehension (Blanton et al., 2007; Sesma et al., 2009). Effective instructional methods should include teaching
strategies and curriculums that expose students to collaborative and integrated learning opportunities (Cone, Werner, Cone, & Woods, 1998; Marchand-Martella et al., 2013). At the elementary, middle, and high school levels, research supports the use of collaborative learning as a way to increase student achievement (Marchand-Martella et al., 2013). Collaborative learning supports both academic and social success of students during the age of globalization (Zhao, 2009). Bandura’s social cognitive theory posits that students learn through an effectively structured social context involving observation (Schunk, 1991); thus, learning has a social aspect (Yilmaz, 2011). In addition, principles associated with Bandura’s social cognitive theory have been applied to learning that involves the development of social and self-regulatory skills (Schunk, 1991).

Effective reading instruction and interventions for struggling adolescent readers must take into account the way that the brain processes text and stores information in the working memory, such as the content of the text which may influence the depth of processes utilized during reading (Bohn-Gettler & Rapp, 2011). An individual’s physiological functioning affects his or her ability to learn (Caine & Caine, 1991). During the adolescent years, a major change occurs in both the development and the behavior patterns of the brain (Romer et al., 2011). For example, sixth-grade students’ adjustment to middle school may be extremely taxing on the brain due to changes in the school environment and classroom instruction, as well as an increase in the number of teachers with whom the students. These things require students to make significant cognitive adjustments (Jacobson, Williford, & Pianta, 2011). The middle school
transition causes an increase in the student’s use of the developing executive function, causing a need for more self-regulation and working memory (Jacobson et al., 2011).

Research from Biancarosa and Snow (2006) suggested motivation is an integrated element for successful reading instruction for middle school students. For struggling adolescent readers, reading teachers are unable to teach motivation (Allington, 2009; Marchand-Martella et al., 2013). Motivation for struggling readers reflects teaching methods and the text interactions teachers promote with their struggling students (Marchand-Martella et al., 2013). To be successful in middle school, students must be able to read and ascertain knowledge in different subjects, which requires the reader to use a variety of reading strategies (Ehren, 2009).

Improving adolescent reading achievement requires teachers to implement strategies that increase the motivation of struggling readers (Mucherah & Yoder, 2008). Once student motivation during reading instruction is increased, reading achievement begins to improve in struggling readers (Melekoglu, 2011). Because the emotional and cognitive domains are impossible to separate, students’ attitudes and feelings regarding learning are encompassed in the learning process (Caine & Caine, 1991). By providing students with a richer and more stimulating environment, teachers may increase academic achievement (Caine & Caine, 1991; Melekoglu, 2011; Mucherah & Yoder, 2008). As such, structured discourse between students during reading instruction supports an increase in stimulating environments, which support motivation through new and meaningful learning experiences (Blanton et al., 2007). The brain learns by constructing meaning from surrounding information (Jensen, 2005). Research shows students acquire
knowledge through learning experiences, which include authentic discussions and metacognitive conversations centered on specific subject matter (Allington, 2009; Blanton et al., 2007).

**Interdisciplinary approach.** Integrating reading tasks into literacy assignments of interest to struggling readers is critical to improving effective reading instruction that supports adolescent reading achievement (Blanton et al., 2007). By creating engaging and motivating environments, teachers are able to provide students with quality instruction while using effective instructional methods (Marchand-Martella et al., 2013; You, 2011). Classrooms that actively engage students in the learning process promote motivating environments of learning, which are essential to quality instruction (You, 2011). Enhancing instruction with physical activity not only motivates and captures student’s interest, but also may cause an increase in student achievement (Cone et al., 1998).

Integrating physical activity into classroom instruction as a means to increase academic achievement is a well-known concept in the field of physical education (Cone et al., 1998). Supporters of physical education have theorized about the benefits of combining physical education and core academic concepts (Parks, Solomon, & Lee, 2007). As early as the 1970s, Cratty’s *Intelligence in Action* (1973) and *Active Learning* (1971) encouraged the use of physical education activities to enhance academic achievement (Cone et al., 1998). Likewise, recent research results from a randomized control study successfully demonstrated how incorporating physical activity into an academic-based curriculum could increase academic achievement (Donnelly et al., 2009).
By combining academic lessons with physical activity, many students will become more motivated, thus having an increased opportunity to be successful in the classroom when performing academic tasks (Cone et al., 1998).

Often used interchangeably, interdisciplinary and multidisciplinary approaches to learning enhance what students learn (Cone et al., 1998). When using a multidisciplinary approach during reading, meaningful educational experiences may result for less motivated students (Allington, 2009; Cone et al., 1998; Parks et al., 2007). The use of a multidisciplinary approach allows educators to include knowledge and skills that reflect daily life (Cone et al., 1998). A multidisciplinary curriculum that includes the delivery of instruction from a physical education teacher integrated with reading instruction from a reading teacher may help students learn and perform at their optimal level.

Two highly qualified subject area teachers, one qualified in each subject, should teach multidisciplinary classes to ensure that students receive effective instruction in the subject areas being integrated (Cone et al., 1998; Eveland-Sayers, Farley, Fuller, Morgan, & Caputo, 2009; Parks et al., 2007; Wilkins et al., 2003). Incorporating lessons from two subject areas during classroom instruction facilitates teamwork and planning among teachers working to deliver highly effective instruction (Cone et al., 1998). Collaboratively, effective teachers in both subject areas are able to deliver effective instruction (Cone et al., 1998; Parks et al., 2007). As a result, students begin to understand how the skills and knowledge learned in one subject may both transfer to another subject area and be applied to life (Cone et al., 1998; Parks et al., 2007; Wittberg et al., 2012).
In physical activity, as in core academic subjects such as reading, teacher quality and preservice training affect quality (Collier, 2011). Since the late 1990s, physical education experts have documented the benefits of physical activity provided through physical education classes by trained physical education teachers (Sallis et al., 1999). Effective teachers, delivering instruction to low-performing students, know when to implement a specific teaching method to support a student’s comprehension of certain material (Blanton et al., 2007; You, 2011). As such, physical education teachers understand the relationship between integrating physical education, specifically delivering physical activity with other subject areas (You, 2011).

Those against the use of a multidisciplinary approach, which includes physical activity, may fear the use of one subject area overshadowing another or that teachers’ lack of expertise when integrating multiple subject areas (Cone et al., 1998). Parks et al. (2007) conducted a review of the literature on perceptions of integrating physical activity into other academic subjects. They found that, traditionally, when using an interdisciplinary approach to instruction, physical educators incorporated reading and other core subjects into their lessons but rarely was physical activity effectively incorporated into reading education. Effectively incorporating physical activity into the reading instructional environments requires the combined expertise of a physical education and reading teacher (Cone et al., 1998).

**Physical Activity and Physical Education**

Physical education teachers recognized as effective teachers understand the relationship between physical activities and the learning process (You, 2011). The use of
physical activity encourages students to become actively involved in the learning process, which leads to an increased understanding of academic material (Cone et al., 1998; Russell & Newton, 2008). By including effective physical activity, participating students experience improved academic performance, physical health, and self-esteem (Russell & Newton, 2008).

Research also indicates that physical activity through visually stimulating environments such as Exergames increases self-efficacy (Russell & Newton, 2008). Exergames are video games that require the user to engage in vigorous physical movement and may have a positive impact on cognitive development (Best, 2010; Trout & Christie, 2007). The use of Exergames in both a social setting and a partner/group setting in school may have a stronger impact on the development of a student’s executive function than when played alone (Best, 2010). Exergames increase physical activity levels, which provide immediate enjoyment and motivational incentives for user (Russell & Newton, 2008).

Some overweight children have significantly lower reading scores than their non-overweight peers (Tremblay, Inman, & Willms, 2000). Research shows that a sedentary lifestyle is associated with the growing obesity rate in children (Kristjansson, Sigfusdottir, Allegrante, & Helgason, 2009). Also, engaging in large bouts of sedentary activity can have a negative impact on a student’s cognitive development (Best, 2010). A lack of physical activity also contributes to risk factors associated with coronary heart disease (Janz, Golden, Hansen, & Mahoney, 1992). These issues have important
implications for school curricula and how students learn because students spend a large percentage of the school day in limited movement, by sitting at a desk or tables.

The time needed by educators to create quality learning experiences for students is often absent from the school day (Cone et al., 1998; Parks et al., 2007; Wilkins et al., 2003). The Center on Education Policy (as cited in McMurrer, 2008) reported that 46% of school districts across the United States, which include elementary, middle, and high schools, increased the time spent on subjects such as math and reading, by decreasing the allotted time spent on physical education classes by at least 25 minutes. Additionally, many schools that have approved physical education programs do not provide physical education on a daily basis (Eyler et al., 2010; McMurrer, 2008).

As federal guidelines implement requirements for high-stakes testing, both physical activity and physical education continue to hold less value in the public school setting due to statewide standardized testing (Collier, 2011). In the past, public schools in the United States addressed the issue of obese or overweight children through daily physical education classes, which included physical activity (Kristjansson et al., 2009). Almost every school requires students to take some form of physical activity before graduating from high school; however, due to high-stakes testing, many schools do not provide time during the school day for instruction involving physical education (McMurrer, 2008). The implementation, purpose, and function of physical education programs as a school subject vary by school across the United States (McMurrer, 2008; Naul & Hardman, 2002; You, 2011).
The majority of states in the United States require physical education at every level (You, 2011). Sallis et al. (1999) noted the strong relationship links between physical activity and learning; they noted that physical activity stimulates areas of the prefrontal cortex used in learning and problem solving. Jensen (2005) stated, “The evidence has become a groundswell, and most neuroscientists agree that movement and cognition are powerfully connected” (p. 61).

Armstrong (1998) stated that adolescents should participate in physical activity that requires elevated levels of exertion for at least 20 minutes, three or more times per week. Fox, Barr-Anderson, Neumark-Sztainer, and Wall (2010) determined that students who engage in intense physical activity during the school day have a significant increase in academic achievement. Physical activity provides the brain the oxygen it needs for the growth of new neurons (Willis, 2006). Further, students who engage in consistent physical education programs during the school day exhibit excellent fine motor skills and fitness, as well as better academic performance and a better attitude toward school (Jensen, 2005).

Evidence continues to show the physical and mental benefits of physical activity in youth of all ages (Parks et al., 2007). When students are physically active, their brains are supplied with the oxygen-rich blood necessary for optimal academic performance (Jensen, 2005). The benefits of physical activity are impossible to achieve if physical education and the remaining academic subjects work in isolation (Parks et al., 2007).
Overall, previous studies have reported that students who engage in daily physical education programs not only perform academically better, but also have a better attitude toward school (Fox et al., 2010; Silverman, 1993).

**Measuring physical activity.** Accurately measuring physical activity in the school setting is difficult due to the different components included in physical activity such as the type, frequency, time period, and level of intensity (Hussey, Bell, & Gormley, 2007; Lee & Gorelick, 2011). For the amounts and intensity levels of physical activity that affect student achievement to be understood, physical activity must be measured (Chaddock, Pontifex, Hillman, & Kramer, 2011; Hussey et al., 2007; Lee & Gorelick, 2011). Interventions to increase physical activity should be designed on the basis of the intensity of physical activity needed to affect increased cognitive performance (Wittberg et al., 2012). In the past, to assess the use of physical activity in children, researchers used heart rate monitoring to determine intensity levels of physical activity (Hussey et al., 2007).

The development of heart rate monitoring devices has provided researchers with a tool to measure levels of physical activity (Hussey et al., 2007). An accurate measure of the heart rate is essential to monitoring the intensity level of physical activity (Lee & Gorelick, 2011). An electrocardiograph provides the best measure of heart rate, but its use is not very practical in the school setting (Lee & Gorelick, 2011). Multiple other devices are available to monitor the level of physical activity (Hussey et al., 2007; Laurson, Brown, et al., 2008). The use of a heart rate monitor is one approach to measure physical activity (Hussey et al., 2007). Both pedometers and electronic heart rate
watches are accessible tools used to measure physical activity in children (Hussey et al., 2007).

An electronic heart rate monitor watch to measure physical activity is a form of instructional technology. When used effectively, heart rate monitors such as heart rate watches can benefit the teaching and learning process by motoring students’ activities and providing immediate feedback (You, 2011). Because the studies investigating physical activity and heart rate outcomes on curricular activities in adolescents are few, the need for more research is warranted (Gao, Hannon, & Carson, 2009).

Understanding and assessing a child’s physical activity level depends on the definition used to determine the resting heart rate. Determining the resting heart rate has an impact on the intensity level of physical activity. Interpretations of physical activity levels depend on the maximums range set to determine the intensity level of physical activity (Hussey et al., 2007). The use of a heart rate monitor helps individuals work at the proper physical activity levels designated by their target heart rate zone (McGinnis & Beers, 2004).

The relationship between an individual’s heart rate and oxygen consumption supports the validity of using heart rate monitoring tools when assessing physical activity in the school setting (Chaddock et al., 2011; Hussey et al., 2007; Janz et al., 1992; Lee & Gorelick, 2011). Increasing the flow of oxygen to the brain supports the various functions of the brain and the brain’s ability to learn new information (Jensen, 2005). Oxygen is one of the major sources of energy for the brain (Wolfe, 2001). Increasing physical activity is a way to increase the blood flow of oxygen to the brain. Since the
section of the brain that processes movement is the same part of the brain that processes learning, physical activity can increase learning and enhance motivation (Jensen, 2005).

**Florida’s physical education policy.** Before enrolling any student to participate in physical education classes, school districts in the state of Florida are required to notify each parent of the their available options (Fla. Stat. 2010, §1003.455). Exemption policies for physical education in the United States are not exclusive to high schools, but also exist in both elementary and middle schools. However, per §1003.455, when students perform significantly below the state reading proficiency level, they are enrolled in mandatory remedial reading courses and automatically lose access to required physical education classes.

In Florida, there are over 21,000 teachers with physical education credentials. Approximately 7,000 of the physical education teachers in Florida have physical education certification in grades 6 through 12 (FLDOE, 2012). Certified physical education teachers have the proper training to support reading education through the use of effective physical activity.

**Summary of Literature**

The literature clearly demonstrates the increasing interest in and multiple attempts by policymakers, educational researchers, and practitioners to improve the education process for every student in the United States. The literature also documents education stakeholders’ demands for a quality public education system in which schools receive additional resources to support academic instruction that meets the needs of a technological society.
A large body of psychological and educational research consistently points to the need for teachers to provide students with learning experiences that prepare them for success both in school and in the workplace. In this regard, there is universal understanding that reading is a fundamental skill for being a productive member of society. The literature shows a connection between the decline in reading achievement and decline in the U.S. economy. Overall, the literature clearly points to the need to improve reading achievement.

Traditionally, the use of computer-based reading programs as a reading intervention has proven to be ineffective in improving reading achievement among struggling readers (Allington, 2009). However, technology has now provided educators with a menu of tools to adjust curricula and instruction to fit the specific academic needs of student learners. By using interactive technology, educators are able to gain the attention and interest of students, provide immediate feedback to them, and offer them a variety of learning opportunities (Willis, 2006).

Although evidence of the relationship between reading achievement, technology, and the use of physical activity as an effective instructional strategy has been established, no such relationship has been investigated as a call to action for new educational policies at the state and local levels. For instance, federal, state, and local education policies recognize the need for change in the instructional approach for teaching students how to read, but the literature is limited in regard to the connection between physical activity and reading instruction. Future studies must be conducted to determine the long-term impact
of physical activity and, specifically, Exergaming, on executive functions and reading achievement.
CHAPTER III
METHODOLOGY

This chapter presents the methodology used to examine the impact of the inclusion of physical activity, in the form of Exergames, on overall reading achievement among sixth-grade students. The chapter begins with a restatement of the purpose of the study and the research questions, followed by a presentation of the research design, participants, instrumentation, procedures, and data analysis.

Purpose of the Study

The purpose of the study was to investigate the effect of physical movement, through the use of Exergames, on reading achievement of middle school students.

Research Questions

The following questions guided the study:

1. Does integrating physical activity into the reading curriculum improve overall reading achievement, as comprised of vocabulary, informational text, and literary analysis?

2. Does integrating physical activity into the reading curriculum improve reading achievement as it pertains to levels of complexity?

3. Does integrating physical activity into the reading curriculum improve reading achievement as it pertains to type of text?

Research Design

To evaluate the use of physical movement as a reading intervention for students with low reading achievement, the researcher used a quasi-experimental, pretest-posttest,
nonequivalent group design. The nonequivalent aspect of the design, in other words, the use of a control group, enabled the researcher to measure the effect of the treatment.

Participants

As shown in Table 1, during the 2012 school year, the total student population of 1,067 students, from which the sample was drawn, had a demographic breakdown as follows: 64% Hispanic/Latino, 20% African American/Black, 12% Caucasian, 2% Asian, 1% Other, 1% Multicultural, and 0% American Indian/Alaska Native. Additionally, 20.1% of students were considered English Language Learners (ELLS) and 19.5% of students were considered disabled and qualified for additional educational support (ESE). Further, 54.6% of the students were male and 45.4% were female. Finally, 84.72% of the students qualified for a free or reduced-cost lunch, which means that the school is classified as high poverty (FLDOE, 2012). In FLDOE, students completed the FCAT in reading. Students whose test scores resulted in being classified at level one in reading were assigned to intensive reading classes.
Table 1

*Total Student Population*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>64%</td>
</tr>
<tr>
<td>African American/Black</td>
<td>20%</td>
</tr>
<tr>
<td>Caucasian</td>
<td>12%</td>
</tr>
<tr>
<td>Asian</td>
<td>2%</td>
</tr>
<tr>
<td>Multicultural</td>
<td>1%</td>
</tr>
<tr>
<td>Other</td>
<td>1%</td>
</tr>
<tr>
<td><strong>Education Classification</strong></td>
<td></td>
</tr>
<tr>
<td>English Language Learners (ELL)</td>
<td>20.1%</td>
</tr>
<tr>
<td>Exceptional Student Education (ESE)</td>
<td>19.5%</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>54.6%</td>
</tr>
<tr>
<td>Female</td>
<td>45.4%</td>
</tr>
<tr>
<td><strong>Socio-Economic Status (SES)</strong></td>
<td></td>
</tr>
<tr>
<td>Free &amp; Reduced Lunch</td>
<td>84.72%</td>
</tr>
</tbody>
</table>
Sample selection. Two level-one intensive reading middle-school classes, each of which had 22 students between the ages of 11 and 13, were selected. Both intensive reading classes were sixth-grade-level classes and were taught by the same credentialed reading teacher, who has over ten years of experience in the field of reading. The students in one class served as the treatment group, and the students in the other class served as the control group. Thus, a total of 44 sixth-grade middle school students, which included 20 girls and 24 boys, were selected to participate.

Students present for 13 or fewer of the 18 sessions of physical activity were excluded from this study. For the students' data to be included in the sample, he or she must have attended at least 14 of the 18 sessions of physical activity.

Instrumentation

Florida Reading Ready. The Florida Reading Ready (FRR) assessment consists of 55 questions related to both expository and narrative text, which was given before and after the intervention. The FRR is a program published by Curriculum Associates used to support reading instruction for students preparing to participate in the FCAT grades 3-8. After seeking permission, the FRR assessment was used to measure the reading progress of both the treatment and nontreatment groups (Appendix C). The FRR is a valid measure for students preparing for the FCAT (Appendix D).

According to the most recent study published by the Educational Research Institute of America, the pretest and posttest from the FRR show correlations with the FCAT 2.0 (Educational Research Institute of America, 2011). The FRR assessment was administered by the researcher immediately before the intervention began and then
immediately after it ended. Like the FCAT, the sixth-grade assessment included questions of varying cognitive complexity in four reporting categories: vocabulary, reading application, literary analysis of fiction and nonfiction, and information text.

**FCAT.** The FCAT is the Florida state assessment used to measure progress toward the goals of NCLB. The FCAT is designed to measure strengths and weaknesses of basic reading skills of all students at each grade level, beginning in the third grade. The FCAT is a state-mandated assessment in which each student is measured against the state reading achievement standard. Both the fifth- and sixth-grade reading FCAT contain 50 to 55 questions and each passage ranges between 200 and 1100 words with an average of 700 words. Both the fifth- and sixth-grade reading FCAT contain 50% literary text and 50% informational text.

The sixth-grade assessment includes questions of varying cognitive complexity. Of the questions in reading achievement, 15%-25% is of low complexity, 50%-70% is of moderate complexity, and 15%-25% is of high complexity. The FCAT was reviewed for potential bias and discrepancies in sensitivity, and found to be a valid and reliable instrument. Schools place students into leveled reading classes based on results from this high-stakes assessment.

**Heart-rate monitor.** The study used the EKHO WMP-88 Heart-Rate monitor, which is in the form of a wristwatch. The heart rate monitor, which measures the resting heart rate and heart rate during activity, is an important instrument in the field of exercise science (Lee & Gorelick, 2011). The monitor provided participants with immediate
feedback on the intensity level of their movement, and the researcher monitored physical activity to ensure that students were working in their target heart rate zone.

Before beginning the activity, students determined their target heart rate zone based on the Karvonen mathematical formula used to calculate the target heart rate zone. Once students determined their target heart zone, they had a baseline from which to compare subsequent readings. The heart rate readings provided the researcher with data for frequency and intensity of physically activity necessary to influence reading achievement.

To conduct a heart rate reading, students placed two fingers from the opposite hand on sensors located at the top of the watch. This movement caused the arm to cross the front of the body, enabling the watch to calculate a heart rate reading. The watch calculated the current heart rate. Although the watch is a valid electronic gauge, individual heart rates are affected by age, gender, temperature, emotional stress, and fatigue. Before using the heart-rate watch, each student calculated his or her minimum and maximum heart-rate zone using his or her current age. The heart-rate calculation did not take into consideration the temperature, emotional stress, or physical fatigue of the student.

**Procedures**

The Palm Beach County School District Research Department approved the study during the 2012-2013 school year. Parents or legal guardians of the potential student participants were provided with written information about the study and written consent, in accordance with the university’s IRB and the school district’s research department.
Additionally, parents were asked to provide the researcher with a signed statement that their child has no condition that would prevent him or her from participating in physical activity in 18 sessions over the course of 5 weeks.

Before beginning the physical movement intervention, students from both groups took the FRR assessment. The assessments provided a baseline that allowed the researcher to measure improvement, as reflected in posttest data. Specifically, the researcher tracked the students' scores in the different areas of reading. During the treatment, the researcher was not able to monitor or modify any student transfers between classrooms and neighboring schools; the researcher expected the attrition rate among students in both the control and treatment groups to be high.

Beginning March 4, 2013, and ending April 20, 2013, the 22 students in the treatment group received 66 minutes per week (for a total of 18 sessions) of physical movement intervention with a certified physical education teacher, using the X Box Kinect gaming system and the game Kinect Sports, before beginning daily reading instruction with a reading specialist. During each intervention session, each student completed the physical activity simultaneously with a self-selected partner. Each partner group had its own Kinect gaming system. After each physical activity session, the students in the treatment group had 5 minutes of rest before beginning the remaining 27 minutes of reading instruction. Both the control group and the treatment group received the same reading passages at different times during the day. The control group received reading instruction from 10:53 a.m. to 1:12 p.m., during which time there was a lunch
period from 11:50 a.m. to 12:20 p.m. At 1:12 p.m., students proceeded to their next class. The treatment group received reading instruction from 2:09 p.m. to 3:53 p.m.

During each X Box Kinect session, the EKHO WMP-88 Heart-Rate monitor continuously presented the heart-rate. The monitor has an alarm that sounds once the heart rate is detected, and the current heart rate is displayed. The researcher recorded the heart rate data before, during, after each use of the X Box Kinect. Before beginning each X-box Kinect session, each participant used the monitor to determine his or her resting heart rate. At the end of each session, the participant recorded his or her ending heart rate on a form developed by both the researcher and the physical education teacher.

The use of a heart-rate monitor helped each student work at his or her proper physical activity level designated by his or her individual target heart rate zone. During each treatment, regular monitoring of each student’s heart-rate provided an accurate interpretation of physical activity level used during each treatment session.

Data Analysis

To protect the identity of each participant, each participant was assigned a code, and the data was stored in a secure location, to which only the researcher has access. SPSS was used for the statistical analysis of the pretest and posttest FRR data as well as for the scores on the common assessment and for heart rate. For a participant’s data to be used, he or she was required to be present at 15 of the 18 sessions and have 90% class attendance average. Due to potential student transfers between classrooms and neighboring schools, the researcher expected the attrition rate among students in both the control and treatment groups to be high. Additionally, frequencies and related statistics
for demographic information was generated. The researcher used a $t$-test to address the research questions.

**Limitations**

This study had certain limitations. The research was conducted over a 6-week period; however, this was not sufficient time for the researcher to determine whether the effect, if any, of physical activity on reading achievement would last over time. Additionally, the sample size was small, and had the possibility of becoming smaller through the attrition, which limits the generalizability of the findings. Further, for both the treatment and control groups, the researcher delivered the reading instruction. The researcher's experience, literacy training, and knowledge of the proposed reading intervention resulted in subjectivity and a modified delivery of reading instruction.

There was the possibility that participants in either group could play the X Box Kinect games at home. The participants kept a journal to record the number of hours and games that they played outside of the school-based intervention. Additionally, participants in both groups took part in reading tutorial services, which could have affected the posttest results. For example, since control group participants made use of such services, this decreased or closed the potential difference in scores between the treatment and control groups.
CHAPTER IV
RESULTS

This chapter presents the findings relevant to reading achievement, levels of text complexity, the Florida Reading Ready Assessment (FRR), the Florida Comprehensive Assessment Test (FCAT), and the impact of the inclusion of physical activity, in the form of Exergames, to improve overall reading achievement among sixth-grade students. The chapter begins with a restatement of the research questions followed by a presentation of the collected data and results. The Statistical Program for the Social Sciences (SPSS) 21.0 was used to code and analyze the data.

Research Questions

The results address the following research questions:

1. Does integrating physical activity into the reading curriculum improve overall reading achievement, as comprised of vocabulary, informational text, and literary analysis?

2. Does integrating physical activity into the reading curriculum improve reading achievement as it pertains to levels of complexity?

3. Does integrating physical activity into the reading curriculum improve reading achievement as it pertains to type of text?

Participant Composition

The total number (N) of 39 participants had a demographic breakdown as follows: 69.2% Hispanic/Latino, 23.1% African American/Black, and 7.7% Caucasian. As shown in Table 2, overall, 97.4% of the participants qualified for a free or reduced-cost lunch based on their socioeconomic status (SES). Additionally, some 20.1% of participants
were considered English language learners (ELL) and 19.5% of participants were considered disabled and qualified for additional educational support (ESE). All participants in both the treatment group and the control group were classified as level 1 in reading, in accordance with their 2011 FCAT assessment scores. All participants were assigned to 100 minutes of uninterrupted reading instruction through a level 1 intensive reading class.

Table 2

*Participants' Socio-Economic Status & Ethnicity*

<table>
<thead>
<tr>
<th></th>
<th>Does not Qualify</th>
<th>Does Qualify</th>
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<td>100.0</td>
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**Control and treatment group.** Table 3 displays the race and ethnic breakdown by treatment versus control condition. A Pearson chi-square test indicated that the groups did not differ by race/ethnicity, $\chi^2 (2) = 1.15, p = .56$. 
Table 3

Demographics Treatment & Control Participants

<table>
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<tbody>
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<td>Control</td>
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<tr>
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<td>3</td>
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<tr>
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<td>1</td>
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<tr>
<td>Hispanic/Latino</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>18</td>
</tr>
</tbody>
</table>

Table 4 displays the educational classification by treatment versus control condition. A Pearson chi-square test indicated that the groups did not differ by educational classification, $\chi^2 (2) = 6.04, p = .11$.

Table 4

Education Classification

<table>
<thead>
<tr>
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</thead>
<tbody>
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<td>Control</td>
<td>Treatment</td>
</tr>
<tr>
<td>ESE &amp; ELL</td>
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<td>4</td>
</tr>
<tr>
<td>English Language Learner (ELL)</td>
<td>8</td>
<td>4</td>
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<tr>
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<td>6</td>
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<tr>
<td>Regular</td>
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<tr>
<td>Total</td>
<td>21</td>
<td>18</td>
</tr>
</tbody>
</table>

There was a trend for more females in the control group and more males in the treatment. Table 5 displays the gender classification by treatment versus control condition. A Pearson chi-square test indicated a trend-level effect for gender differences by group, $\chi^2 (2) = 3.39, p = .065$. 
Table 5

Gender Classification

<table>
<thead>
<tr>
<th>Gender</th>
<th>Control or Treatment</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Treatment</td>
</tr>
<tr>
<td>Female</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Male</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>18</td>
</tr>
</tbody>
</table>

Treatment group. The gender composition within the treatment group consisted of 27.8% female participants and 72.2% male. Table 3 includes the demographic breakdown of participants in the treatment group, of which 61.9% were Hispanic/Latino, 16.7% were African American/Black, and 5.6% were Caucasian.

The treatment group consisted of 18 participants—46.2% of the total participant composition. As indicated in Table 4, the total treatment group had an educational classification breakdown as follows: 33.3% exceptional education but not English language learner (ELL), 22.2% exceptional student education (ESE) and ELL, 22.2% ELL but not ESE, and 22.2% regular education students. Additionally, of the 46.2% of participants that began the treatment on March 4, 2013, 16.7% of participants assigned to the treatment group were excluded from the final results once attendance data was calculated.

Control group. The control group consisted of 21 participants, 53.8% of the total participant composition. Table 3 includes the demographic breakdown of participants in the control group: 61.9% were Hispanic/Latino, 28.6% were African American/Black, and 9.5% were Caucasian. As shown in Table 4, the final control group had an
educational classification breakdown as follows: 38.1% English language learner, 38.1% regular education, 19.9% exceptional student education and English language learner, and 4.8% exceptional student education. Additionally, Table 5 shows both the gender and educational breakdown within the control group; 70.6% of the control participants were female and 40.9% were male. Participants in the treatment group used the Karoven mathematical formula to calculate their target heart rate zone before using the heart-rate watches. Each participant calculated his or her minimum and maximum heart rate zones by using his or her current age and resting heart rate. Target heart rate zones varied by student due to age and the number of beats required by each participant’s heart at rest (Hussey et al., 2007). The heart rate calculation did not take into consideration the temperature, emotional stress, or physical fatigue of each participant. As shown in Table 6, the numbers of participants in the treatment group are identified by the count. The minimum and maximum heart rate zones varied from 148 to 194 beats per minute. After data for some participants were excluded because of attendance issues, the final number of participants in the treatment group consisted of 14 participants.
Table 6

**Target Heart-Rate Zone**

<table>
<thead>
<tr>
<th>Target</th>
<th>Count</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>148-184</td>
<td>2</td>
<td>14.3%</td>
</tr>
<tr>
<td>149-186</td>
<td>2</td>
<td>14.3%</td>
</tr>
<tr>
<td>151-186</td>
<td>2</td>
<td>14.3%</td>
</tr>
<tr>
<td>153-186</td>
<td>2</td>
<td>14.3%</td>
</tr>
<tr>
<td>153-187</td>
<td>1</td>
<td>7.1%</td>
</tr>
<tr>
<td>154-192</td>
<td>1</td>
<td>7.1%</td>
</tr>
<tr>
<td>158-189</td>
<td>1</td>
<td>7.1%</td>
</tr>
<tr>
<td>163-185</td>
<td>1</td>
<td>7.1%</td>
</tr>
<tr>
<td>163-192</td>
<td>2</td>
<td>14.3%</td>
</tr>
<tr>
<td>169-194</td>
<td>1</td>
<td>7.1%</td>
</tr>
<tr>
<td>Included Participants</td>
<td>15</td>
<td>100%</td>
</tr>
<tr>
<td>Excluded Participants</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>

Once participants assigned to the treatment group determined their target heart zones, each participant had a baseline against which to compare subsequent readings for data frequency and intensity of physical activity necessary to influence overall reading achievement. The heart-rate watches monitored how often participants worked within their target heart rate zones. As shown in Table 7, the underlined numbers indicate 7.8% of participants assigned to the treatment group were able to consistently meet their target average heart-rate zones.
Table 7

*Average Heart-Rate Zone*

<table>
<thead>
<tr>
<th>Heart-Rate Not Measured</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>126</td>
<td>1</td>
<td>2.6%</td>
<td>64.1%</td>
</tr>
<tr>
<td>132</td>
<td>1</td>
<td>2.6%</td>
<td>66.7%</td>
</tr>
<tr>
<td>135</td>
<td>1</td>
<td>2.6%</td>
<td>69.2%</td>
</tr>
<tr>
<td>136</td>
<td>1</td>
<td>2.6%</td>
<td>71.8%</td>
</tr>
<tr>
<td>137</td>
<td>1</td>
<td>2.6%</td>
<td>74.4%</td>
</tr>
<tr>
<td>138</td>
<td>1</td>
<td>2.6%</td>
<td>76.9%</td>
</tr>
<tr>
<td>142</td>
<td>1</td>
<td>2.6%</td>
<td>79.5%</td>
</tr>
<tr>
<td>143</td>
<td>1</td>
<td>2.6%</td>
<td>82.1%</td>
</tr>
<tr>
<td>147</td>
<td>1</td>
<td>2.6%</td>
<td>84.6%</td>
</tr>
<tr>
<td>148</td>
<td>1</td>
<td>2.6%</td>
<td>87.2%</td>
</tr>
<tr>
<td>149</td>
<td>1</td>
<td>2.6%</td>
<td>89.7%</td>
</tr>
<tr>
<td>159</td>
<td>1</td>
<td>2.6%</td>
<td>92.3%</td>
</tr>
<tr>
<td>161</td>
<td>1</td>
<td>2.6%</td>
<td>94.9%</td>
</tr>
<tr>
<td>166</td>
<td>1</td>
<td>2.6%</td>
<td>97.4%</td>
</tr>
<tr>
<td>180</td>
<td>1</td>
<td>2.6%</td>
<td>100.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>39</strong></td>
<td><strong>100.0%</strong></td>
<td></td>
</tr>
</tbody>
</table>

Summary of Analyses

The Florida Reading Ready (FRR) assessment was used to measure the reading level and progress of both the treatment and nontreatment groups before and after the intervention. The FRR assessment consisted of 55 questions related to both expository and narrative text. The assessment included questions of varied cognitive complexity in four reporting categories: vocabulary, reading application, literary analysis of fiction and nonfiction, and informational text. The number of questions for each reporting category
include: 21 reading application, 13 questions for informational, 11 literary analysis of fiction and nonfiction, and text 10 vocabulary (Florida Center for Reading Research [FCRR], 2007).

At the culmination of the intervention, participants from both the treatment and control groups completed the FRR postassessment. The results from the postassessment administered on April 20, 2013, were compared with the results from the preassessment administered on March 4, 2013. The comparisons between the two assessments measured the increase or decrease in the number of participants, type of questions, and overall reading achievement as measured by FRR. Additionally, the results of the FRR were compared with the 2013 FCAT results.

**Results for research question 1.** Does integrating physical activity into the reading curriculum improve overall reading achievement, as comprised of reading application, vocabulary, informational text, and literary analysis?

As Tables 8-13 indicates, during the preassessment period, the total population was comprised of 39 participants. Of those 39 participants, four students, 10.3% of the total participant sample, did not participate in the FRR preassessment. In the control group, one student, comprising 4.8% of control participants, was not present for the preassessment and in the treatment group, three students, comprising 16.7% of treatment participants, were not present during the preassessment administered on March 4, 2013.

After completing the intervention, participants from both the treatment and control groups completed the FRR postassessment. Participants from both the treatment and control groups were unavailable during the FRR postassessment. Overall, 17.9% of
the total participant population did not complete the postassessment. The postassessment had an overall 7.6% increase in the number of students not present for the FRR assessment at the end of the intervention. Of the 21 participants identified in the control group, 5.1% did not complete the postassessment, and of the 18 participants of the treatment group, 12.8% did not complete the postassessment. The control group had a 2.5% increase in percentage points for participants not accessible for the FRR postassessment and the treatment group had a 5.1% increase in participants not accessible for the FRR postassessment.

Table 8

*Florida Reading Ready Pre- & Post-Data Comparison*

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>M</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Florida Reading Post-Test</td>
<td>39</td>
<td>0</td>
<td>85</td>
<td>44.38</td>
<td>23.854</td>
</tr>
<tr>
<td>Covariate</td>
<td>Florida Ready Pre-Test</td>
<td>39</td>
<td>0</td>
<td>87</td>
<td>37.46</td>
</tr>
</tbody>
</table>

As indicated in Table 8, irrespective of group, a covariance analysis indicated an overall increase of approximately seven points between the pre- and postassessment scores. Covariates appearing in the model are fixed at value: 37.46 for the pretest.

Table 9

*Treatment vs. Control on Florida Reading Ready Post-Assessment*

<table>
<thead>
<tr>
<th>Treatment or Control</th>
<th>Mean</th>
<th>Std. Error</th>
<th>95% Wald Confidence Interval</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>53.52</td>
<td>4.665</td>
<td>44.38</td>
<td>62.67</td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>33.72</td>
<td>5.039</td>
<td>23.85</td>
<td>43.60</td>
<td></td>
</tr>
</tbody>
</table>
Displayed in Table 9, the control group performed significantly better than the treatment group on the postassessment ($\chi^2(1) = 8.316, p = .004$). As displayed in Table 10, the difference in the mean score is equal to 19.802 between participants in the treatment and control group. Parameter estimates include the dependent variable: Florida Reading Post-Assessment. The subscript $a$ represents zero because the parameter is redundant and subscript $b$ indicates the maximum likelihood estimate.

Table 10

*Florida Reading Ready Post-Assessment*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>Std. Error</th>
<th>95% Wald Confidence Interval</th>
<th>Hypothesis Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>33.722</td>
<td>5.0387</td>
<td>23.847 - 43.598</td>
<td>Wald Chi-Square</td>
</tr>
<tr>
<td>Control</td>
<td>19.802</td>
<td>6.8666</td>
<td>6.343 - 33.260</td>
<td>8.316</td>
</tr>
<tr>
<td>Treatment</td>
<td>0$^a$</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>(Scale)</td>
<td>456.996$^b$</td>
<td>103.4892</td>
<td>293.193 - 712.314</td>
<td></td>
</tr>
</tbody>
</table>

Participants with comparable data scored significantly below grade level on the 2012 FCAT. In 2012, the baseline data for all participants in both the treatment and the control group equaled performance level 1 as measured by the FCAT. Noted in Table 11, a covariance analysis of both the treatment and the control group showed participants had an increase of approximately 11 points on the 2013 FCAT toward an overall performance level increase.
Table 11

2012 vs. 2013 FCAT Data

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>M</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013 FCAT</td>
<td>39</td>
<td>-15</td>
<td>36</td>
<td>11.87</td>
<td>12.110</td>
</tr>
</tbody>
</table>

On average, participants in the treatment group increased by 11.33 points whereas participants in the control group increased by 12.33 points. Table 12 shows no significant statistical difference between the control group and the treatment group. Parameter estimates include the dependent variable: 2013 FCAT point gain. The subscript \(a\) represents zero because the parameter is redundant and subscript \(b\) indicates the maximum likelihood estimate.

Table 12

2013 FCAT Point Gain

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>Std. Error</th>
<th>95% Wald Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>11.333</td>
<td>2.8150</td>
<td>5.816 – 16.851</td>
</tr>
<tr>
<td>[PARTICIPANT=C ]</td>
<td>1.000</td>
<td>3.8362</td>
<td>-6.519 – 8.519</td>
</tr>
<tr>
<td>[PARTICIPANT=T ]</td>
<td>0a</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(Scale)</td>
<td>142.632b</td>
<td>32.2999</td>
<td>91.508 – 222.320</td>
</tr>
</tbody>
</table>

In Table 13, the difference in the mean score is equal to 1.000 point between participants in the control group versus participants in the treatment group.
Table 13

2013 FCAT Comparison Gains

<table>
<thead>
<tr>
<th>Treatment or Control</th>
<th>Mean</th>
<th>Std. Error</th>
<th>95% Wald Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>12.33</td>
<td>2.606</td>
<td>7.23</td>
</tr>
<tr>
<td>Treatment</td>
<td>11.33</td>
<td>2.815</td>
<td>5.82</td>
</tr>
</tbody>
</table>

**Results for research question 2.** "Does integrating physical activity into the reading curriculum improve reading achievement as it pertains to levels of complexity?" cannot be answered. The FRR and FCAT included questions of varied cognitive complexity in four reporting categories: vocabulary, reading application, literary analysis of fiction and nonfiction, and informational text. There is no available data for cognitive complexity by questions.

**Results for research question 3.** Does integrating physical activity into the reading curriculum improve reading achievement as it pertains to type of text?

The FRR assessment contained 13 questions for informational text and 11 literary analysis questions (see Table 14-18), comprising over half of the assessment with a total of 24 questions (Florida Center for Reading Research [FCRR], 2007). Overall, 17.9% of the total participant population did not complete the postassessment administered on April 20, 2013. The postassessment had an overall 7.6% increase in the number of students not present for the FRR assessment at the end of the intervention. Of the 21 participants identified in the control group, 5.1% did not complete the postassessment, and of the 18 participants in the treatment group, 12.8% did not complete the postassessment administered on April 20, 2013. The control group had a 2.5% increase
in percentage points for participants not accessible for the FRR postassessment and the treatment group had a 5.1% increase in participants not accessible for the FRR postassessment.

As shown in Table 14, the dependent variable is the total number of informational questions correct. On average, participants in the treatment group answered 5.73 of informational text questions correctly and participants from the control group answered 8.56 of informational text questions correctly on the postassessment.

Table 14

Informational Text Questions Post-Assessment

<table>
<thead>
<tr>
<th>Treatment or Control</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>8.56</td>
<td>1.617</td>
<td>18</td>
</tr>
<tr>
<td>Treatment</td>
<td>5.73</td>
<td>1.849</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>7.48</td>
<td>2.181</td>
<td>29</td>
</tr>
</tbody>
</table>

Indicated by Table 15, irrespective of group, a covariance analysis indicated an overall decrease of approximately 1 point between the pre- and postassessment scores of informational text questions.

Table 15

Informational Text Question Comparisons Pre-/Post-Assessment

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Total Number of Questions Correct</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>29</td>
<td>4</td>
<td>12</td>
<td>7.48</td>
<td>2.181</td>
</tr>
<tr>
<td>Covariate</td>
<td>Pre-Informational Correct</td>
<td>29</td>
<td>2</td>
<td>13</td>
<td>6.55</td>
<td>3.007</td>
</tr>
</tbody>
</table>
Displayed in Table 16, on average participants in the treatment group answered 4.36 literary analysis questions correctly and participants in the control group answered 6.33 literary analysis questions correctly on the postassessment. The dependent variable is the total number of literary questions answered correctly.

Table 16

*Literary Text Questions Post-Assessment*

<table>
<thead>
<tr>
<th>Treatment or Control</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>6.33</td>
<td>2.223</td>
<td>18</td>
</tr>
<tr>
<td>Treatment</td>
<td>4.36</td>
<td>1.804</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>5.59</td>
<td>2.260</td>
<td>29</td>
</tr>
</tbody>
</table>

As indicated by Table 17, the dependent variable is the total number of preliterary analysis questions correct on the postassessment. Irrespective of group, a covariance analysis indicated an overall increase of approximately 1 point between the pre- and postassessment scores.

Table 17

*Literary Question Comparisons Pre-/Post-Assessment*

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>M</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questions Correct</td>
<td>29</td>
<td>1</td>
<td>11</td>
<td>5.59</td>
<td>2.260</td>
</tr>
<tr>
<td>Pre-Literary Analysis Correct</td>
<td>29</td>
<td>0</td>
<td>10</td>
<td>4.14</td>
<td>2.774</td>
</tr>
</tbody>
</table>

As depicted in Table 18, on average, participants in the control group responded correctly to approximately two more questions when compared to participants in the
treatment group. The dependent variable is the total of number of questions correct. The subscript a represents zero because the parameter is redundant and subscript b indicates the maximum likelihood estimate.

Table 18

<table>
<thead>
<tr>
<th>Literary Question Comparisons Point Gain Pre-/Post-Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
</tr>
<tr>
<td>(Intercept)</td>
</tr>
<tr>
<td>Control</td>
</tr>
<tr>
<td>Treatment</td>
</tr>
<tr>
<td>(Scale)</td>
</tr>
</tbody>
</table>

**Summary of Results**

Although the treatment and control group did not differ significantly in demographic data, the number of participants in the treatment group outnumbered the participants in the control group. Participants from both groups had an overall increase between the pre- and post-Florida Ready Reading assessment. An analysis of both groups revealed participants from the control group outperformed the treatment group on the postassessment when adjusting for preassessment scores. Overall, both groups experienced increased scores on the FRR and FCAT assessment. Participants from the control group outperformed the treatment group on the FCAT assessment.
CHAPTER V

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

This chapter presents the conclusions relevant to reading achievement as measured by the Florida Reading Ready Assessment (FRR), the Florida Comprehensive Assessment Test (FCAT), and the impact of the inclusion of physical activity, in the form of Exergames, on overall reading achievement among sixth-grade students. The chapter begins with a restatement of the research questions followed by a presentation of data results, discussion, implications for practice, and recommendations.

Purpose of the Study

The available instructional methods for reading teachers neglect to consider research that shows the positive effect of brain stimulation, brought about by physical activity inducing technology, on reading achievement. Regular participation in physical activity, through the use of video games, may produce a positive impact on the developmental outcomes of students, ranging from improved cognition to physical health (Best, 2010; Russell & Newton, 2008). In efforts to improve reading achievement among struggling readers, the need for a research study that determines the connection between physical activity and reading instruction may provide evidence for a more effective reading intervention for struggling readers. Thus, the purpose of the study was to investigate the effects of physical activity through the use of Exergames on reading achievement of middle school students.
Summary of Results

The results addressed the following research questions:

1. Does integrating physical activity into the reading curriculum improve overall reading achievement, as comprised of vocabulary, informational text, and literary analysis?

2. Does integrating physical activity into the reading curriculum improve reading achievement as it pertains to levels of complexity? (Note: The available data does not address this research question)

3. Does integrating physical activity into the reading curriculum improve reading achievement as it pertains to type of text?

In order to address these research questions, participants in the treatment group completed a 6-week intervention, which incorporated physical activity in the reading curriculum, through the use of Exergames under the supervision of a reading specialist and physical education educator. After completing the intervention, participants completed a classroom postassessment followed by the state assessment. The data were collected and then coded using the Statistical Package for the Social Sciences (SPSS). Coded data from the treatment group was compared to coded data collected from a control group.

Conclusions related to research question 1. The data from a covariance analysis indicated that irrespective of group, participants experienced an overall increase of approximately seven points between the pre- and postassessment scores on the FRR. Final scores from the FRR indicated the control group performed significantly better than
the treatment group on the postassessment. Due to limitations of this study, such as sample size and time period, the data analyzed in research question 1 does not provide the researcher with ample evidence to conclude the impact of physical activity on classroom reading assessments administered as an intervention for struggling adolescent readers.

Before treatment began, all participants were assigned to intensive reading classes because of state-mandated test scores from the previous year. In 2012, each participant's final state reading score resulted in a level 1 on the FCAT. Final scores from the 2013 FCAT indicated that the control group performed significantly better than the treatment group on the postassessment. A covariance analysis of both the treatment and the control group showed participants in the treatment group increased approximately 11 points on the 2013 FCAT. Participants in the control group increased approximately 12 points on the 2013 FCAT. Due to limitations of this study, such as sample size and time period, the data analyzed in research question 1 does not provide the researcher with sufficient information to determine the impact of physical activity on the Florida state administered reading assessment, as an intervention for struggling adolescent readers.

**Conclusions related to research question 2.** Although the FRR and FCAT included questions of varied cognitive complexity in four reporting categories—vocabulary, reading application, literary analysis of fiction and nonfiction, and informational text—there is no accessible FRR and FCAT data as it pertains to levels of cognitive complexity by questions. The complexity levels include low, moderate, and high complexity. When answering test questions with varying text complexities, the items may range from low complexity, which may require students to complete one step
in order to answer the question correctly, to high level complexity questions, which require students to analyze and synthesize information (FLDOE, 2012a). This research question cannot be answered.

Conclusions related to research question 3. Informational text and literary analysis questions comprised over half of the FRR assessment with a total of 24 questions, 13 questions for informational text and 11 literary analysis questions (Florida Center for Reading Research [FCRR], 2007). After completion of the 6-week intervention, a covariance analysis indicated irrespective of group, all participants experienced an overall increase of approximately 1 point between the pre- and postassessment scores when responding to literary analysis questions.

After a data analysis irrespective of group, participants experienced an overall decrease between the pre- and post-FRR assessment when responding to informational text questions. Upon completion of the 6-week intervention, the control group outperformed the treatment group when responding to informational text questions. Due to limitations of this study such as sample size and time period, the data analyzed in research question 3 does not provide the researcher with sufficient information to conclude that the impact of physical activity on classroom and state administered assessments is an effective intervention for struggling adolescent readers.

Discussion of Results

The data presented in research questions 1 and 2 do not show the need to reduce or increase academic time as a means to improve reading achievement among struggling readers in sixth grade. Under Florida Statute §1003.455 (2010), when students perform
significantly below the state reading proficiency level, they are enrolled in mandatory remedial reading courses and automatically lose access to required physical education classes.

**Treatment group.** Data results for research question 1 from participants in the treatment group revealed after the completion of the 6-week intervention, participants outperformed their preassessment score and an increased in their overall reading achievement on the FCAT. Previous research demonstrates that students enrolled in physical education programs during the school day not only exhibit both excellent fine motor skills and fitness levels, but also perform better academically, in addition to showing signs of a better attitude towards school (Jensen, 2005).

**Control group.** As with the treatment group, results for research question 1 from participants in the control group revealed that those who did not participate in the physical activity intervention experienced an increase in their overall reading achievement. Such results show the need for additional data collection and comparison between the treatment and the control group. To determine if an increase in reading achievement results from the implementation of Exergames as an intervention for struggling readers, additional data collection is required.

**Comparison of results.** Data results compared between the treatment group and the control group indicated more research is needed to determine the impact of physical activity as a reading intervention for struggling readers. In most cases, results demonstrated both groups outperformed their preassessment scores. Additionally, results indicated the control group outperformed the treatment group.
Discussion of research question 2. Results for research question 2 were not available for research. Without accessible data regarding the cognitive text complexity by question, the researcher is unable to measure the impact of physical activity through the use of Exergames by question. The categories include low, moderate, and high complexity, ranging from students completing one-step, multiple steps, and eventually requiring participants to answer questions by analyzing and synthesizing information from a passage (FLDOE, 2012a).

Discussion of research question 3. Results from research question 3 demonstrated when working with struggling adolescent readers responding to literary text questions, including physical activity as part of an integrated reading curriculum did not hinder reading achievement. Including physical activity did not impede the student’s ability to learn through the reduction of instructional time. Almost every school requires students to take some form of physical activity before graduating from high school; however, due to high-stakes testing, many schools do not provide time during the school day for instruction involving physical education (McMurrer, 2008). The use of physical activity encourages students to become actively involved in the learning process, which leads to an increased understanding of academic material (Cone et al., 1998; Russell & Newton, 2008). Participants in the treatment group outperformed their preassessment scores. Additionally, participants from the control group outperformed both their preassessment scores and the scores of participants from the treatment group. More research is required to determine the impact of physical activity when analyzing the impact of physical activity on literary text questions. For example, future research should
include more quantitative research questions, which record the frequency between physical activity and literary text questions during the intervention.

Results from research question 3 demonstrated when working with struggling adolescent readers responding to informational text questions, including physical activity as part of an integrated reading curriculum did not support an increase in academic achievement. Participants in the treatment group did not outperform their preassessment scores. Additionally, participants from the control group did not outperform their preassessment scores. More research is required to determine the impact of physical activity when analyzing the impact of informational text questions.

**Implications for Practice**

Research from this study and future studies may be used to more effectively communicate with different stakeholders within and across organizational boundaries. As noted by Jensen (2005), evidence of the relationship between reading achievement and the use of physical activity as an effective instructional strategy has been established by other researchers (p. 63). This dissertation will help scholars and researchers in the field of educational technology, reading instruction, and physical education impact educational practices and policies at the state and local levels. Such research can aid in the development of sophisticated cross-curriculum models that include physical activity, Exergames, and reading instruction. Developing reading intervention curriculums that include Exergames may motivate struggling readers to read outside of the regular school day. For example, students participating in Exergames during the school day may seek additional gaming information in an attempt to outperform their peers. This may include
Internet searches and seeking informational support from the game manual. Students identified as struggling readers are placed in remedial reading classes, which can decrease their motivation to learn (Donaldson & Halsey, 2007).

An increase in student motivation provides struggling students with opportunities to perform at the optimal learning levels (Allington, 2009; Marchand-Martella et al., 2013). The implementation and regulation of effective physical education practices may contribute to an increase in reading achievement among students not experiencing success in a traditional reading setting. By enhancing academic instruction through physical activity, which motivates and captures student's interest, practitioners will increase student achievement (Cone et al., 1998). With the expertise of a physical education teacher and a reading specialist, Exergames can be combined with the reading curriculum to increase reading achievement at the middle school level.

Limitations

This research has several limitations that impact the generalizability of the findings to students of other grade levels, ages, or types of reading intervention classes. Only students between the ages of 11 and 13, from two level-1 intensive reading classes participated in this study. Along with the small sample size, all data was collected by the researcher during a 6-week period, an insufficient duration for the researcher to determine whether the effect of physical activity on reading achievement would last over time. Many physical activity interventions range from 6 months to an entire year. Additionally, the researcher’s role as the lead teacher during the study may significantly underestimate the level of teacher motivation and preparation time outside of the regular
school needed for a reading intervention to be successful that includes Exergames. The knowledge of the researcher as a reading specialist with multiple degrees and certifications in reading may exceed the knowledge of a reading teacher.

Along with the possibility of this subjectivity, this research contained no additional data such as participants' perceptions and satisfaction with the implemented intervention. The data did not include parental perceptions and satisfaction with the implemented intervention. The research study did not include the educational goals for the ESE and ELL students. The research did not determine if participants with specific educational goals met or exceeded their reading ability. In addition, during reading instruction, the researcher did not collect or document data on the instructional strategies used during reading instruction.

Recommendations for Future Research

There are several suggestions for further research that can be generated from the results of this study. A similar study could seek to identify the impact of physical activity on reading achievement through the comparison of Exergames and traditional methods of physical activity. The use of physical activity encourages students to become actively involved in the learning process, which leads to an increased understanding of academic material (Cone et al., 1998; Russell & Newton, 2008). A study focusing on a comparison between Exergames and traditional methods of physical activity would allow for a deeper understanding of the most effective methods when infusing physical activity into a reading curriculum. Different from traditional methods of physical activity and exercise,
Exergames provide immediate enjoyment and motivational incentives for users (Russell & Newton, 2008).

For example, the control group would receive an intervention that includes a more traditional approach to physical activity and the treatment group would receive physical activity through the use of Exergames. Some researchers suggest that Exergames may not provide participants with the same cognitive benefits as traditional physical activity (O’Leary et al., 2011). There is limited research on the use of interactive video games in physical education (Trout & Christie, 2007). Such an approach would allow the researcher to account for specific variables that may impact a study focusing on physical activity through the use of Exergames. These variables include time of day, teacher quality, instructional practices, and pedagogical knowledge.

While teacher quality and pedagogical knowledge were not related confounders to this study, other research has noted the impact of both variables on student learning. Effective reading teachers have extensive subject area knowledge, supported by effective teaching strategies that provide quality instruction, which improves achievement among all students, including struggling readers (Allington, 2009; Helf & Cooke, 2011). In addition, monitoring for the implementation of effective reading strategies would allow the researcher to gain specific insight into the overall impact of physical activity through the use of Exergames when paired with reading instruction.

Attempts were made in this dissertation to add a deeper understanding to the necessary levels of physical activity which must be exerted by adolescents, in order to impact reading achievement. The relationship between an individual’s heart rate and
oxygen consumption supports the validity of using heart rate monitoring tools when assessing physical activity in the school setting (Chaddock et al., 2011; Hussey et al., 2007; Janz et al., 1992; Lee & Gorelick, 2011). Increasing the flow of oxygen to the brain supports the various functions of the brain and the brain’s ability to learn new information (Jensen, 2005). In the past studies, researchers used heart rate monitoring to determine intensity levels of physical activity in children (Hussey et al., 2007). During this study, the researcher used heart rate monitors to determine the intensity levels exerted during physical activity, but data could be improved by monitoring the participants’ heart rate throughout the entire school day, in addition to each physical activity session. The use of accelerometers would provide a more direct approach to assessing physical activity during the school day. In addition, the monitoring period must extend beyond the 6-week period used for this dissertation.

During this dissertation, the researcher was unable to monitor the overall impact physical activity has on a student’s life. Another approach for future studies regarding physical activity may include the use of more specific research questions that address physical activity conditions both during and after the school day. For example, new research questions should address the possible increase and decrease of physical activity among students after beginning a physical activity intervention.

Students in middle school and beyond must be prepared to comprehend a variety of genres and different text complexity levels when they enter new grade levels (Marchand-Martella et al., 2013). Another potential for extending research similar to the study conducted in this dissertation includes using a pre- and postassessment which
provides accessible data for measuring the varying cognitive complexity levels of each question. This could be used to further explore the relationship between physical activity through the use of Exergames and reading achievement among struggling adolescent readers. By including effective physical activity, participating students experience an improved academic performance, physical health, and self-esteem (Russell & Newton, 2008).

**Summary**

Research focusing on new methods to help struggling adolescent readers will help policy makers support more nontraditional instructional methods. There is no clear evidence supporting the need for more academic time and less physical activity as a solution for improving academic achievement (Coe et al., 2006). Increasing physical activity is a way to increase the blood flow of oxygen to the brain. Physical activity can increase learning and enhance motivation (Jensen, 2005). When educators create an engaging and motivating learning environment, teachers are able to provide students with quality instruction while using effective instructional methods (Marchand-Martella et al., 2013; You, 2011). One method that not only motivates, but captures students' interest is to enhance instruction by incorporating physical activity; including physical activity may cause an increase in student achievement (Cone et al., 1998).

Far too little attention focuses on the connection between physical activity through Exergames and reading achievement. There is limited research on the required levels of intensity for physical activity through the use of Exergames necessary to impact reading achievement in adolescent readers, and, as such, this is an area worthy of
investigation. The goal of this study was to extend the accessible research regarding regular participation in physical activity through the use of Exergames to explore a unique approach to reading instruction provided to struggling adolescent readers. The results from the accessible data suggest that each research question was met with success. Practitioners can use these results to not only compare current instructional methods, but also as a way to encourage success among struggling adolescent readers through the use of physical activity which includes the use of Exergames.
REFERENCES


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APPENDICES
Appendix A

ELL Levels

**Literacy Level 1** represents little to limited ability to read and write in any language.

**Literacy Level 2** represents limited to extensive ability to read and write in at least one language at the Beginning oral proficiency level.

**Literacy Level 3** represents an extensive ability to read and write in English.

**Literacy Level 4** represents a reading and writing level in English that meets the appropriate grade-level student progression requirements for all pupils.

Each student's ELL Plan addresses their program eligibility, instructional setting, instructional focus and adequate progress. Teachers must fill out the ELL Plan for each of their active ELL students upon entry to the ESOL program, with a mid-year review, and continue this every year after as long as the student is in the ESOL program. This plan is signed and dated by the student's English/Language Arts teacher twice yearly (prior to the October and February FTE surveys). The teacher checks off the ELL students' program strand (sheltered or support) and checks the box that appropriately identifies the oral/literacy level as defined in the ELDC. The appropriate strategies and instructional settings will be provided for students based on their oral/literacy level on the ELL Plan.

12a) What procedures are used to ensure that the Student ELL Plans are updated to reflect a student's current services? List the title of the person responsible and provide link to the Student ELL Plan form, as appropriate.

To ensure the ELL plan dates are updated, data checks are performed by school-based ESOL coordinators/contacts, area ESOL resource teachers, district ESOL coordinators and the ESOL compliance specialist. Reports are generated for each school and reviewed for current ELL plan dates twice yearly (prior to FTE).

http://www.palmbeach.k12.fl.us/Records/PDF/1649.pdf

13) Parent Notification

Indicate the process that has been implemented to notify parents/guardians of the placement of the ELL in the ESOL program.

☐ Standard letter used by all schools in a language the parents/guardians understand, unless clearly not feasible.

(http://www.palmbeach.k12.fl.us/Records/PDF/1511.pdf)

☐ Individual communication in a language the parents/guardians understand, unless clearly not feasible.

☐ Other (Specify)

13a) List the languages used in the Parent Notification Letters (check all that apply):

☐ English

☐ Spanish

☐ French

☐ Haitian Creole

☐ Portuguese

☐ Vietnamese

☐ Other (Specify)
Appendix B

FCAT Achievement Levels

Achievement Levels
Achievement Levels describe the success a student has achieved with the content assessed. Achievement Levels range from 1 to 5, with Level 1 being the lowest and Level 5 being the highest. To be considered on grade level, students must achieve Level 3 or higher. Level 3 indicates satisfactory performance.

The following Achievement Level Policy Definitions apply to FCAT 2.0 Reading and Mathematics:

Level 5 Students at this level demonstrate mastery of the most challenging content of the Next Generation Sunshine State Standards.

Level 4 Students at this level demonstrate an above satisfactory level of success with the challenging content of the Next Generation Sunshine State Standards.

Level 3 Students at this level demonstrate a satisfactory level of success with the challenging content of the Next Generation Sunshine State Standards.

Level 2 Students at this level demonstrate a below satisfactory level of success with the challenging content of the Next Generation Sunshine State Standards.

Level 1 Students at this level demonstrate an inadequate level of success with the challenging content of the Next Generation Sunshine State Standards.

Tables 1 and 2 list the Achievement Levels for FCAT 2.0 Reading and Mathematics Developmental Scale Scores (DSS), by grade level.

Table 1: Achievement Levels for the FCAT 2.0 Reading Developmental Scale Scores (140 to 302)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
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<td>140-181</td>
<td>182-197</td>
<td>198-209</td>
<td>210-226</td>
<td>227-269</td>
</tr>
<tr>
<td>4</td>
<td>152-191</td>
<td>192-207</td>
<td>208-220</td>
<td>221-237</td>
<td>238-269</td>
</tr>
<tr>
<td>5</td>
<td>162-199</td>
<td>200-215</td>
<td>216-229</td>
<td>230-245</td>
<td>246-277</td>
</tr>
<tr>
<td>6</td>
<td>167-206</td>
<td>207-221</td>
<td>222-236</td>
<td>237-251</td>
<td>252-283</td>
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<tr>
<td>7</td>
<td>171-212</td>
<td>213-227</td>
<td>228-242</td>
<td>243-257</td>
<td>258-289</td>
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<tr>
<td>8</td>
<td>175-217</td>
<td>218-234</td>
<td>235-248</td>
<td>249-263</td>
<td>264-296</td>
</tr>
<tr>
<td>9</td>
<td>176-221</td>
<td>222-239</td>
<td>240-252</td>
<td>253-267</td>
<td>268-302</td>
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<tr>
<td>10</td>
<td>188-227</td>
<td>228-244</td>
<td>245-255</td>
<td>256-270</td>
<td>271-302</td>
</tr>
</tbody>
</table>

Table 2: Achievement Levels for the FCAT 2.0 Mathematics Developmental Scale Scores (140 to 298)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
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<td>183-197</td>
<td>198-213</td>
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<td>229-260</td>
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<td>4</td>
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<td>197-209</td>
<td>210-223</td>
<td>222-239</td>
<td>240-271</td>
</tr>
<tr>
<td>5</td>
<td>163-204</td>
<td>205-219</td>
<td>220-233</td>
<td>234-246</td>
<td>247-279</td>
</tr>
<tr>
<td>6</td>
<td>170-212</td>
<td>213-226</td>
<td>227-239</td>
<td>240-252</td>
<td>253-284</td>
</tr>
<tr>
<td>8</td>
<td>187-228</td>
<td>229-240</td>
<td>241-255</td>
<td>256-267</td>
<td>268-298</td>
</tr>
</tbody>
</table>
Appendix C
Permission To Use Florida Ready Post Test

The School District of Palm Beach County Mail - RE: Customer's comments
Page 1 of 2

Christina Phillips

RE: Customer's comments
2 messages

Tue, Mar 12, 2013 at 12:01 PM

To: [Redacted]
Cc: [Redacted]

Dear Ms. Phillips,
Thank you so much for your interest in Florida Ready. You do have our permission to use the Post Test in your experiment and in your findings.

Your experiment sounds very interesting—we’d love to get a copy of your results once they’re available.

Best,
Daniele

Daniele Buczek | Product Marketing Director, Ready, Reading and Math
Curriculum Associates

>-----Original Message-----
>From: Web Comments [mailto:]
>Sent: Monday, March 11, 2013 8:35 AM
>To: Ariene Zousoumas; Victoria O'Leary
>Cc: Sandy Batista
>Subject: Customer's comments
>
>First Name: Christina
>Last Name: Phillips
>Job Title: Specialist, Remedial Reading
>School:
>Address:
>City:
>State: FL
>Zip:
>Country: US
>Email: [Redacted]
>Phone:
>Comments about: Other
>Product name:
>Comments: As a Reading Specialist, I am very impressed with your product.
>This is the best product going as it relates to commercial products for
>6th grade FCAT 2.0. Subsequently, I am asking your permission to use
>your 6th grade Posttest for a little 'experiment' I am using at Middle School.
>We are infusing a reading curriculum with physical education, due to
>the quality of your pre and posttest, I would like to use your Posttest
>as part of the experiment.
>The test will not be altered in any form and Curriculum Associates will

https://mail.google.com/mail/u/0/?ui=2&ik=u013bb2484&view=pt&q=florida%20reading%... 8/5/2013
Appendix D
Florida Ready Post Test

Read the magazine article "Swarm Intelligence" before answering Numbers 1 through 9.

Look up the word intelligence in the dictionary. You'll see that it means "able to learn and apply what is learned to other information." Humans are intelligent. They can learn, and they can use what they learn to make the world a better place. We may not all be geniuses like Thomas Jefferson or Leonardo da Vinci. Our accomplishments may not improve the world in some dramatic way. However, we do try to use our heads. And for the most part, we are successful.

Are other creatures intelligent? Many people think their pets are intelligent because they can obey commands and learn tricks. For instance, some pets help people who have physical problems—such as the loss of sight or the use of a limb—to live full, active lives. Other pets have been called heroes for saving their owners from fires and other dangerous situations. Surely, these animals display some level of intelligence.

Is it possible that creatures even as small as ants and termites also have intelligence? If you are about to answer "absolutely not," it might be because you don't have all the facts.

Now, no one is saying that ants or termites have brains like you and I have, or that there is an Einstein living in an anthill in your backyard. However, scientists do believe that social insects that live in groups demonstrate a kind of swarm intelligence.
According to scientists, swarm intelligence is the group behavior that is displayed by individuals responding to what is happening around them without being shown what to do. For example, imagine that a group of ants needs to get from a dangling leaf to a tree branch. All the ants will pitch in to form a bridge so that the ants can get to the branch. The individual ants aren't thinking, "This is what I have to do, so I'll do it." There isn't a boss giving them orders or showing them what to do. But they all understand what the goal is. Then they work together to achieve that goal for the good of the whole group.

Termites also demonstrate swarm intelligence. Termites, which look like ants and are sometimes called "white ants," live in colonies. They eat wood and other plant fibers.

Termites that live in tropical environments build mounds, or towers, that can reach 15 feet high. These mounds are complex structures. They have compartments for food, housing, and safety from other creatures. There is no head termite showing the individual termites what to do or how to construct the towers. Like the ants, they just seem to know what to do.

Other animals also exhibit swarm intelligence. These include naked mole rats and pistol shrimp. Such creatures live in a society. They work together as a group to preserve and protect their societies.

Today, researchers have developed ways to apply the theory of swarm intelligence to computer science, medicine, and other fields. To improve their delivery routes, some businesses have studied how ants hunt for food. One company has improved the way airplanes arrive and depart, based on ant behavior. The swarm-intelligence theory has even helped communication, by making telephone calls go faster on networks. So, although ants and termites don't have anything to learn from humans, it seems that humans are intelligent enough to know there is a lot to learn from them.
Now answer Numbers 1 through 9 on your Answer Form on page 163. Base your answers on the magazine article "Swarm Intelligence."

1. The author used the title "Swarm Intelligence" because
   A. a nest of termites is smarter than one human being.
   B. a swarm of bees is the most intelligent kind of insect.
   C. people who live and work alone tend to be very intelligent.
   D. insects that live in groups work together without being shown what to do.

2. Based on information in the article, which of the following statements about swarm intelligence is most accurate?
   F. Termites are smarter than ants.
   G. Only humans display swarm intelligence.
   H. Bees that live in a hive lack swarm intelligence.
   I. Swarms of ants accomplish tasks by doing things together.

3. The information in the article would be most useful for a student's science project about
   A. ants in an ant colony.
   B. the life span of a termite.
   C. pets that have saved people’s lives.
   D. the farming accomplishments of Thomas Jefferson.

4. Which of these is a result of swarm intelligence?
   E. a fox den
   G. a bee hive
   H. a bird nest
   L. a dog house

5. With which statement would the author of the article most likely agree?
   A. Scientists do not believe in swarm intelligence.
   B. Humans in crowded cities live like ants and termites.
   C. Different types of animals exhibit swarm intelligence.
   D. Humans have nothing to learn from studying ants and termites.
The author's main reason for writing "Swarm Intelligence" was

E. to explain which creatures live in groups.
G. to inform readers about swarm intelligence.
H. to entertain readers with stories about swarms.
I. to persuade readers to study the intelligence of ants and termites.

Read this sentence from the article.

Our accomplishments may not improve the world in some dramatic way.

The phrase in some dramatic way is most similar in meaning to the phrase

A. in a way that stands out.
B. in a way that is very unusual.
C. in a way that will be forgotten.
D. in a way that is similar to a play.

How does the author organize the information in this article?

F. She provides examples of animals that exhibit swarm intelligence.
G. She places the names of animals that exhibit swarm intelligence in lists.
H. She explains how the behavior of ants and termites is different from other animals.
I. She arranges details about animals that exhibit swarm intelligence in order of importance.

According to the article, studying swarm intelligence could possibly help humans

A. create faster airplanes.
B. build stronger bridges.
C. find better delivery routes.
D. overcome physical problems.
Read the story “Everybody Has a Secret” before answering Numbers 10 through 18.

Everybody Has a Secret

by Evelyn Woolf

Nathan opened his mouth to take the first bite of his tuna-and-avocado sandwich, made with homemade rye bread he had baked himself.

“So what's your secret?” Ali asked abruptly.

“What?” Nathan asked as his sandwich remained suspended in front of him like a balloon.

“Don't mind her,” Mike said, “she's completely harmless, as long as you cooperate with her fully and pass the lie detector test.”

Ignoring Mike's sarcasm, Ali persisted. Once again, she asked Nathan, “What's your secret?”

Reluctantly, Nathan put his sandwich down on the cafeteria table beside his carton of milk. “I don't have a secret,” he said somewhat defensively, “and if I did, why would I tell someone I had just met?”

Gina chuckled. “You may want to rethink hanging out with the three of us then,” she said. “There are lots of great kids at our school, but none of them is as weird as Ali.”

Nathan smiled, picked up his sandwich from the table, and lifted it toward his mouth. Without skipping a beat, Ali gave Nathan a better explanation. “I'm not talking about the kind of secrets you tell our inner selves. People in confidence and then make them swear not to tell,” she said. “I'm talking about the secrets of our inner selves.”

Gina was right, Nathan thought, Ali is weird. But he put his sandwich down again without taking a bite. His stomach growled, his head ached, and his sandwich was getting stale. Nathan glanced at the huge clock on the wall. At this rate, it looked as if he'd be going back to class hungry, so he might as well figure out what she was talking about. Then he might have time to bolt down his lunch before math class.

“Okay, I give in,” he said, surrendering to Ali's demand.

Gina and Mike rolled their eyes, but Ali was clearly delighted. “See,” she said, “it's like this. We're all something on the outside—good student, basketball player, band member—but we're also something on the inside, which we don't show to people. Our secret may be something we want to be when we grow up or some goal we'd like to achieve. Sometimes we are aware of our secret; however, sometimes we aren't. Want to know what Mike's secret is?”

Mike interrupted Ali. “Nathan, you should know that Ali has driven us all a little nuts with this wacky theory of hers. Initially, I was skeptical and only humored her so she'd leave me alone—but it turns out she was right after all.”

Nathan was intrigued. “So tell me Mike's secret,” he said.

“Mike wants to create sound effects for movies and television,” Ali said. “Want to know how we unearthed his secret?”

“Sure,” Nathan said curiously.

“Well, whenever we were watching TV and a commercial would come on, he'd turn down the sound and then make his own sound effects to go with the commercial. He can produce all kinds of realistic noises by using his voice or just about any common object found around the house, including garbage cans, books, bottles, and rocks.”

1 sarcasm: a witty saying or sayings that often include irony
Nathan smiled politely. "Interesting story," he said firmly. "But with me, what you see is what you get."

"Uh, oh!" Mike said.

"You've just thrown down a challenge," Gina said gleefully. "She'll hound you until she figures out your secret, so you'd better make one up or face the consequences."

Ali made a face at her friends and said confidently, "I would know if his secret were made up. Nathan may think he doesn't have a secret, but he does, and I'm going to help him figure it out."

After eating lunch at the same table with Nathan for a few weeks, Ali figured out his secret. By then, Ali, Nathan, and the others had all become good friends.

On Tuesday, Ali, Mike, Gina, and Nathan were in the cafeteria when Ali announced that she knew Nathan's secret. Before she said anything out loud, though, she slipped Nathan a piece of paper. When he read what Ali had written on it, he nodded and started to laugh.

"You can tell them," he said enthusiastically.

"Have any of you noticed what Nathan brings for lunch? He never has just a plain old sandwich," she said. "It has been my observation that he usually brings sandwiches with fresh herbs and exotic cheeses or green salads sprinkled with slivered nuts and dried cranberries. And did you know that he fixes his own lunch every day, unlike the rest of us who rely on our family members to make our lunch? Oh, and how about all of those cooking programs that he watches on television? By carefully observing what Nathan does and by listening to what he talks about, I figured out that Nathan's secret is his passion for food."

Nathan shrugged hesitantly. "I do love experimenting with different combinations of foods," he said. "Sometimes the results are strange, but it's fun. Who knows? Maybe I'll be a chef, a restaurant owner, or a food critic some day."

Suddenly Ali became distracted by Tanya, the new student, who was walking by with a pair of binoculars dangling from her backpack. "Oh, I wonder what her secret is ...," Ali said thoughtfully. Waving her hand to get Tanya's attention, Ali invited Tanya to sit at their table.

Looking at each other knowingly, Gina, Mike, and Nathan said, "Here we go again!"
Now answer Numbers 10 through 18 on your Answer Form on page 165. Base your answers on the story "Everybody Has a Secret."

10 Read this excerpt from the story.

Reluctantly, Nathan put his sandwich down on the cafeteria table beside his carton of milk. "I don't have a secret," he said somewhat defensively, "and if I did, why would I tell someone I had just met?"

What does this excerpt NOT reveal?

F. the setting
G. the conflict
H. Gina's personality
I. Nathan's personality

11 What does Ali believe is true of all people?

A. They can't keep a secret.
B. They want to hide their true selves from others.
C. They aren't always aware of what they want in life.
D. They are afraid to share their inner feelings with friends.

12 Based on information in the passage, the illustration on page 142 shows

F. Ali explaining her question to Nathan.
G. Mike telling the others what his secret is.
H. Gina getting upset with Ali for asking Nathan her question.
I. Nathan explaining how he made his sandwich that morning.

13 How does Nathan's opinion of Ali change from the beginning of the story to the end of the story?

A. First, Nathan thinks Ali is silly, but then he thinks she is brilliant.
B. First, Nathan thinks Ali is rude, but then he thinks she is annoying.
C. First, Nathan thinks Ali is unkind, but then he thinks she is friendly.
D. First, Nathan thinks Ali is odd, but then he thinks she makes good sense.
Read this excerpt from the story.

Ignoring Mike's sarcasm, Ali persisted. Once again, she asked Nathan, "What's your secret?"

The word persisted in the excerpt above means

F. argued.
G. resisted.
H. stopped.
I. continued.

Based on story events and what you know about Ali, what do you think will happen after the story ends?

A. Ali will tell Nathan her inner secret.
B. Ali will ask Tanya what her secret is.
C. Ali will ask Nathan to fix her lunch from now on.
D. Ali will come up with a whole new theory about people.

Read this sentence from the story.

"What?" Nathan asked as his sandwich remained suspended in front of him like a balloon.

The author compares Nathan's sandwich to a balloon to show that the sandwich

E. is round.
G. is very light.
H. stays up in the air.
I. has a string attached to it.

How does Ali discover Nathan's secret?

A. She observes Nathan carefully.
B. She tricks Nathan into telling her.
C. She has Nathan take a lie detector test.
D. She asks Nathan to write it on a piece of paper.

Read this sentence from the story.

"She'll hound you until she figures out your secret, so you'd better make one up or face the consequences."

Which sentence below uses hound in the same way as in the sentence above?

F. Our dog Bluebell is a basset hound.
G. Jim is a rock hound who explores caves.
H. That news hound always lands a big story.
I. Will's parents always hound him to clean his room.

Post Test
Humans take so many important things for granted. For example, how often do most of us think about the air that surrounds us? Just because we can’t see it, touch it, smell it, taste it, or hear it, we tend to forget about it. However, without air and the oxygen that it provides, we wouldn’t be able to breathe.

Florida is known as “the Sunshine State.” Even so, the sun is another thing that we Floridians don’t always appreciate. When it’s cloudy or rainy, we miss its light. But when it’s there, shining high in the sky, day after day, are we truly grateful for its presence?

The sun is a fiery star and the center of our solar system. It is approximately 93 million miles from Earth. As it turns out, that’s just the right distance to support life on Earth. A few million miles closer or farther away, and we’d just be another lifeless planet, like Mercury or Neptune.

The sun is a major source of energy. This energy reaches Earth as light and heat. The sun’s energy powers the wind, ocean currents, and the water cycle (cloud formation, precipitation, and evaporation). Plants use the sun’s energy to grow and to release oxygen into the air, which we then breathe in. We also rely on these plants for food.

The sun’s rays help keep us warm. They also help the body produce vitamin D, which keeps bones strong and prevents cancers and other diseases. As a result, most doctors encourage people to get a sensible amount of sun every day. However, the sun’s heat can be blistering—literally—even though the sun is 93 million miles away. Too much exposure to the sun’s rays can result in serious sunburns as well as skin damage or even skin cancer.

Long ago, people were so awed by the power of the sun that they worshipped it as a god. They held ceremonies to honor the sun god and offered it gifts to keep it happy. We no longer worship the sun, but we should appreciate the sun for all that it provides.
A solar eclipse is an exciting event. During a solar eclipse, the moon passes directly between Earth and the sun. As the moon blocks the light from the sun, the moon casts its shadow over the surface of Earth, and the sky darkens briefly. On the parts of Earth where the moon completely blocks the light from the sun, this is called a total eclipse. On the parts of Earth where the moon only partly blocks the sun's light, it's called a partial eclipse.

If you want to view a solar eclipse, you must protect your eyes. You should never look at the sun directly with the naked eye. The sun's rays can severely damage your eyes. One way to safely observe a solar eclipse is by using a special viewer. Here are directions for making your own.

**What You Will Need**

- a large, empty cereal box
- a piece of white construction paper
- a small square piece of aluminum foil
- a pin
- glue or a glue stick
- a ruler
- a colored marker
- tape
- scissors
Steps

1. First, cut the construction paper to fit against the bottom of the cereal box. Then open the box and glue the slip of construction paper to the inside of the bottom of the box.

2. Close the box, using the tabs at the top. With a colored marker and ruler, draw a straight line across the closed flaps at one end of the box. Make the line about 1½ to 2 inches from the edge of the box.

3. Draw a second line across the top of the box at the opposite end. Also make this line about 1½ to 2 inches from the box's edge.

4. Now open the box, and cut across the lines. Cut away the small pieces on the sides and ends of the box, leaving only the middle section with the box's tabs.

5. Next, use the tabs to close the box again. There should be a small opening at either end of the box where you cut away part of the flaps.

6. Place the square piece of foil over either opening at one end of the box. Tape it firmly.

7. Use a pin to poke a tiny hole through the center of the foil.

8. Take your viewer outdoors on a sunny day. Stand with the sun behind you. Hold your viewer so that the sun is shining on the pinhole.

9. Finally, look through the uncovered “window” in the box. Move the box around until an image of the sun is projected onto the white paper at the bottom of the box. Now you can safely look at the sun during a solar eclipse!
Now answer Numbers 19 through 28 on your Answer Form on page 163. Base your answers on the editorial “Don’t Forget About the Sun” and the directions “How to Make an Eclipse Viewer.”

19 The author’s main reason for writing “Don’t Forget About the Sun” was most likely
A. to explain the causes and effects of global warming.
B. to convince readers to appreciate what the sun provides.
C. to tell readers an entertaining story about ancient sun worship.
D. to inform readers about the importance of protecting themselves from the sun.

20 According to “Don’t Forget About the Sun,” all of these are a result of the sun’s energy EXCEPT
E. heat.
F. wind.
G. oxygen.
H. ocean currents.

21 Based on information in “Don’t Forget About the Sun,” which is the most accurate statement about exposure to the sun?
A. People should worship the sun.
B. People should never expose their skin to direct sunlight.
C. People should spend as much time in the sun as possible each day.
D. People should spend a moderate amount of time in the sun each day.

22 The information in “Don’t Forget About the Sun” would best be used for making a presentation about
F. ceremonial sun dances.
G. planets in the solar system.
H. various uses of solar energy on Earth.
I. health problems caused by the sun’s rays.

23 The What You Will Need box is important to “How to Make an Eclipse Viewer” because it
A. shows how to operate the eclipse viewer.
B. identifies the steps for making an eclipse viewer.
C. shows how a completed eclipse viewer will look.
D. identifies the materials for making an eclipse viewer.
24. To help readers make the eclipse viewer, the author organizes the directions by using
   E. a chart with headings.
   G. a numbered list of steps.
   H. a series of paragraphs with topic sentences.
   I. a clear explanation of what a solar eclipse is.

25. According to Step 8, the eclipse viewer is best used
   A. at dusk or after dark.
   B. only on a cloudy day.
   C. outside when the sun is shining.
   D. indoors in a brightly lit classroom.

26. Read this excerpt from "How to Make an Eclipse Viewer."

   Move the box around until an image of the sun is projected onto the white paper at the
   bottom of the box. Now you can safely look at the sun during a solar eclipse!

What does the word projected mean in the excerpt above?
   F. burned
   G. arranged
   H. transmitted
   I. photographed

27. How is the information in "Don’t Forget About the Sun" and "How to Make an Eclipse Viewer" similar?
   A. Both give facts about solar eclipses.
   B. Both tell the distance of the sun from Earth.
   C. Both describe the uses of energy from the sun.
   D. Both warn about the harmful effects of the sun.

28. Both the editorial and the directions suggest that the sun
   F. produces too little energy.
   G. produces too much energy.
   H. sends powerful rays to Earth.
   I. is too far from Earth to provide power.
Read the poem "A Thunder-Storm" before answering Numbers 29 through 37.

**A Thunder-Storm**

by Emily Dickinson

The wind began to rock the grass
With threatening tunes and low,—
He flung a menace at the earth,
A menace at the sky.

The leaves unhooked themselves from trees
And started all abroad;
The dust did scoop itself like hands
And throw away the road.

The wagons quickened on the streets,
The thunder hurried slow;
The lightning showed a yellow beak,
And then a livid claw.

The birds put up the bars to nests,
The cattle fled to barns;
There came one drop of giant rain,
And then, as if the hands

That held the dams had parted hold,
The waters wrecked the sky,
But overlooked my father's house,
Just quartering a tree.
Now answer Numbers 29 through 37 on your Answer Form on page 163. Base your answers on the poem “A Thunder-Storm.”

29. Read this line from the first stanza of the poem.

The wind begun to rock the grass

Which sentence below uses rock in the same way as in the line above?

A. Waves rock the sailboats in the harbor.
B. The election results will rock the town.
C. Cindy’s favorite rock band is Mud Slide.
D. José moved a large rock off the bike path.

30. Read these lines from the third stanza of the poem.

The lightning showed a yellow beak,
And then a livid claw.

Emily Dickinson compares the storm’s lightning to a bird with a beak and a claw because the lightning

F. nests in the trees.
G. looks like a hawk.
H. flies across the sky.
I. makes a screeching sound.

31. Which line from the poem best conveys the overall tone of the poem?

A. “A menace at the sky”
B. “There came one drop of giant rain”
C. “But overlooked my father's house”
D. “The leaves unhooked themselves from trees”
32. Read lines 7 and 8 from the poem.

The dust did scoop itself like hands
And throw away the road.

Which sentence best explains what is happening in these lines?

A. The wind blew dust onto the road in huge handfuls.
B. The dust took a scoop and shoveled the road off to the side.
C. A powerful wind scooped up so much dust that the dirt road began to disappear.
D. Someone scooped up dust from the road and then tossed it into the wind so it flew around.

33. Based on details she included in the poem, with which statement would Emily Dickinson most likely agree?

A. Thunderstorms don’t create much damage.
B. Thunderstorms are unpredictable and powerful.
C. Thunderstorms have little effect on animal behavior.
D. There’s no way to predict when a thunderstorm is approaching.

34. Which of these lines from the poem best shows how the author gives the thunderstorm human characteristics?

A. “The cattle fled to barns”
B. “He flung a menace at the earth”
C. “There came one drop of giant rain”
D. “The wagons quickened on the streets”

35. Which pair of words from the poem is most similar in meaning?

A. flung, held
B. fled, parted
C. quickened, hurried
D. showed, overlooked

36. What happens as a result of the wind during the thunderstorm?

A. The leaves blow off the trees.
B. A tree is torn into four pieces.
C. Thunder rumbles in the distance.
D. The speaker’s father’s house is knocked down.

37. Read this excerpt from the poem.

The waters wrecked the sky,
But overlooked my father’s house,
Just quartering a tree.

What does the word overlooked mean in the excerpt above?

A. flooded
B. ignored
C. targeted
D. destroyed
Do you like to throw a burger on the grill, toss a salad, or bake a cake? If so, you might consider a career as a chef. A chef is someone who has learned how to prepare food and works in a professional kitchen. Many amateur cooks have turned their skills at home into a career.

What personality traits does a good chef have?

First of all, you should be creative, since chefs often invent their own recipes. Restaurant kitchens are hectic places, so you must be able to handle pressure and do more than one thing at a time. It's also useful to be good at making split-second decisions. Since customers sometimes have complaints, you must be able to accept criticism calmly. In addition, you should be flexible and adaptable. Whenever the seasons change, restaurants typically change their menus to offer different items. Also, some customers may have to avoid certain ingredients because they have food allergies or special diets. You should be willing to work hard. A chef does not work from nine to five. He or she works long hours, often on weekends and holidays. Lastly, a chef works with many different people every day, so it's essential for you to be "a people person."

There are different ways of training to become a chef. You can apprentice in a restaurant and learn on the job. You can also attend a special cooking school. There, most of your time will be spent practicing how to prepare food. However, you may also take courses in the use and care of kitchen equipment, menu planning, purchasing foods in quantity, food cost control, making use of leftovers, and public-health rules.

Jobs in the Kitchen

- A head chef is in charge of the kitchen but often does very little cooking.
- A sous chef assists the head chef with cooking. Sous means "under" in French.
- A line cook manages a particular area of production in the kitchen.
- A prep cook chops vegetables and assembles the entrées.
- A saucier makes sauces, stews, and sometimes pan fries food to order.
- A pantry chef prepares cold food, such as salads.
- A pastry chef makes desserts.

Once you have your training, the sky is the limit. Of course, you can work in the kitchen of a restaurant. But you might also get a job in a hospital or nursing home, a hotel, a diner, or even on a cruise ship. Some chefs work in schools, prisons, or other large institutions. Personal chefs, on the other hand, work just for an individual or a family.

Some well-known chefs have become very successful. They write their own cookbooks and sell their own food-related products in stores around the country. A few even have their own television programs. Who's your favorite celebrity chef? Maybe one day you will have a professional career like he or she does.
Now answer Numbers 38 through 46 on your Answer Form on page 163. Base your answers on the career profile “Becoming a Chef.”

38 Which statement is supported by details in “Becoming a Chef”?
   F. A good chef must have many different skills.
   G. A good chef must be focused completely on cooking.
   H. A good chef must have studied at a well-known cooking school.
   I. A good chef must have experience cooking in a variety of settings.

39 When the author states, “Once you have your training, the sky is the limit,” she means that
   A. a trained chef can also become a trained pilot.
   B. a chef can never go above the sky in an airplane.
   C. a chef’s training guarantees him or her a large salary.
   D. a professional chef will have many opportunities available.

40 Based on information in the Jobs in the Kitchen box, someone who likes to create new pie and cake recipes would most likely enjoy a career as a
   F. saucier.
   G. sous chef.
   H. pastry chef.
   I. pantry chef.

41 The Jobs in the Kitchen box is an important feature of the career profile because it
   A. tells the reader where to apply for training.
   B. tells the reader how to get a job after training.
   C. tells the reader what skills a chef should have.
   D. tells the reader what jobs different chefs perform.

42 Which pair of words from this career profile are most opposite in meaning?
   F. flexible, adaptable
   G. training, apprentice
   H. employment, career
   I. amateur, professional
43. What is most likely the author's purpose for writing this article?
   A. to urge readers to become professional chefs
   B. to explain why some chefs become very successful
   C. to inform readers what it's like to have a career as a chef
   D. to share an entertaining story about chefs working in a restaurant

44. A professional chef who works in a restaurant should be
   F. famous.
   G. a published author.
   H. a graduate of a cooking school.
   I. capable of making quick decisions.

45. What does a saucier in a restaurant kitchen do?
   A. makes salads
   B. makes pizzas
   C. makes sauces
   D. makes desserts

46. The information in this profile would be best used for a student's report on
   F. restaurant management.
   G. successful diet programs.
   H. careers in the food-service industry.
   I. cooking schools in the United States.
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down its length. Her eyes danced as she crowed, "I think you've found one!"

Mikey asked, "What kind of rock is it?"

With barely-contained excitement, Holly announced, "It's not a rock, Mikey. It's a dinosaur bone!"

Realizing that the flood had probably released other dinosaur bones from the surrounding rock, too,

the friends started looking around. Before long, they'd discovered several more possible dinosaur bones.

"So, do we try to dig up the whole dinosaur ourselves?" Mikey asked.

Jamie answered, "No, this is a job for an expert. Holly, since you want to study dinosaur fossils when you grow up, do you know of any good paleontologists?"

Holly did. Before they left, Jamie marked the spot with a flag, and Mikey used his cell phone to take pictures. Then they raced back to Holly's house, where she included the pictures from Mikey's phone in an e-mail to her aunt, a paleontologist at a local museum. While waiting for a reply, Holly conducted more research and created some dinosaur fact cards. Mikey and Jamie, meanwhile, fed lettuce to Holly's pet iguana, Igor.

About an hour after sending the e-mail, Holly heard from her Aunt Rose. "My team and I will arrive at your house around noon, and you and your friends can take us out to see those bones."

Shortly after noon, the crunch of tires on the gravel driveway announced the team's arrival. Aunt Rose and her team grabbed their gear and followed Jamie, Holly, and Mikey back to the dried creek. Aunt Rose alone went down the creek's bank. Step by careful step, she'd stop, look, and then snap pictures of what was there. Occasionally, she'd stick a numbered marker beside a rock as she photographed it. The group followed Aunt Rose as she traced the creek bed for about a half mile in each direction. When Aunt Rose finally climbed out of the creek bed, she immediately shook Jamie's hand.

"Congratulations, Jamie, on finding your first dinosaur!"
Everyone cheered and clapped Jamie on the back. Amid the noise and excitement, Holly approached her aunt and asked, “Do you know what kind of dinosaur we found, Aunt Rose?”

“I won’t know for sure until we dig out the bones and examine them more closely, but I did find some clues that are pointing toward one specific kind of dinosaur.”

Aunt Rose decided to see if her niece could figure out the answer from what she already knew, her own observations, and the clues Aunt Rose had discovered. Holly’s aunt pointed to the Y-shaped bone with the two knobs on top that Jamie had found and said, “Holly, you’ve seen this kind of bone before in my lab. Do you recall what it is? And what does it tell you about what this dinosaur might be?”

Holly didn’t hesitate and said, “It’s a hip bone, right?” Aunt Rose nodded in agreement, and Holly continued, “That Y shape at the top tells me that this hip bone belongs to a dinosaur with bird hips.”

Holly knew that paleontologists classify dinosaurs by their hip structure. Dinosaurs with lizard hips, like many reptiles today, have lower hip bones that point away from one another, but dinosaurs that have bird hips have both lower hip bones pointing toward the rear.

Aunt Rose clapped lightly for her bright student. The small group walked a bit farther before Aunt Rose crouched and pointed to a rock about three centimeters long. “This one should look very familiar to you.”

With her magnifying glass, Holly examined the rock, which sloped down to a blunt point at one end and had ridges. “It’s not a bone or a rock, is it?” Holly asked.

Disappointed, Jamie exclaimed, “I thought it was another dinosaur bone.”

Holly proudly stated her conclusion. “This is a dinosaur tooth. It is sloped and ridged so that this dinosaur could grind the plants it ate. This tooth is similar to the ones Igor has. If this dinosaur is the one I think it is,” Holly said, “I got its name because of its similarity to the iguana. Here, I’ll show you.”

Holly pulled a fact card from her vest pocket.

**Iguanodon**
- Lived during the Early Cretaceous period (about 119 to 75 million years ago)
- About 30 feet long
- Weighed 4 to 5 tons
- Plant eater
- Bird-hipped
- Walked on either two or four feet
- Named for its ridged teeth—similar to an iguana’s teeth

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Now answer Numbers 47 through 55 on your Answer Form on page 163. Base your answers on the story "Dinosaur Creek."

47 Read this excerpt from the story.

Loose rocks skittered down the slope as Jamie's two best friends, Holly and Mikey, followed him. After a while Mikey stopped to dump pebbles out of his shoes. While waiting, Jamie poked through the debris.

What does the word debris mean in the excerpt above?
A. trash
B. bones
C. underbrush
D. loose gravel

48 Aunt Rose does not tell Holly the likely name of the dinosaur because
F. she has no idea which dinosaur it might be.
G. she wants Holly to figure it out for herself.
H. she wants to keep the name of the dinosaur a secret.
I. she doesn't want to discuss the discovery in front of Holly's friends.

49 The word that best describes Holly's response to Jamie's discovery in the creek bed is
A. boastful.
B. annoyed.
C. confused.
D. informed.

50 The reader can conclude that the three friends in the story will
F. keep looking for fossils.
G. name the dinosaur Igor.
H. have an argument about their find.
I. receive no credit for their discovery.
Why is Holly's fact card important to the story?

A. It shows what bird hips look like.
B. It proves that the discovery is important.
C. It gives important details about Dinosaur Creek.
D. It reveals the likely source of the dinosaur fossils.

Jamie finds a dinosaur fossil in the creek bed because

E. a flood uncovered it.
G. a rock slide uncovered it.
H. Jamie dug it out of the dirt.
I. a team of paleontologists left it there.

Read this excerpt from the story.

Holly knew that paleontologists classify dinosaurs by their hip structure. Dinosaurs with lizard hips, like many reptiles today, have lower hip bones that point away from one another, but dinosaurs that have bird hips have both lower hip bones pointing toward the rear.

Read this excerpt from the story.

Occasionally, she'd stick a numbered marker beside a rock as she photographed it.

Which sentence below uses *stick* in the same way as in the sentence above?

A. Erik will stick his pencils in his desk.
B. Buddy, our dog, likes to chase a stick.
C. Use tape to stick the poster on the wall.
D. Stick the map with a pin to show the city's location.

In the story "Dinosaur Creek," how are Holly and Aunt Rose similar?

A. Both Holly and Aunt Rose own a pet iguana.
B. Both Holly and Aunt Rose work at a museum.
C. Both Holly and Aunt Rose are paleontologists.
D. Both Holly and Aunt Rose study dinosaur fossils.