

**Impact of Computer Assisted Learning/Computer Assisted Instruction
on Academic Achievement in the Area of Fourth Grade
Reading and Mathematics**

by

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Abstract

Today in the field of education, as a result of the accountability movement, public school administrators, teachers, students, and parents are faced with continuous pressure to raise standardized test scores. Test performance has become a sole criterion for measuring academic achievement, specifically, the measurement of growth of individual students in reading and mathematics, placing a great deal of pressure on the principal as an instructional leader. The need to provide teachers with individualized instructional programs that are engaging and proven to show an increase in academic achievement, especially in the area of reading and mathematics, while minimizing planning time and resources required, often results in principals turning to Computer Assisted Learning programs in hopes of immediate increased growth in academic performance. Results of this study examined the extent to which the usage of a Computer Assisted Learning program, specifically the Compass Learning program, was related to achievement in fourth grade reading and mathematics in a 7A school district in southeastern Alabama as measured by the reading and mathematics portion of the American College Testing ASPIRE. Results indicated that the Compass Learning program was not found to be effective at increasing student achievement in reading and mathematics in fourth grade, and pointed to further research needed regarding Computer Assisted Learning/Computer Assisted Instruction with respect to student socio-economic status.

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CHAPTER I: INTRODUCTION

Introduction

Chapter I provides the basis for this study. It provides a history of high stakes education policy and statement of the problem. Additionally, Chapter I provides the purpose of the study along with the research questions. The significance of the study is outlined in Chapter I, as well as the limitations and assumptions of the study. Chapter I provides the definitions of terms and concluded with the organization of the study.

High Stakes Education Policy

Over the past decade, the United States Department of Education has implemented policies, such as No Child Left Behind Act of 2001 (NCLB), which was the beginning of school systems holding principals accountable for Adequate Yearly Progress (AYP) of all of the students enrolled within their respective schools (Duncan, 2009). No Child Left Behind established annual benchmarks for schools to obtain for all demographics and subgroups. After No Child Left Behind and during the administration of President Barack Obama, the American Recovery and Reinvestment Act of 2009 and the Race to the Top Initiative of 2012 were implemented, linking significant federal funds to local and state school systems for the use of measuring student growth in learning (Duncan, 2009). The afore-referenced programs were followed by the Every Student Succeeds Act (ESSA) in December of 2015, also signed into law by President Obama. ESSA was an overhaul of the federal education law, which essentially replaced President Bush's No Child Left Behind Act (NCLB). ESSA limits the broad federal oversight of

public primary and secondary schools imposed by NCLB and offers more flexibility and oversight at the state and local levels in the area of educational decision making. ESSA does have parameters for local and state educational programs to adhere to but is not as imposing as NCLB. As a result, states are required to develop their own plan designed to close achievement gaps, increase equity of instruction and increase outcomes for all students. Alabama's Department of Education developed and implemented *Alabama Plan 2020* to address this requirement. Alabama's Plan 2020 vision statement is "Every Child a Graduate – Every Graduate Prepared For College/Work/Adulthood In The 21st Century" (Alabama State Department of Education, 2016).

Since the passing of these historic federal and state mandates, state, regional and local school systems have faced a continual focus on increased student gains in all subgroups within a school. This focus on increased student gains in all subgroups requires educators to evaluate deficiencies in individual student growth and learning, which may have been overlooked in years past due to a previous focus only on all students. This emphasis on measurement using assessment scores, along with the elimination of tenure for upcoming principals, has changed the perspective and objectives of principals in Alabama. This change has broadened the perspective and expectations of principals from manager of the students and faculty to school instructional leader. Prior to this shift, most principals simply left the instructional processes to the teachers within their buildings (Bowers, Shoho, Barnett, 2014; Hassenpflug, 2013; Lambert, 2002). Now, with the varied accountability measures and expectations placed upon them, school administrators are required to seek out additional methods and resources to aid teachers in their efforts to increase student learning for all students, particularly the individual

students determined to be at-risk in the area of reading and mathematics (Hord & Summers, 2008).

In order for teachers to effectively fill in the often varied learning gaps existent in a classroom, teachers need an inordinate amount of time. Time is the one resource that teachers have in limited supply, especially, when it comes to the amount of time needed to effectively identify and address varied learning gaps (Montague & Jitendra, 2012). Due to the time constraints that prevent teachers from effectively meeting students' varied needs, other resources and/or aids are required. The need for alternate and engaging curriculum to fulfill the needs of tiered instruction has resulted in principals and educators turning to Computer Assisted Learning programs as a means for providing individualized instruction.

Statement of the Problem

Otterness (2009) referenced how varied the differences were in the students who come through the doors of public schools and how it is imperative that instruction be differentiated to close the existing gaps apparent for any number of reasons ranging from home life, prior instruction, individual student aptitude, and experiences. When taking into consideration all of the many obstacles facing teachers in order to create a level playing field for each student, Otterness indicated it is obviously apparent that teachers need assistance to effectively and efficiently meet the varied academic needs of their students. "Differentiated instruction stems from beliefs about differences among learners, how students learn, differences in learning preferences, and individual interests. By its nature, differentiation implies that the purpose of schools should be to maximize the capabilities of all students" (Algozzine & Anderson, 2010, p. 50). With this mindset

being the catalyst, it is imperative teachers be afforded assistance in helping each student to reach his/her maximum potential, which requires at a minimum that educational learning gaps be closed. One possible avenue to assist educators with this dilemma is Computer Assisted Learning programs. With the multitude of Computer Assisted Learning programs on the market, it is important that instructional leaders evaluate whether or not Computer Assisted Learning programs are appropriate for implementation in their school curriculum.

There are inconclusive results as to the effectiveness of Computer Assisted Learning/Computer Assisted Instruction programs on student learning outcomes based on the literature. There have been studies indicating positive effects (Kulik, 2003), studies showing no strong impact (Angrist & Lavy, 2002) and studies finding negative effects (Campuzano, Dynaski, Agodini, & Rall, 2009; Spiezia, 2010) of using computer software in teaching and learning (De Witte, Haelermans, & Rogge, 2014). De Witte, Haelermans, and Rogge (2014) indicated that some of the disparity in results comes from the fact that the impact of educational technology has been studied from different perspectives.

Gile (2011) noted that the school principal is at the center of managing initiatives and reforms but revealed that more conclusive research is needed around school leadership practices that lead to student achievement. Programmatic reforms do not necessarily lead to improved results, but focus and the ability to sustain an effective practice over time does have the potential to lead to improved results for students (Gile, 2011). This disparity significantly justifies the need for further research.

Purpose of the Study

The purpose of this study was to examine the extent to which the use of a Computer Assisted Learning program, specifically the Compass Learning program, is related to achievement in fourth grade reading and mathematics in a 7A school district in southeastern Alabama as measured by the reading and mathematics portion of the ACT ASPIRE.

Research Questions

The following research questions were addressed in this study:

- 1) What is relationship of time spent using the Compass Learning program related to mathematics achievement as measured by ACT ASPIRE and Socio-Economic Status (SES) level?
- 2) What is relationship of time spent using the Compass Learning program related to reading achievement as measured by ACT ASPIRE and Socio-Economic Status (SES) level?

Significance of the Study

With the goal of schools being to increase learning for each student, it is imperative that effective resources are utilized when and where appropriate to aid teachers in meeting the educational needs of all students despite the wide variations of prior knowledge that can exist in a single classroom. The limited financial resources available to procure educational resources must be utilized in the most beneficial manner or risk failing individuals in the opportunity to obtain an education. Valid and reliable research regarding the effectiveness of Computer Assisted Learning/ Computer Assisted Instruction will allow administrators to make more clear decisions regarding whether or

not such programs are worth the resources spent based on the academic growth achieved as a result.

Limitations of the Study

The following limitations were identified in this study:

- Student data are limited to one academic school year (2015-2016).
- Results are limited to five elementary schools, within one school district, in southeastern Alabama.
- The implementation of the Compass Learning program is subject and grade level specific; therefore, the study will only measure reading and mathematics achievement of fourth graders on the ACT ASPIRE.

Assumptions of the Study

The following assumptions were identified in this study:

- All faculty members have been properly trained and are proficient in implementing the Compass Learning program.
- All faculty members implemented the Compass Learning program to fidelity.
- All students participated to the best of their ability when using the Compass Learning program.
- All students performed to the best of their ability on the reading and mathematics portion of the ACT ASPIRE.
- The results of the ACT ASPIRE are valid and reliable.

Definition of Terms

- **Accountability:** holding public schools responsible for meeting academic standards. Following the guidelines for accountability is usually required for schools to receive some type of federal or state funding.
- **ACT ASPIRE:** a standards-based system of assessments used to monitor progress toward college and career readiness from grade three through high school, connecting each grade level to the next (Discover ACT ASPIRE, 2018).
- **Adequate Yearly Progress (AYP):** the level of academic growth determined as appropriate by the measures defined by No Child Left Behind.
- **Alabama’s Plan 2020 –** Alabama State Department of Education’s response to meeting the requirements of Every Student Succeeds Act (ESSA), which “requires states to adopt challenging standards in reading, mathematics, and science, and may have standards for any other subject [coupled with] [I]levels of achievement aligned with entrance requirements for higher education and CTE [career technical education] institutions” (Alabama Department of Education, 2016, p. 18).
- **Common Core State Standards (CCSS):**

The Common Core is a set of high-quality academic standards in mathematics and English language arts/literacy (ELA). These learning goals outline what a student should know and be able to do at the end of each grade. The standards were created to ensure that all students graduate from high school with the skills and knowledge necessary to succeed in college, career, and life, regardless of where they live. Forty-one states, the District of Columbia, four territories, and the Department of Defense Education Activity (DoDEA) have voluntarily adopted and are moving forward with the Common Core. (Common Core State Standards, 2010, p. ii)

- **Compass Learning:** provides digital curriculum for grades K-12 that can be used as primary or supplemental instruction. A diagnostic is used to offer a personalized learning path, which has the capability of being monitored and altered by the teacher (Compass Learning Inc, 2018).
- **Computer Assisted Learning:** is an alternative delivery system using technology to facilitate student learning (Fuchs & Allinder, 1993). For purposes of this study, the terms Computer Assisted Learning and Computer Assisted Instruction are used interchangeably.
- **Computer Assisted Instruction (CAI):** “a type of educational technology that delivers instruction via computer-based technologies or computer-based programs” (Pei-Lin Weng, 2014, p. 167). For purposes of this study, the terms Computer Assisted Instruction and Computer Assisted Learning are used interchangeably.
- **Differentiated Instruction:** “an educator’s strategies for purposely adjusting curriculum, teaching environments, and instructional practices to align instruction with the goal of meeting the needs of individual students. Four elements of the curriculum may be differentiated: content, process, products, and learning environment” (Center on Response to Intervention at American Institutes for Research and National Center on Intensive Intervention, 2014, p. 3).
- **Enrichment:** educational opportunities offered beyond the normal required educational activities. The goal of enrichment is often to provide exposure to a greater depth of knowledge.

- Every Student Succeeds Act (ESSA): Federal education law signed by President Obama on December 10, 2015. ESSA represents a shift in educational policy and procedure affording state education systems the ability to design their own accountability systems to determine appropriate supports and interventions (Alabama Department of Education, 2016; Darling-Hammond, et al., 2016).
- Levene’s Test- is used to assess equal variances for your various groups prior to conducting statistical test (Brown & Forsythe, 1974).
- No Child Left Behind (NCLB): the No Child Left Behind Act of 2001, a Federal law passed under the George W. Bush administration. NCLB represents legislation that attempts to accomplish standards-based education reform (Lewis, 2015).
- Race to the Top Initiative of 2012: the Obama administration’s educational initiative that was designed to identify, fund (totaling four billion dollars), and learn from states with viable plans for improving education (Weiss & Hess, 2016).
- Reinforced Instruction: a time set aside during the regular classroom day or during extended hours to reinforce and reteach instruction taught during the regular classroom. Reinforced Instruction typically takes place in a smaller group setting and is focused.
- Response to Intervention (RtI):
 - integrates assessment and intervention within a multi-level prevention system to maximize student achievement and reduce behavior problems. With RtI, schools identify students at risk for poor learning outcomes, monitor student progress, provide evidence-based interventions and adjust the intensity and nature of those interventions depending on a student’s responsiveness, and identify students with learning disabilities or other

disabilities. (Center on Response to Intervention at American Institutes for Research and National Center on Intensive Intervention, 2014, p. 7)

- Socio-Economic Status (SES): the combination of one's social and economic status. SES has been studied extensively and is commonly known to be an indicator of school success. For purposes of this study and in Alabama public schools in general, the lunch status of free and/or reduced classifies one in a low Socio-Economic Status.

Organization of the Study

This study is comprised of five chapters with Chapter I providing a discussion of the research problem and the purpose of the study. The basis of the study was introduced and the significance of the study was explained. Research questions were presented to direct this study, as well as the definition of terms and limitations and assumptions. Chapter II includes the literature review, which will cover a review of the research applicable to this study. Chapter III will include the methods used to select the participants, instruments in the study, the data collection procedures and the data analysis procedures. Chapter IV will provide an explanation of the data screening, demographics, and data analysis. Chapter V, the final chapter, will summarize the results, provide conclusions, implications, and recommendations.

CHAPTER II: LITERATURE REVIEW

Introduction

Chapter II reviews the literature relative to the study. Chapter II covers the background of high stakes education policy, the purpose of the study and research questions addressed by the study. Additionally, the mathematics achievement gap, differentiated instruction, and the overall impact of Computer Assisted Learning/Computer Assisted Instruction are discussed. Components of successful Computer Assisted Learning/Computer Assisted Instruction Program are provided in Chapter II as well.

Purpose of the Study

The purpose of this study was to examine the extent to which the use of a Computer Assisted Learning program, specifically the Compass Learning program, is related to achievement in fourth grade reading and mathematics in a 7A school district in southeastern Alabama as measured by the reading and mathematics portion of the ACT ASPIRE.

Research Questions

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- 2) What is relationship of time spent using the Compass Learning program related to reading achievement as measured by ACT ASPIRE and Socio-Economic Status (SES) level?

History of High Stakes Education Policy

Today in the field of education, as a result of the accountability movement, public school administrators, teachers, students, and parents are faced with continuous pressure to raise standardized test scores. Test performance has become a sole criterion for measuring academic achievement, specifically, the measurement of growth of individual students in reading and mathematics, placing a great deal of pressure on the principal as an instructional leader. The need for alternate and engaging curriculum to fulfill the needs of tiered instruction has resulted in principals and educators turning to Computer Assisted Learning programs as a means for providing individualized instruction.

Since the turn of the century, the United States Department of Education has implemented multiple policies and acts establishing more accountability for public schools with an enhanced focus on identifying and correcting learning and growth deficiencies of individual students. This change in perspective has evolved from an emphasis on all students (which included an evaluation and analysis of all subgroups) served to include an emphasis on all demographic groups served based on individual progress. Prior to this shift, smaller traditionally underserved subgroups, such as special education and minority students, could underperform and a school or district could still be considered successful if the majority of the population scored at a proficient level.

The implementation of the United States Department of Education's No Child Left Behind Act of 2001, signed into law by President George W. Bush, was the

beginning of holding individual schools and administrators accountable for the Adequate Yearly Progress of all students enrolled within their respective schools. No Child Left Behind (NCLB) established specific parameters to determine what was deemed as adequate progress for each subgroup indicated by the Annual Measurable Objective (AMO). The No Child Left Behind Act of 2001 was followed by the American Recovery and Reinvestment Act of 2009 and Race to the Top Initiative 2012 of President Barack Obama's administration.

“In December 2015, President Obama's signature reauthorized the 1965 Elementary and Secondary Education Act as the Every Student Succeeds Act (ESSA), which opened up new possibilities for how student and school success are defined and supported in American public education” (Darling-Hammond, et al., 2016, p. 1). Every Student Succeeds Act is a significant shift from No Child Left Behind in that it delegated greater responsibility to states to devise and regulate their own accountability systems, as well as determined which supports and interventions school systems would use to meet the academic needs of the students served (Darling-Hammond, et al., 2016). No Child Left Behind's focus was effective at producing gains on state assessments, but not so much on the National Assessment of Educational Progress (NAEP). “The rate of gain on the NAEP was about half of the pre-NCLB era. And on the Program for International Student Assessment (PISA) – a more open-ended test evaluates how students apply their knowledge and demonstrate their reasoning – U.S. performance declined in math, reading, and science between 2000 and 2012, both absolutely and in relation to other countries” (Darling-Hammond, Wilhoit, & Pittenger, 2014, p. 4).

According to Darling-Hammond, et al. (2016), ESSA was an important move towards a more holistic approach to accountability by encouraging the use of multiple measures of school and student success along with creating opportunities for local innovation to develop new approaches of accountability and improvement. As a result of the documented decrease in learning gains in the areas of mathematics and reading, it is imperative and a requirement of ESSA that educators provide effective evidence based interventions to close any instructional gaps (Darling-Hammond, et al., 2016).

Reading Achievement Gap

The reading achievement gap refers to the disparity in academic performance between all students and specific demographic groups, such as cultural background, income levels, or gender with respect to reading capability peers (Teale, Paciga, & Hoffman, 2007). Literacy has long been identified as a key building block of educational progress and achievement (Adelson, Dickinson, & Cunningham, 2016). Despite this common perception, there has not been a consensus in ensuring every child achieves at comparable levels of literacy. This is evidenced by the disparity in student reading performance. According to the National Center for Education Statistics (NCES), as cited by Adelson, Dickinson and Cunningham (2016), nationally only 36% of fourth graders are performing at or above proficiency in reading. Jeynes (2015) emphasized that this is not a new phenomenon. According to Green (2001) and Simpson (1981), “[f]or five decades, one of the most enduring debates in education has been on how to close the achievement gap between White students on one hand and Black and Hispanic students on the other,” as cited by Jeynes (2015, p. 524). National Assessment of Educational Progress (NAEP) scores from 2015 indicated there has been minimal change in the

achievement gap over multiple years prior to 2015. There has been minimal progress in closing this identified disparity as shown in 1992 and 2011 NAEP results despite the numerous initiatives implemented to eliminate or at the least minimize this noted disparity (National Center for Education Statistics, 2015). Some of the government initiatives designed and implemented in an effort to decrease and ideally eliminate the academic disparities associated with SES and racial inequity amongst students are as follows: Head Start, the school lunch program, President Clinton's national standards programs, numerous affirmative action programs, President George W. Bush's No Child Left Behind, and President Obama's American Recovery and Reinvestment Act of 2009, Race to the Top Initiative of 2012, and Every Student Succeeds Act (ESSA) (Alabama State Department of Education, 2016; Duncan, 2009; Evans, 2005; Green et al., 2000; Jeynes, 2008).

Literacy and Socio-Economic Status

The United States literacy gap consists of children from low incomes scoring significantly lower in reading and writing than children from middle and high incomes. A similar gap exists between African American and Latino students and their higher scoring Caucasian peers (Evans, 2005; Teale, Paciga, & Hoffman, 2007). Buckingham, Beaman, and Wheldall (2014) referenced the relationship between socio-economic disadvantage and poor reading as one of the most enduring problems in the realm of education. The notion that socio-economic disadvantaged students often have poor literacy skills is supported from the research of Molfese, Modglin, and Molfese (2003) and Smart et al. (2008) which emphasized the gap present from the onset of a student's formal education. The literacy gap continues throughout the educational experience in

the primary grades (Feinstein & Byner 2004; Hecht et al., 2008; Kieffer 2010; Lubienski & Crane, 2010) if not corrected in the early years of formal education this disparity will follow a student into high school (Organization for Economic Cooperation and Development, 2010).

Socio-economic status is a variable beyond the control of the student and is directly related to a parents' economic status (Jeynes, 2015). Socio-economic status is generally represented in two methods socio-economically advantaged or disadvantaged based upon household income, parent occupation, and parent education as the primary indicators for indicating whether a student is identified as low socio-economical status (Sirin, 2005). Low socio-economic status has been found to have a small, yet significant relationship with cognitive development and literacy (Blanden & Gregg, 2004). This relationship is even more significant if the low socio-economic status is persistent in nature (Dickerson & Popli, 2012; McLoyd, 1998).

However, low socio-economic status is seldom the most significant variable in the achievement gap (Buckingham, Beaman, & Wheldall, 2013). There is a significant amount of research which indicates parent education has the most significant impact on student achievement and not merely socioeconomic status (Buckingham, Beaman, & Wheldall, 2013; Cheadle, 2008; Downer & Pianta, 2006; Marks, Cresswell, & Ainley 2006; Marks, 2008; The Sutton Trust, 2010). There is no direct correlation that socio-economic status plays a significant role in student's cognitive and academic development, but rather the variables which are associated with low socio-economic status households, such as the parent's education level, occupation and reading level which all help determine the home learning environment (Mol & Bus, 2011; Senechal & LeFevre, 2002;

Taylor, Clayton, & Rowley, 2004). Malacova et al. (2009) and Rothstein (2010) reference the student's physical health and well being as additional variables which could be negatively impacted as a result of low socio-economic status and thusly impact a student's academic achievement. All of the afore-referenced variables can impact a student's motivation and attitudes toward reading and education in general (Buckingham, Beaman, & Whedall, 2013; Cunningham, 2008; Petscher, 2010). Fortunately, the association of these variables is merely related and not causal to student learning and achievement, which means low socio-economic status variables does not ensure low academic achievement for students falling under this umbrella (Snow, Burns, & Griffin, 1998).

Jeynes (2015) referenced the diverse groups who have attempted to address the achievement gap including social scientists, politicians, educators and community leaders. Despite the diversity of these varied groups and their differing perspectives, there is still a lack of consensus as how to decrease the achievement gaps within our nation's schools.

Mathematics Achievement Gap

The need to find and eliminate the learning gaps in mathematics for underserved students is critical to the future of the individual student, as well as, our society according to The National Commission on Mathematics and Science Teaching for the 21st Century (2000). The report specified the following:

[F]our reasons for our nation's children to achieve competency in mathematics and science: (1) the rapid pace of change in both the increasingly interdependent global economy and in the American workplace demands widespread mathematics- and science-related knowledge and abilities; (2) our citizens need both mathematics and science for their everyday decision-making; (3) mathematics and science are inextricably linked to the nation's security interests;

and (4) the deeper, intrinsic value of mathematical and scientific knowledge shapes and defines our common life, history, and culture. Mathematics and science are primary sources of lifelong learning and the progress of our civilization. (The National Commission on Mathematics and Science Teaching for the 21st Century, 2000, p. 7)

The report further stated:

It is not just the role that mathematics, science, and technology play in the changing economy and workplace that matters. Mathematics and science have become so pervasive in daily life that we tend to overlook them. Literacy in these areas affects an individual's ability to understand weather and stock reports, develop a personal financial plan, or understand a doctor's advice. Taking advantage of mathematical and scientific information does not generally require an expert's grasp of those disciplines. But it does require a distinctive approach to analyzing information. We *all* have to be able to make accurate observations, develop conjectures, and test hypotheses—in short; we have to be familiar with a scientific approach. (The National Commission on Mathematics and Science Teaching for the 21st Century, 2000, p. 14)

Research shows that based upon the results of the Trends in International Mathematics and Science Study, Alabama educators have some significant progress to make in the area of mathematics. Alabama's eighth graders scored lower than the average among the eighth graders studied, according to the Trends in International Mathematics and Science Study, as well as lower than the United States average in mathematics. Trends in International Mathematics and Science provided scores in the following four ranges:

- advanced (625)- able to reason with information, draw conclusions, make generalizations, and solve linear equations.
- high (550)- able to apply knowledge and understanding to complex situations.
- intermediate (475)- able to apply basic mathematical knowledge in situations that are straight forward.

- low (400)- have some knowledge of whole numbers and decimals, operations, and basic graphs (Provasnik, et al., 2012).

The Trends in International Mathematics and Science Study scale average score was 500 and the United States average was 509, with Alabama scoring an average of 466 (Provasnik, et al., 2012). Alabama's average score is in the low benchmark range of 400-474.

Mathematics and Socio-Economic Status

The U.S. Census Bureau (2017), in 2017 reported 18.4 percent of the United States children lived in a home identified as below the poverty level. The percentage of Alabama students indicated as living below the poverty level was even higher at 24.6 percent. The U.S. Census Bureau (2017) identified a family of four making \$25,094 or less into the category of below the level of poverty. Socioeconomic status (SES) has long been identified in the educational realm as one of the best predictors of academic achievement (Currie, 2009; Duncan, Featherman, & Duncan, 1972; Kim & Quinn, 2013; Sirin, 2005). Duncan, Featherman, and Duncan's (1972) defined SES as encompassing three different indicators, none of which the child can impact; parental income, parental education, and parental occupation as the three main indicators of SES. Parental income as an indicator of SES reflects the potential for social and economic resources that are available to the student. The second SES component, parental education, considered to be one of the most stable aspects of SES because it is typically established at an early age and tends to remain the same over time. Moreover, parental education is an indicator of parent's income because income and education are highly correlated in the United States (Sirin, 2005).

There is a strong correlation between low Socio-Economic Status and low student achievement in mathematics. “Nearly 90% of the variance in students’ math scores on some tests can be predicted without knowing anything about their schools; one only need to know the number of parents in the home, the level of education, the type of community in which the family lives, and the state’s poverty rate” (Evans, 2004, p. 584). Evans assertion is further supported by Gardner (2000) who surmises a student’s probability of completing college and eventual income can be predicted through a child’s ZIP code. The impact of low Socio-Economic Status is not merely a variable impacting an individual’s K-12 formal education, but it is also reflected in their college success. Bailey and Dynarski indicated an increase in college completion rates of high-income families, whereas students from low-income families completion rates have remained stagnant (2011). To further exacerbate this disparity, students from high-income families make up a greater percentage of the enrollment at the more prestigious colleges and universities than their low-income peers, despite having similar academic records and test scores (Baily & Dynarski, 2011; Belly & Lochner, 2007; Karen, 2002; Reardon, 2013).

According to Jeynes (2015) over the last 45 years, there has been a considerable amount of research undertaken focused specifically on reducing the achievement gap. Despite the significant amount of time dedicated to this cause, there still appears to be no clearly identified method, philosophy, or strategy to impliment that successfully addresses this well documented disparity (Bailey & Dynarski, 2011; Currie, 2009; Duncan, Featherman, & Duncan, 1972; Gottfried, 1985; Hauser, 1994; Kim & Quinn, 2013; Sirin, 2005). Research points to a lack of consensus about what strategies should be

implemented to diminish this gap for the students served within our K-12 public schools (Jeynes, 2015).

Public schools and education as a whole are looked at as the vessel to be the great equalizer when it comes to closing these documented academic disparities between high and low Socio-Economic Status levels (Reardon, 2013). This is understandable, given the correlation between education and earnings, health, and well-being. Finding interventions that effectively improve the educational achievement of disadvantaged children is of considerable importance and a high priority for society as a whole (Dietrichson, et. al. 2017; Sirin, 2005; UNESCO, 1994). The amount of research suggesting a student's family's Socio-Economic Status can negatively impact a student's achievement has led to the United States federal government to attempt offset or correct this disparity through additional funding. Title I funding is available to qualifying schools which serve large low Socio-Economic populations. However, the infusion of additional funds, such as Title I funding, have not proven to be overwhelmingly successful in addressing the intended objective (Baker & Johnston, 2010).

According to Rouse and Barrow (2006) educational outcomes are greatly impacted by family Socio-Economic Status. Rouse and Barrow provided research identifying why family background is so strongly linked to education (2006). They denote that more advantaged, i.e. higher Socio-Economic level, parents tend to have higher educational expectations of their children than low Socio-Economic level parents have for their children. Both the higher and lower Socio-Economic groups' expectations have potentially divergent impacts. The impact of low educational expectations from a parent/guardian can adversely impact the self-esteem and the academic objectives of

their child. Thusly, children could face higher psychological costs if lower parental expectations cause children to have less confidence in their academic ability. Children from lower Socio-Economic Status backgrounds tend to obtain different information than children from more privileged families about the costs and benefits of more schooling. These differences may be driven by differences in access to quality schools (Baker & Johnston, 2010; Rouse & Barrow, 2006).

The theory of whether children learn is not totally dependent on what happens in school, but more so on the experiences, habits, values, and ideas they obtain from their home environment is supported by others. Despite school being a viable portion of a student's environment, it is only a portion of their environment (Aikens & Barbarin, 2008; Baker & Johnston, 2010; Csikszentmihalyi, 1995; Evans 2004; Evans, 2005). Evans (2005) noted that by the time a senior graduates at age 18, they have spent only ten percent of their lives, including none of their formative first years, in school. For most children, the nature of their schooling is not nearly as significant as the nature of the parenting they receive, or of their Socio-Economic Status, or, for that matter, of the media culture that surrounds them. Increasingly, the 90% of their lives that students spend outside of school affects their "experiences, habits, values, and ideas" in ways that undermine academic achievement (Evans, 2004; Evans 2005). The impact of low Socio-Economic Status on students is further emphasized through what Bracey (2002) labels as "summer loss," which is the regression of academic progress obtained during the school year over the summer when students are not receiving a formal education. Their education is then derived from their current environment consisting of their home and

neighborhood, which may be conducive to many things other than education (Bracey, 2002; Evans, 2005).

Despite the effort it may take, it is imperative that educators as a whole, coupled with legislators continue to work to eliminate the mathematical achievement gap in the lives of students. The need for mathematical knowledge and skills cover a wide range of areas from simple calculations in daily life to high level academic research. In daily life, individuals use mathematics as a tool in order to make the right decision in various activities that require selection and comparison (Yurt, 2014). In addition, it is seen that mathematical processes are used intensely in the analysis of scientific data in academic studies. It is also stressed that individuals and societies that can use mathematics effectively in this culture of rapid change will have a voice regarding the increasing opportunities and potentials which can shape their future (NCTM, 2000).

Therefore, it is understood that mathematical knowledge and skills have particular importance for the success of individuals both in their daily academic and long-term professional life. In this respect, it has been understood that having mathematical knowledge and skills and becoming successful in mathematics is of continued importance. With this continued importance, we must remember that achievement gap will not be closed without the implementation of successful methods within schools.

Differentiated Instruction

One possible method of addressing both the reading and mathematics achievement gap is through intensified and purposeful differentiated instruction. Otterness (2009), a senior engineer on the Apollo project in the 1960s, referenced his kindergarten teaching experience as follows:

When I started teaching kindergarten, my students were four to five years old. They differed in physical maturity, mental maturity, and life experiences by at least 20%. In adult terms, that would be like comparing someone just out of college with someone with four years of experience. We worked with heterogeneous groupings to try to narrow the gap. We tried a wide range of ideas to help students who weren't learning what we wanted. But, because of that 20% difference, we couldn't expect every student to perform to the same level at the same time. If our rocket parts had differed by 20%, we might still be throwing rocks at each other. (p. 87)

It is because of the real life classroom experiences like those referenced by Otterness (2009) that there is a need for varied methods and levels of instruction to attempt to meet the diverse educational needs of all students. In order to meet the varied levels and needs of student populations, it is necessary to first determine the learning levels and needs of all students. Otterness' observation is further supported by other research (Berliner & Biddle, 1995; Hall, Strangman, & Meyer, 2009; Tomlinson, 1999, 2001; Tomlinson & Jarvis , 2009) which acknowledges all students are not alike and what works for some students will not work for all. Most any classroom tasked with more than one student potentially presents a range of diverse learning needs. As a result of these diverse needs teachers often times struggle to present all their students with specific learning activities focused and designed to what works best for each individual student. Teachers can not simply think that a singular chosen method to deliver instruction will work for all students within their classroom as it would be a rare occurrence for that to be the case (Berliner & Biddle, 1995).

Tomlinson (2001) defined differentiated instruction as a teaching theory which is based on the assumption that instructional practices should vary and be adapted in relation to the individual and diverse students within a classroom. "Differentiating instruction makes sense because it offers different paths to understanding content,

process, and products, considering what is appropriate given a child’s profile of strengths, interests, and styles” (Dixon, Yssel, McConnell, & Hardin, 2014, p 111). Differentiated instruction is not solely focused on altering the curriculum for underperforming or low achieving students, as one might think.

Differentiated instruction includes both students with learning disabilities as required by the Individuals With Disabilities Act (IDEA, 2004) as well as those students identified as gifted and talented. The Individuals With Disabilities Act (IDEA, 2004) communicates to school’s their responsibility to ensure that students with disabilities have access to the core curriculum of general education in the least restrictive environment (Dixon, Yssel, McConnell, & Hardin, 2014). The National Association for Gifted Children’s website (NAGC, 2018) defines gifted and talented students as follows:

The federal Elementary and Secondary Education Act defines gifted and talented students as “Students, children, or youth who give evidence of high achievement capability in areas such as intellectual, creative, artistic, or leadership capacity, or in specific academic fields, and who need services and activities not ordinarily provided by the school in order to fully develop those capabilities.” [Title IX, Part A, Definition 22. (2002)] Many states and districts follow the federal definition. (NAGC, 2018)

The National Association for Gifted Children (2018) website offers a simpler definition of what is ‘giftedness’ beyond what the federal government defines it in the Elementary and Secondary Act of 2002. “Children are gifted when their ability is significantly above the norm for their age” (NAGC, 2018). Giftedness is varied in the domains of which it is measured. Gifted traits can be assessed in one or more domains such as; intellectual, creative, artistic, leadership, or in a specific academic field such as language arts, mathematics or science (NAGC, 2018).

“It is not easy to teach such disparate groups—the gifted as well as the struggling

learners—while at the same time serving yet a third group, the grade-level students” (Dixon, Yssel, McConnell, & Hardin, 2014, p 112). Tomlinson and Jarvis (2009) shared this perspective on the topic of differentiation:

Differentiation is an approach to curriculum and instruction that systematically takes student differences into account in designing opportunities for each student to engage with information and ideas and to develop essential skills. Differentiation provides a framework for responding to differences in students’ current and developing levels of readiness, their learning profiles, and their interests, to optimize the match between students and learning opportunities. These three dimensions of student difference can be addressed through adjustments to the content, process, products, and environments of student-learning, and each is justified by a research-based rationale. (p. 599)

Dixon et al. (2014) shared their perspective on teachers who differentiated their instruction through three different dimensions. The first dimension was the content dimension of differentiation, which required the teacher to respond to learner needs through the way content was presented. The second dimension was the process dimension, during which the teacher focused was directed towards the way students responded to the content. The third dimension is called the product dimension and the teacher is focused on the ways students responded to the content. These adaptations when properly implemented are expected to assist teachers in effectively meeting the specific characteristics of the individual learners as well as to maximize their time in school (Dixon et al., 2014).

According to Tomlinson (2000, 2008), differentiated instruction is a philosophy adopted by teachers who recognize using a single instructional strategy makes it highly improbable all students level of learning within their class will be maximized. “To offer the same curriculum and instruction to all

students is to deny that individual differences exist or matter in the enterprise of learning” (VanTassel-Baska, 1997, p. 11). Students with differing abilities and experiences in the same class should not be denied the level of instruction specific to their individual needs to be successful and master whatever content and objective are expected to be mastered as a result of the instruction. “Excellence should be promoted in all learning endeavors, but at different levels, based on personal mastery of material” (Dixon et al., 2014, p 113).

Despite the amount of research supporting differentiated instruction, there is just as much research stating how difficult it is for classroom teachers to effectively and efficiently implement differentiated instruction due to a variety of reasons. Some recognized road blocks hindering teachers effectiveness in implementing this philosophy are limited resources, lack of or a need for quality professional development, and the absence of administrative support (Dixon et al., 2014; Jones, Yssel, & Grant, 2012; Tomlison, 2000, 2008; VanTassel-Baska & Stambaugh, 2005).

Effective implementation of differentiated instruction is when the curricular content taught falls within each student’s zone of proximal development. Proximal development is the zone of a student’s optimal learning ability, meaning the assignments are not too easy or too hard, therefore the student is challenged academically, but not to the point of frustration and they shut down (VanTassel-Baska, 1997). According to Dixon et al. (2014), differentiated instruction is student centered instruction at its best. Based on fact, differentiated instruction, focuses on accomodating varied levels of

understanding within each concept for which instruction is provided. An example shared by Dixon et al. (2014),

For example, in teaching for readiness, teachers may teach a concept for those students who understand at the knowledge/comprehension level; they must adjust the same concept for those who understand at the application/analysis level; and then they must adjust yet again for those who understand information at the evaluation/create level. These adjustments may occur in the content to be studied, in the activities used to learn the content, or in the product completed to indicate mastery of the content. (Dixon et al., 2014, p 113)

The concept of every teacher effectively and efficiently being able to differentiate instruction for all of their students sounds wonderful in theory, but it does not happen as a direct result of a teacher obtaining a teaching degree and state certification. The colleges and universities typically do not provide much more than a cursory introduction into differentiated instruction. Proper implementation of the differentiated classroom takes planning, professional development, and additional resources, along with administrative and peer support. Implementation also includes providing proper funding for resources and high quality professional development for teachers to use in their efforts to meet the varied levels of instructional needs of the students they are charged with serving (Dixon et al., 2014; Jones, Yssel, & Grant, 2012; Tomlison, 2000, 2008; VanTassel-Baska & Stambaugh, 2005).

Data Driven Decision Making

Ikemoto (2007) defines Data Driven Decision Making (DDDM) as the process by which educators, administrators and teachers, collect and analyze student and teacher data in an effort to guide a range of educational decisions which impact student achievement. Anderson, Leithwood & Louis (2012); Leithwood & Louis, (2012) indicate the push for greater attention to data by school personnel is a result of the accountability-driven, large scale reform efforts emphasizing systematically collected data as critical in the effort to improve student performance. Schools' success or failure have been tied to standardized test scores in accordance to President George Bush's signing of No Child Left Behind Act of 2001. No Child Left Behind's implementation was a key catalyst in the push towards data driven decision making, which has been followed by President Barak Obama and United States Secretary of Education, Arne Duncan's, initiatives such as the American Recovery and Reinvestment Act of 2009 and the Race to the Top Competition (Hamilton, 2009). Gummer (2013) references the United States Department of Education's emphasis on data driven decision making at all levels. "Data Driven Decision Making is an expectation whereby it is no longer accepted to rely on gut feelings, anecdotes, or solely experience. As one educator noted, "without data, you are only an opinion"(Gummer, 2013, p. 1).

The push for educators to be data literate has increased due to the availability of technology, greater accountability for student outcomes and financial support from policymakers tied to student growth outcomes (Hamilton, 2009; Marsh & Farrell, 2015). An example of financial support being tied to student outcomes is evident in one of the caveats for states to receive funding from the Recovery and Investment Act of 2009

(Duncan, 2009). The Recovery and Investment Act of 2009 requires that states build data systems which can track student performance from one year to the next and from one school to another, so that those students and parents know when they are making progress and when they need extra attention. This information must also be put in the hands of educators so they can use it to improve instruction (Duncan, 2009, p. 2).

Additionally, the Alabama Accountability Act (AAA) of 2013 points to local systems and school administrators having greater control over decisions, such as, budgets, staffing, personnel, scheduling and educational programming, including but not limited to curriculum and instruction in order to meet “diverse educational needs of a diverse population (Act 2013-64, 2013, p. 112).

Orland (2013) identified that the such policies, are unprecedented and significant initiatives with great promise.

However, even the most ardent supporters of these policies are not likely to argue that they are sufficient in and of themselves to change the culture of educational decision making so that educators place a greater premium on data. And without such a change, such investments will not fulfill their promise. (Orland, 2013, p. 50)

According to Earl and Katz (2006), the underlying actions of policies of this nature was to put the appropriate data in educators’ hands and require educators to know how to analyze, interpret, and use the data to make informed decisions in all areas of education, from professional development to student learning to enhance student outcomes. The term appropriate data is critical because, due to the afore referenced policies, school leaders have been inundated with data, which makes it difficult for leaders to sift through and determine what data is most relevant to the intended goal of

student learning (Bowers, 2014). Bowers (2014) further states finding the appropriate data is not as simple as it sounds. He goes on to give this analogy:

More data does not cause improvement, just as driving more miles to work does not cause a commute to improve. This analogy is apropos since “improve” for a commute to work could be defined in multiple ways (as with a definition of “improve” for schools), and so for the commute analogy, improvement could be defined by different people as quicker, shorter, more scenic, quieter, with an important stop such as daycare on the way, etc. Driving more miles may “improve” the commute, or it may not. The point is not the total amount, but how it is used, and so it goes for data in schools. (Bowers, 2014, p. 2)

This information overload is contrary to the assumption of when school and district leaders become knowledgeable about data use, they can more effectively review their existing capacities, identify weaknesses, and better chart plans for improvement (Earl & Katz, 2006;. Mandinach & Honey (2008) and Levin & Datnow (2012) take data usage a step further in discussing how teachers’ ability to analyze test results should lead to more targeted instructional practices to meet students’ individual needs. In order for this to occur on a consistent basis the instructional leader of the school needs to set the appropriate example of analyzing data to build capacity with teachers. It has been noted that school leaders play a critical role in supporting Data Driven Decision Making in schools, but it is also noted the challenges they face in their efforts to support teachers in this focus. These challenges include but are not limited to lack of time, data literacy, and tools to effectively convey this knowledge to teachers (Datnow, 2009; Marsh & Farrell 2015; Pool, Carter, Johnson & Carter, 2012).

Research has noted principals as important players in Data Driven Decision Making through their modeling of effective data use and enabling teachers to use technology (Mandinach & Honey, 2008; Ikemoto, 2007; Levin & Datnow, 2012).

However, principals' effectiveness in properly modeling appropriate data use can be severely hampered by their lack of data literacy (Wu, 2009; Levin & Datnow, 2012). Earl and Katz (2006) define a data literate leader as one who is able to:

- think about the purpose of the data
- recognize sound and unsound data
- possess knowledge about statistical and measurement concepts
- make interpretation paramount
- pay attention to reporting and to audiences (Earl & Katz, 2006; Levin & Datnow, 2012).

Wu and others concur that exacerbating this issue was a lack of or insufficient training in understanding, analyzing and interpreting data, therefore making it difficult at best for principals to properly train their teachers to effectively utilize the available data (Levin & Datnow, 2012; Mandinach & Honey, 2008; Wu, 2009). According to Markarian (2009) lack of active engagement by the principal in the Data Driven Decision Making process was cited as an additional hindrance to effective data literacy for teachers.

Determining Needs

According to Toste et al. (2014) in order to determine individual student needs and learning levels, sufficient data should be collected and analyzed. The results thereof should be utilized to determine individual and collective learning levels. This information helps to assess which students fall into the category of being at-risk of not mastering the standards necessary to complete their current grade level (Batsche et al., 2005; Fuchs & Fuchs, 2006; Harn, Chard, Biancarosa, & Kame'enui, 2011). A subgroup

of at-risk students is identified from which non-responders are likely to emerge. Non-responders are individuals who have not adequately responded to the previous instruction and intervention(s) implemented during the educational process to help close the academic gap or deficiency, based upon pre-determined criteria such as a benchmark score (Toste, et al., 2014).

Disaggregating the data from each assessment for each individual student allows teachers to better determine the specific needs of the individual, as well as the group. This disaggregation further assists in the planning and implementation of curriculum standards. Disaggregation of data is also critical in helping to determine which student is most in need of differentiated instruction in the particular area in which they are at-risk, and how much potential intervention will be required to fill in where educational gaps exist (Toste, et al., 2014).

Planning for Differentiated Instruction

Upon identifying the varied academic discrepancies within a particular classroom, it is incumbent on the teacher to plan accordingly to meet the varied needs of all of his/her students. These differences are met through appropriate planning which includes varied levels of instruction of the designated standards by attempting to meet each student or group of students where they are via varied assignments and instructional methods. This variation in targeted instruction to overcome academic weaknesses, typically in reading and mathematics is referred to as Response to Intervention (RtI). Response to Intervention was developed as result of President George W. Bush signing into law the Individuals with Disabilities Education Improvement Act (IDEA), which included and required the use of Response to Intervention in an effort to minimize the

disparaging difference in the number of minorities in special education within America's schools (Yell, Shriner, & Katsiyannis, 2006). Response to Intervention is a means of providing early intervention to all at-risk students prior to referring them for special education services (Fuchs & Fuchs, 2006). The National Center on Response to Intervention defined Response to Intervention as a form of differentiated instruction that “[i]ntegrates assessment and intervention within a multi-level prevention system to maximize student achievement and to reduce behavior problems’ (U.S. Department of Education, Office of Special Education Programs, National Center on Response to Intervention, 2010, p. 2). Response to Intervention has four essential components:

- multi-level, school wide instructional and behavioral system for the purposes of proactively preventing school failure
- screening
- progress monitoring
- data based decision making for instruction and movement within the tier and disability identification in accordance with state law (U.S. Department of Education, Office of Special Education Programs, National Center on Response to Intervention, 2010).

The multi-tiered instructional structure has three focus levels: primary, secondary, and tertiary level of prevention. This is also commonly referred to as Tiers 1, 2, and 3. As students progress through a tier, based on data, instruction becomes increasingly more intentional, groups become smaller, and instruction occurs at greater intervals, with the goal of responding quickly and effectively to documented learning

problems and ensuring appropriate identification of needs. The multi-tiered levels of instruction are described more in detail below:

- Primary (Tier 1): high quality core instruction. This instruction commonly takes place in a whole group setting.
- Secondary (Tier 2): more intense instruction, using research based intervention. This instruction is typically provided in smaller groups, for specified periods of time, and for a specified number of times per week. The goal is to address learning and/or behavioral challenges for most at risk students.
- Tertiary (Tier 3): individualized intervention for those students who have not responded to instruction at the two previous levels. This instruction often occurs in a pull-out setting or a collaborate setting with specialized instruction and the regular classroom teacher working together to address needs.

Ultimately, the building level principal is responsible for ensuring, through instructional supports, that the students' differentiated instructional needs are met. Because of the extensive and timely planning required by teachers to develop lessons targeted for students at each of the multi-levels of instruction, instructional leaders have often turned to Computer Assisted Learning/Computer Assisted Instruction to assist teachers in meeting student needs, with the ultimate goal of closing the achievement gap (U.S. Department of Education, Office of Special Education Programs, National Center on Response to Intervention, 2010).

Computer Assisted Learning/Computer Assisted Instruction

One possible method of providing differentiated instruction is through Computer Assisted Learning, also known as Computer Assisted Instruction. Fuchs and Allinder (1993) defined Computer Assisted Instruction as an alternative delivery system for facilitating the learning of students with disabilities. Computer Assisted Instruction has since been defined as educational technology which delivers instruction via computer based technologies or computer based programs to the student, without the specifying children with disabilities meaning it is a viable instructional tool for all learners (Pei-Lin Weng, Maeda, & Bouk, 2014; Soe, Koki, & Chang, 2000; Valdez et al., 1999).

Computer Assisted Instruction has assisted at-risk students since the mid to late 1980s (Ashbrook, 1984; Baer, 1988). Jimenez, et al., (2003) noted the importance of focusing on efficient delivery of intervention. Burns, Kanive and DeGrande (2012) noted Jimenez, et. al., (2003) work to justify the increase in the number of schools using computer based interventions, “in which interventions are delivered by having students interact with a computer program with little supervision by a teacher or interventionist” (Burns, Kanive, & DeGrande, 2012, p. 185).

According to Dede (2010), the National Educational Technology Plan (NETP) 2010 technology-based learning and assessment systems was to be pivotal in improving student learning and generating data that could be used to continuously improve the education systems at all levels, thus further enhanced the idea of utilizing Computer Assisted Instruction as a method to close the gap in learning achievement of individual students and groups.

The National Educational Technology Plan 2010 was defined as follows:

a national long-range technology plan that describes how the secretary will promote: (a) higher student academic achievement through the integration of advanced technologies, including emerging technologies, into curricula and instruction; (b) increased access to technology for teaching and learning for schools with a high number or percentage of children from families with incomes below the poverty line; and (c) the use of technology to assist in the implementation of state systemic reform strategies. In addition, Section 2422 specifies that this report should also include a description of joint activities of the Department of Education and other federal departments or agencies that will promote the use of technology in education. (U.S. Department of Education Office of Educational Technology, 2010, p. ii)

Types of Computer Assisted Learning/Computer Assisted Instruction

There are several methods of utilizing computers to assist students with learning disparities ranging from using programs as reinforcers and motivators for maintaining attention and increasing student learning to tutorials (Okolo, 1992). Three main types are defined below:

- **Drill and Practice:** a traditional instructional method promoting the acquisition of knowledge through repetitive exposure and recall of facts (Bahr, 1989).
- **Game-Based Learning (GBL):** is the implementation of game design elements (e.g. points, leader boards, and badges) to promote user engagement in non-game contexts (Attali and Arieli-Attali, 2015).
- **Tutorial programs:** Tutorial programs are intended to present new information using effective instructional practices. For example, “new information is presented, steps for learning the new information are presented, and opportunities for learning the new information under guided and independent practice are provided” (Shiah, Mastropieri, Scruggs, & Mushinski Fulk, 1994-1995, p. 132).

- Intelligent tutoring systems: intelligent tutoring systems assess the current knowledge base of the individual and then through the use of artificial intelligence techniques generate a learning path to suit the needs of the learner by allowing the student to work every step of a problem in the program, such as solving a quadratic equation (VanLehn, K., 2011).
- Computer assisted instruction (CAI): provides immediate feedback to the student answers to whether it is a congratulatory response for a correct response or a hint to an incorrect response to try again. However, unlike intelligent tutoring systems, the student works on paper and pencil to solve a math problem and inputs his/her response (VanLehn, K., 2011).

Overall Impact of Computer Assisted Learning/Computer Assisted Instruction

Cheung and Slavin (2012) referenced the difficulty in determining how to best incorporate technology in the classroom with the continuous and rapid progression of available educational technologies. Further exacerbating the ability to effectively determine what and how to implement technology is the diversity of instructional needs of the students makes it difficult for teachers to reach every learner without the aid of technology (Karich, Burns, & Maki, 2014; Ysseldyke & McLeod, 2007; Ysseldyke, et al., 2003). “Computer Assisted Instruction programs are considered as a way to improve learning outcomes of students. However, little is known about the schools who implement CAI programs” (De Witte, Haelermans, & Rogge, 2014, p. 1). Even though the use of computers and technology in schools has increased in recent years, research on the effectiveness has yielded mixed results according to Machin, McNally and Silva, (2007). “Research investigating the use of technology beyond a simple comparison of

the same task completed in a traditional format verses aided by a computer is lacking” (Karich, Burns, & Maki, 2014, p. 393).

Skinner was an early proponent for the use of technology in the classroom. Skinner published papers in the 1950’s explaining “his belief that the use of teaching and learning (he uses the term ‘teaching machines’) might benefit the learning efficiency of pupils” (De Witte, Haelermans, & Rogge, 2014, p. 3). Skinner (1958) saw ‘teaching machines’ as capital equipment which would be used to save teachers time and effort. The teacher retained their role as vital to the instructional process, but the implementation of teaching machines would allow the teacher to teach more students through the ability to assign certain mechanizable functions to machines. Skinner noted that the use of such devices was “probably inevitable if the world-wide demand for education is to be satisfied-but he (teacher) will do so in fewer hours and with fewer burdensome chores. In return for his greater productivity he can ask society to improve his economic condition” (Skinner, 1958, p. 9). Nearly a half-century after Skinner’s support of Computer Assisted Instructional programs, Doerr and Zangor (2000) suggested that Computer Assisted Instruction helps students generate greater focus and ability on understanding more difficult and complex concepts. Kaput, Hegedus, and Lesh (2007) concurred with Doerr and Zangor’s (2000) research and added that Computer Assisted Instructional programs can be useful in helping students develop a conceptual understanding of difficult concepts (De Witte, Haelermans, & Rogge, 2014).

Learner Control

Computer Assisted Instruction is capable of providing the student with the ability to control, along with a continuum, how the information is accessed. This provides the student with greater flexibility and ownership of their learning (Karich, Burns, & Maki, 2014). Learner control is defined by Shyu and Brown (1992) as the degree to which students can direct their own learning experiences and furthermore by Hannafin (1984) to include path, pace, and instructional approach. Computer Assisted Instruction can offer students control over variables such as curriculum level, the opportunity to choose how long to focus on a learning objective, the ability to select and sequence a variety of review strategies. These characteristics allow the instructor or student to set parameters to include choice of practice items and/or amount of review material and sequencing of the curriculum. This allows a student to focus solely on the skillset in need of remediation, but once successful allows them to progress to the next area, rather than toiling in skills of which they do not need remediation. This autonomy of learner control allows the learner to freely interact with and direct their learning (Karich, Burns, & Maki, 2014). Wenglinsky (1998) to this as the ability to self-organize learning. “Other points of strength of educational technology are the interactive nature with high interaction frequency between teacher-system-pupil and the adaptive nature which enables to customize instruction and feedback for the needs of the individual pupil” (De Witte, Haelermans, & Rogge, 2014, p. 3).

Learner control within the construct of Computer Assisted Instruction is consistent with Engle’s (2006) and Engle, Nguyen, and Mendelson’s (2011) research on the theory of intercontextuality, which implies learners are responsible for transferring

what they know from one context to another. When the concept of learner control in computer adapted instruction was first introduced, it was assumed that the more control the learner had, the better the student would perform (Lepper, 1985; Mager, 1964; Merrill, 1975). The hypothesis was that students would feel competent and be more interested in those activities in which they were allowed to make choices and affect their own outcomes” (Karich, Burns, & Maki, 2014, p. 394). Merrill (1975) concluded that students making their own instructional decisions would be more inclined to explore tactics for different situations and learn better how to learn in the future. Marshall, Teeman, Mundy, Morrison, and Rudd (2009) provided evidence that the belief of personalizing learning is a key priority and still popular amongst educators. The U.S. Department of Education, Office of Educational Technology (2010), supports technology as a means for educators to empower students to take control of their learning.

Computer Assisted Learning and Reading Achievement

The fundamental objective of reading instruction is to ensure students obtain the necessary skills to understand and extract useful knowledge from text, and the extent to which this occurs is dependent upon a student’s reading comprehension ability (Allington, 2012; Reutzel & Cooter, 2013). Reading comprehension skills are not exclusively paramount for successful formal education, but is also essential beyond the realm of formal education to allow an individual the basis for acquiring important information in their lives (Kim, McKenna, & Park, 2017; Vacca, Vacca, & Mraz, 2011). Reading skill standards have increased as a result of the widely adopted Common Core State Standards (CCSS) of 2010. CCSS was the result of the National Governors’

Association and the Council of Chief State School Officers' efforts to unify curriculum standards nationwide (Common Core State Standards, 2010).

The Common Core is a set of high-quality academic standards in mathematics and English language arts/literacy (ELA). These learning goals outline what a student should know and be able to do at the end of each grade. The standards were created to ensure that all students graduate from high school with the skills and knowledge necessary to succeed in college, career, and life, regardless of where they live. Forty-one states, the District of Columbia, four territories, and the Department of Defense Education Activity (DoDEA) have voluntarily adopted and are moving forward with the Common Core. (Common Core State Standards, 2010, p. ii).

Kim, William, and Park (2017) referenced the increased reading standards found within the Common Core State Standards, such as the following:

- requiring students to read increasing complex texts
- encountering different text structures
- higher expectations to develop content area knowledge through reading.

Despite these increased standards, Kena et al. (2016) noted many students across the nation still struggle with reading comprehension, with one-third of fourth graders falling in the below basic reading category of reader based upon the Common Core State Standards. If this deficit is not addressed prior to these students exiting the elementary level, it is highly probable that they will struggle in secondary level general content courses (Kim, McKenna, & Park 2017; Stetter & Huges, 2011).

Direct Instructional Benefits in Reading

Direct explicit reading instruction that addresses individual deficits in a logical scope and sequence of instruction practices have been linked to positive outcomes of effective reading instruction (Carnine, Silbert, Kame'enui, & Tarver, 2004; Regan,

Berkeley, Hughes, & Kirby (2014). “Explicit instruction of reading entails teacher modeling (Regan & Berkeley, 2012), on going feedback with guided practice (Rupley, Blair, & Nichols, 2009), and ample independent reading practice (Hall, Hughes, & Filbert, 2000)” (Regan, Berkeley, Hughes, & Kirby, 2014, p. 106). Knowing what to do and how to effectively implement the afore-referenced practices is difficult at best in light of the diverse nature of today’s classrooms, with students from varied cultural, socioeconomic and academic backgrounds (Mastropieri & Scruggs, 2010).

Differentiated instruction is a model intended to satisfy the widely diverse needs and ability levels of students in classrooms through the flexible use of time, space, materials, and strategies. Computer Assisted Instruction (CAI) can be used to differentiate and augment traditional face-to-face literacy instruction (Boone & Higgins, 2007; Kennedy & Deshler, 2010; McKenna & Walpole, 2007; Regan, Berkeley, Hughes, & Kirby, 2014).

According to Kim, McKenna, and Park (2017), Computer Assisted Instruction is a potentially promising tool for addressing reading comprehension difficulties for students. Shores and Chester (2008) stressed the benefits of Computer Assisted Instruction as “engaging, permits students to work independently, and provides teachers with flexibility to design a lesson plan, particularly for Tier 2 or Tier 3 interventions” (Kim, McKenna, & Park, 2017, p. 234). Carnine, Silvert, Kame'enui, and Tarver (2004), Hall, Hughes, and Filbert (2000), and Regan, Berkeley, Hughes, and Kirby (2014), further expounded on the benefits of Computer Assisted Instruction as a tool with the following benefits, all of which are listed as effective practices of reading instruction:

- allows learners the ability to work at their own pace
- provides immediate feedback

- provides instructive and consistent corrections
- allows extensive rehearsal or needed repetition
- highly motivates the student.

Computer Assisted Instruction (CAI) also affords students the opportunity to read electronic text on a computer screen, which according to Cullen, Alber-Morgan, Schnell, and Wheaton (2014), could improve student motivation and reading performance.

Computer Assisted Instruction can include computer-based speech technology which can be used to provide additional opportunities for intense reinforcement or practice. It allows the student to read along, read aloud stories and provide decoding support from digitized speech (Higgins, Boone, & Lovitt, 1996; Higgins & Raskind, 2004). According to Cullen, Alber-Morgan, Schnell, and Wheaton (2014), CAI's ability to provide immediate feedback creates the possibility for students with or without learning disabilities to learn independently. The immediate feedback aspect allows students to detect errors immediately as well as recognize correct responses, which is something traditional paper and pencil assessments do not provide. Another benefit of the immediacy of student feedback is it allows students' confidence to grow due to his/her success or require he/she adjust their thought process concerning the current sample set of questions. Computer Assisted Instruction has the capacity to include multimedia options such as video to help facilitates students' understanding as well as maintain their attention (Fitzgerald, Miller, Higgins, Pierce, & Tandy, 2012; Kim, McKenna, & Park, 2017).

Another possible benefit of Computer Assisted Instruction is the ability for electronic dictionaries to be infused into their programming, offering the user the

opportunity to select words and definitions they may not have otherwise used in their text. Audio components will even allow the word or words to be spoken in conjunction with the definition. This provides the capability for the student to choose the correct word, potentially broadening the student's written and spoken vocabulary (Kim, McKenna, & Park, 2017; Moore, 2009). Essentially, "when reading strategies are combined with CAI, the strategies can be taught and practiced using the multiple functions (e.g., electronic dictionary, multimedia, immediate feedback) that computer software provides" (Kim, McKenna, & Park, 2017, p. 234). When designed from theoretically sound pedagogical principles Computer Assisted Instructional programs, have the potential to augment traditional face-to-face literacy instruction. (Boone & Higgins, 2007; Kim, McKenna, & Park, 2017; McKenna & Walpole, 2007; Regan, Berkeley, Hughes, and Kirby, 2014; Torgesen & Barker, 1995).

Computer Assisted Learning and Mathematics Achievement

According to Allsopp, Alvarez McHatton, and Farmer (2010), the role of Computer Assisted Learning program integration within mathematics should be to enhance students' ability to understand and apply mathematics in successful ways in both school and non-school contexts. This research supports previous research by Fuchs, Fuchs, Finelli, Courey, and Hamlett (2004) and Xin and Jitendra (2006) that mathematical problem solving involves the application of mathematical knowledge, skills and strategies to a wide variety of problems. Allsopp, Alvarez McHatton, and Farmer (2010) further indicated that Computer Assisted Learning programs use research based mathematics instructional practices within the program. "The use of visuals (e.g., graphic organizers) to represent mathematical ideas, small daily amounts of practice building

arithmetic fluency, and screening for possible mathematics difficulties were described to have the potential for bringing about positive mathematics outcomes” (Allsopp, Alvarez McHatton, & Farmer, 2010, p. 274).

According to Montague and Applegate (1993) and Seo and Bryant (2012), Computer Assisted Instruction (CAI) may be an effective method for providing students with cognitive and metacognitive strategies for mathematical word problem solving. However, it was concluded that in order for CAI to be used as an effective medium for providing instructional content, it needed to include several computer technology functionalities coupled with features able to effectively deliver cognitive and metacognitive strategy instruction on mathematical concepts. Computer Assisted Instruction can provide the following benefits:

- a sufficient number of real-world problems and situations
- varied instructional tools embedded into the programs
- a variety of virtual manipulatives to facilitate cognitive strategies
- attractive animations and graphics to motive academic interest (Montague & Applegate, 1993; Seo & Bryant, 2012) .

The National Center for Education Statistics (2010, June 30), which is a federally funded entity under the United States Department of Education Sciences that collects, analyzes, and publishes public school data, indicates outcomes for students with disabilities, generally worsening from grade four to grade eight. “At grade four, 41% of students with disabilities scored below the basic level of mathematics competency. Comparatively, at grade eight, 64% of these students scored below the basic level” (Allsopp, Alvarez McHatton, & Farmer, 2010, p. 274).

Components of Successful Computer Assisted Learning/ Computer Assisted Instruction Programs

Cognitive research has shown that learning is most effective when four fundamental characteristics are present: active engagement, participation in groups, frequent feedback, and connections to real world contexts (Roschelle, Pea, Hoadley, Gordin, & Means, 2000). Computer Assisted Learning Programs fulfill all of these fundamental characteristics.

As scientists have understood more about these characteristics of learning, they have realized that the structure and resources of traditional classrooms often provide quite poor support for learning, whereas technology – when used effectively - can enable ways of teaching that are much better matched to how children learn. (Roschelle, Pea, Hoadley, Gordin, & Means, 2000, p. 79)

De Witte, Haelermans, and Rogge (2014) referenced the technology acceptance model, which was originally developed to study and explain computer usage behavior and the users' tendency to accept technology. The technology acceptance model indicates that in order for CAI to be successful, it needs to make the learner experience a feeling of usefulness and ease of use (Arbaugh, 2002; De Witte, Haelermans, & Rogge, 2014; Liu, Liao, & Pratt, 2009; Wu, Tsai, Chen, & Wu, 2006). De Witte, Haelermans, and Rogge (2014) further indicated that the more successful the e-learning tool, in this instance a CAI program, is in generating such emotions, the more positive the learner will be towards using the program and the better their learning experiences and satisfaction. “According to Alavi and Leidner’s framework for technology-mediated learning, e-learning tools will only be effective in generating good outcomes when technology and pedagogy are properly integrated” (De Witte, Haelermans, & Rogge, 2014, p. 5).

According to Kim (2015), gamification or game-based learning (GBL) can also be used for the purpose of improving user engagement and instruction. Villagrasa, Fonseca, Redondo, and Duran (2014) clarified that gamification is not simply playing games; it is ensuring students are motivated to complete the assigned tasks. The researchers revealed that students benefit from the feeling of accomplishment and success of competing against a challenge. Hanus and Fox (2015) and Sandusky (2015) implied that applying gamification to Computer Assisted Instruction can lead to student motivation to learn in new ways or enjoy otherwise tedious tasks. It has been conveyed that games offer a different type of engagement as they demand a constant interaction and attention which aids in keeping students engaged, as opposed to a traditional lecture/presentation format of instruction (Kirriemuir and McFarland, 2004). “It is, therefore, possible for students to adopt different learning styles in game-based learning (GBL) than they adopt in other learning settings” (Soflano, Connolly, & Hainey, 2014, p. 193).

Jameson (2003) identified two types of adaptation process in computing: adaptability and adaptivity. Bontcheva (2002) defines adaptability in computing as the ability of the user to ‘adapt’ to the system by explicitly customizing the system according to the individual learner’s preferences. Adaptivity in computing differs from adaptability in that the program itself adapts to the user's inputs and responses and automatically customizes the program in accordance each user, thus offering a more personal learning experience based on the individual’s strengths and weaknesses. This is typically referred to as a user-adaptive system, due to the user’s ability to influence the adaptation process (Mulwa, Lawless, Sharp, Arnedillo-Sanchez, & Wade, 2010).

Sandusky (2015) identified definitions of intrinsic and extrinsic motivation and how each impacts student learning. “Intrinsic motivation is when learners are interested in what they learn and in the learning process itself. Extrinsic motivation is learners engage in learning because it is a means to an end, relatively disassociated from the content of the subject of learning” (Sandusky, 2015, p. 2). Buckley and Doyle (2014) alluded to the possibility of gamification to either increase or decrease motivation, but considered the intended purpose of this aspect was to increase students’ intrinsic motivation. Research has indicated that gamification is beneficial in achieving its intended goal of increasing intrinsic motivation so long as the design of the program activities are aligned to learning outcomes. Thusly, implying that simply adding gamification attributes to a program does not mean student motivation or learning will increase as a result (Buckley & Doyle, 2014; Sandusky, 2015). Hanus and Fox’s (2015) research further supported Buckley and Doyle’s (2014) findings in that over time student motivation, satisfaction, and empowerment declined compared to individuals measured in the same study on the non-gamified course. Allsopp, Alvarez, McHatton, and Farmer (2010), point to the importance of technology being used in a judiciously manner to address students who are at risk as technology is not currently a viable replacement for the human interaction of a teacher.

Summary

This chapter reviewed previous research related to the history of education requirements leading to the need for all students, not just particular subgroups, to show Adequate Yearly Progress and meet the Annual Measurable Objectives. Additionally, this chapter discussed the reading and mathematics achievement gap, differentiated

instruction and how the need to close the gap requires that educators seek out resources, such as Computer Assisted Learning/Computer Assisted Instruction. Furthermore, in this chapter, Computer Assisted Learning/Computer Assisted Instruction was defined, the overall impact was discussed, and the components of a successful Computer Assisted Learning program were provided.

CHAPTER III: METHODS

Introduction

Chapter III will identify the statement of the problem, purpose of the study, and research questions. Additionally, the participants, instruments, data collection and data analysis procedures are fully described in this chapter.

Statement of the Problem

Otterness (2009) referenced how varied the differences were in the students who come through the doors of public schools and how it is imperative that instruction be differentiated to close the existing gaps apparent for any number of reasons ranging from home life, prior instruction, individual student aptitude, and experiences. When taking into consideration all of the many obstacles facing teachers in order to create a level playing field for each student, Otterness indicated it is obviously apparent that teachers need assistance to effectively and efficiently meet the varied academic needs of their students. “Differentiated instruction stems from beliefs about differences among learners, how students learn, differences in learning preferences, and individual interests. By its nature, differentiation implies that the purpose of schools should be to maximize the capabilities of all students” (Algozzine & Anderson, 2010, p. 50). With this mindset being the catalyst, it is imperative teachers be afforded assistance in helping each student to reach his/her maximum potential, which requires at a minimum that educational learning gaps be closed. One possible avenue to assist educators with this dilemma is Computer Assisted Learning programs. With the multitude of Computer Assisted

Learning programs on the market, it is important that instructional leaders evaluate whether or not Computer Assisted Learning programs are appropriate for implementation in their school curriculum.

There are inconclusive results as to the effectiveness of Computer Assisted Learning/Computer Assisted Instruction programs on student learning outcomes based on the literature. There have been studies indicating positive effects (Kulik, 2003), studies showing no strong impact (Angrist & Lavy, 2002) and studies finding negative effects (Campuzano, Dynaski, Agodini, & Rall, 2009; Spiezia, 2010) of using computer software in teaching and learning (De Witte, Haelermans, & Rogge, 2014). De Witte, Haelermans, and Rogge (2014) indicated that some of the disparity in results comes from the fact that the impact of educational technology has been studied from different perspectives.

Gile (2011) noted that the school principal is at the center of managing initiatives and reforms but revealed that more conclusive research is needed around school leadership practices that lead to student achievement. Programmatic reforms do not necessarily lead to improved results, but focus and the ability to sustain an effective practice over time does have the potential to lead to improved results for students (Gile, 2011). This disparity significantly justifies the need for further research.

Purpose of the Study

The purpose of this study was to examine the extent to which the use of a Computer Assisted Learning program, specifically the Compass Learning program, is related to achievement in fourth grade reading and mathematics in a 7A school district in

southeastern Alabama as measured by the reading and mathematics portion of the ACT ASPIRE.

Research Questions

The following research questions were addressed in this study:

- 1) What is relationship of time spent using the Compass Learning program related to mathematics achievement as measured by ACT ASPIRE and Socio-Economic Status (SES) level?
- 2) What is relationship of time spent using the Compass Learning program related to reading achievement as measured by ACT ASPIRE and Socio-Economic Status (SES) level?

Participants

The school system where the study took place is located in an urban city in Coffee County, Alabama, with a population of 27,772. The median household income for those living in the area studied is \$49,539 with a poverty level of seventeen percent. There is a constant flow of military transient students in and out of the district, creating a diverse population.

There were approximately 3,000 first through sixth grade students within the school district who attended one of five first through sixth grade schools, with 473 of those students being fourth graders. Four of the five schools received Title I at –risk funding. Of the fourth grade data set, prior to outliers being removed, there were 236 males and 237 females. Of this fourth grade population, 49 percent of them receive free and reduced lunch. The original sample consisted of all students attending fourth grade

in the district studied who took the reading and mathematics portion of the ACT ASPIRE during the 2015-2016 school year.

Instruments

ACT ASPIRE

ACT ASPIRE is a comprehensive assessment system with two components: summative and periodic. The Alabama State Department of Education required that the summative ACT ASPIRE be administered in the areas of reading and mathematics to all Alabama students in grades three through eight and ten as a part of the state mandated standardized assessment program. The ACT ASPIRE was administered in the spring of the 2015-2016 school year. The format of the ACT ASPIRE consisted of multiple choice question types, constructed response, selected response, and technology enhanced questions. The length of the exam ranged from 40-75 minutes per subject, depending on the grade level assessed. The ACT ASPIRE may be administered on paper or computer; however, the school system studied chose to use computer administration during the 2015-2016 school year. Scores were reported using the number/percent correct, as well as through the use of four descriptive levels: exceeding, ready, close or in need of support. Students who score in exceeding or ready levels are considered as meeting the ACT Readiness Benchmarks, meaning that they are on target for college readiness when they take the ACT test in eleventh grade (ACT, 2018).

Compass Learning

Compass Learning Odyssey, in general, provides instruction for students in grades K-12 that can serve as both supplemental or primary instruction. A diagnostic was used to determine an appropriate instructional program through a personalized learning path,

able to be monitored and manually altered by the teacher. Comedy and animated stories, as well as actors, were used to deliver the lessons via the web, or through iPad and Android applications. Students moved through their personalized learning paths and assigned courses on their own. The courses included instructional content and formative assessment and were delivered through a combination of reading texts, videos, and animations that are interactive. Teachers and administrators had access to more than 30 different reports, including time spent in a course or activity, the progress of the learning path and assignment status (EdSurge, 2018).

Data Collection Procedures

Permission for the researcher to perform the study was requested via official letter (see Appendix A) and granted as well as the Institutional Board approval (see Appendix B). Individual student test scores for the control and variable groups were identified by the system technologist. Individual student usage time in Compass Learning for the control and variable group were identified. Individual student test scores and usage time for the control and variable group were analyzed. Personal student identifiers were removed to ensure student confidentiality.

Data Analysis Procedures

Data were analyzed through the Statistical Package for the Social Sciences (SPSS). The data sets were acquired from pre-existing sources and secured with permissions. Analysis methods were selected and employed based on the research questions. An ANCOVA with simple Bonferroni correction ($\alpha/2$) was used to avoid inflating the possibility of making a Type 1 Error for each question. An ANCOVA is a special type of an ANOVA with the C standing for Covariate (socio-economic status was

the covariate in this study) which allows control for a variable which could potentially influence the results of a typical ANOVA (Ross & Shannon, 2008). The probability of making a Type 1 error equals your chosen significance level which is usually .05 or 5%. The Bonferroni correction is a technique used to reduce the probability of making a Type I error and simply involves dividing your alpha by the number of tests you wish to conduct. Type I error is when the null hypothesis is rejected when it is actually true (Cabin & Mitchell, 2000; Ross & Shannon, 2008).

The Bonferroni method can greatly negatively impact your power (1-beta). Since power is the ability to find an effect if one exists, losing power is problematic. An alternative, but somewhat more complicated, solution to the Bonferroni correction is to conduct an omnibus test such as an ANOVA. However, a significant ANOVA result does not tell you which of your three or more groups differ, only that one group differs from another. This is where Post Hoc tests such as Tukey's are useful. The Tukey (Tukey, 1977) method was used to determine and eliminate any outliers from the dataset prior to analysis with time spent using the Compass Learning Math Program and time spent using the Compass Learning Reading Program serving as the two independent variables, Socio-Economic Status (SES) serving as the covariate, and ACT ASPIRE reading and math scores serving as the two dependent variables.

Before conducting the ANCOVAs, equivalence of error variances and normality were assessed. To assess the equivalence of error variances, a key assumption required to use an ANCOVA, Levene's Test was used. Normality was also assessed for both of the dependent variables using the Shapiro-Wilk Test. Shapiro-Wilk test can be used to assess a set of measures against the Normal distribution (Shapiro & Wilk, 1965).

Summary

This chapter provided a review of the methods used to investigate whether there was a correlation between time spent on Compass Learning and increased achievement scores on the ACT ASPIRE assessment for fourth grade students in a specific school district. The population was limited to one specific grade during the 2015-2016 academic school year. The datasets used for this study were all pre-existing data, which did not require any specific instrument to create and develop the dataset prior to analysis.

CHAPTER IV: RESULTS

Introduction

Chapter IV will provide the reader of the purpose of the study as well as the research questions. Additionally, Chapter IV provided a clear explanation of the data screening and a description of the demographics of the population studied. Finally, a data analysis was included in Chapter IV.

Purpose of the Study

The purpose of this study was to examine the extent to which the use of a Computer Assisted Learning program, specifically the Compass Learning program, is related to achievement in fourth grade reading and mathematics in a 7A school district in southeastern Alabama as measured by the reading and mathematics portion of the ACT ASPIRE.

Research Questions

The following research questions were addressed in this study:

- 1) What is relationship of time spent using the Compass Learning program related to mathematics achievement as measured by ACT ASPIRE and Socio-Economic Status (SES) level?
- 2) What is relationship of time spent using the Compass Learning program related to reading achievement as measured by ACT ASPIRE and Socio-Economic Status (SES) level?

Data Screening

Before analyzing the data, ACT ASPIRE math and reading scores were screened for missing data and outliers. If a score was not recorded for both variables for any given case, that particular case was removed from the analysis. This resulted in 13 of the original 473 cases being removed. After the cases with missing data were removed, the data were examined for outliers using a technique first proposed by Tukey (1977). Using this method, the inter-quartile range (IQR) is multiplied by 1.5. The resulting product is then subtracted from the 25th percentile (Q_1) and added to the 75th percentile (Q_3). Any score that falls outside of this range, sometimes referred to as Tukey's Fences, is considered an outlier (Tukey, 1977). This formula yielded a range of 405 - 429 for math scores and 399 - 434 for reading scores. As a result, two values of 404 from the math data were identified, and the corresponding cases were deleted. No outliers were identified among the reading data. In total 15 of the original 473 cases were removed either due to missing data or being identified as an outlier.

Demographics

After cases were removed either due to missing data or for having an outlier, data from 458 of the original 473 participants were used. A total of 231 fourth grade females (50.4%) and 227 fourth grade males (49.6%) were included in the final analysis. With respect to race, 291 (63.5%), participants identified themselves as white, 98 (21.4%) identified themselves as black, and 69 (15.1%) selected other. The number of students receiving a free or reduced lunch was 220 (48%), and the number who paid for their lunch was 238 (52%). Although the number of students receiving a free or reduced lunch

did not differ substantially from the number paying for their lunch, the percent of black students (78.5%) and “other” students (68.1%) receiving a free or reduced lunch differed substantially from the percent of white students (33%) who received a free or reduced lunch. Table 1 refers to the student demographics as applicable from the study.

Table 1

Student Demographics and Lunch Status

Gender			Free/Reduced	Paid	Total
Female	Ethnicity	Other	25	13	38
		Black	38	11	49
		White	52	92	144
	Total		115	116	231
Male	Ethnicity	Other	22	9	31
		Black	39	10	49
		White	44	103	147
	Total		105	122	227
Total	Ethnicity	Other	47	22	69
		Black	77	21	98
		White	96	195	291
	Total		220	238	458

Data Analysis

Two separate ANCOVAs were conducted with a Bonferroni correction ($\alpha/2$) used to avoid inflating the possibility of making a Type 1 Error. With the Bonferroni correction in place, significance for this study was $\alpha=.025$ rather than the traditional $\alpha=.05$.

Before conducting the ANCOVAs, equivalence of error variances and normality were assessed. To assess the equivalence of error variances, a key assumption required to use an ANCOVA called Levene’s Test was used. Levene’s test was used to assess equal

variances for the groups. The results indicated the assumption of equivalence violated neither math scores, $F(4, 453) = 1.581, p = .178$, nor reading scores $F(4, 453) = 1.15, p = .332$. Normality was also assessed for both of the dependent variables using the Shapiro-Wilk Test. The Shapiro Wilk's test was used to assess normality. Unfortunately, the p-value for both was less than .001 indicating that the assumption of normality had been violated for both dependent variables. Although the ANCOVA is relatively robust against violations of normality, the results should be interpreted with this limitation in mind.

As can be seen in Table 2, the results for Math Interval were statistically significant, $F(4, 452) = 2.994, p = .019$. However, these results should be interpreted cautiously for two reasons. First, the effect size, partial $\eta^2 = .026$, was small. Second, the effect was not consistent across the five levels of the independent variable. This can be seen by examining Figure 1, which demonstrates that the only consistent effect was that of the covariate, $F(1, 452) = 81.781, p < .001$. The conclusion from this data is that Socio-Economic Status, rather than time spent in Compass Learning, is a greater indicator of academic achievement. Because the results of the independent variable, although significant, were not in the direction predicted, no post hoc tests were performed. That is, longer intervals did not consistently produce higher scores.

Table 2

Tests of Between-Subjects Effects of Compass Math Interval on ACT ASPIRE Math Scores

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1242.694 ^a	5	248.539	19.226	.000	.175
Intercept	7320978.000	1	7320978.000	566312.323	.000	.999
Lunch Status	1057.224	1	1057.224	81.781	.000	.153
Math Interval	154.797	4	38.699	2.994	.019	.026
Error	5843.210	452	12.927			
Total	79704970.000	458				
Corrected Total	7085.904	457				

R Squared = .175 (Adjusted R Squared = .166)

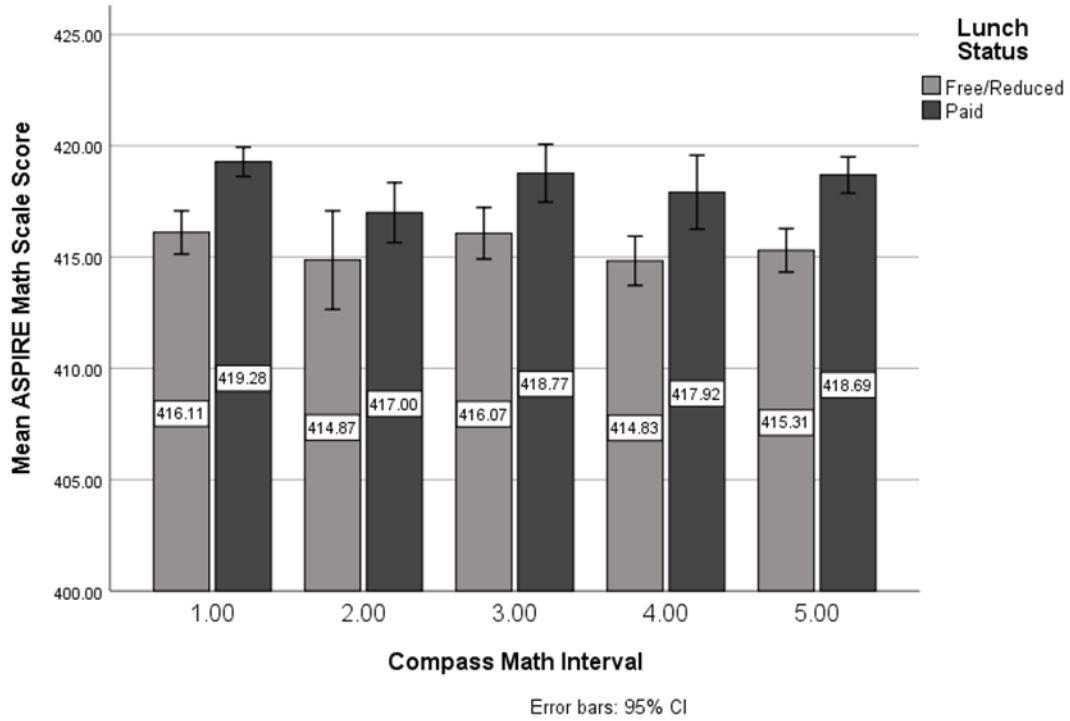


Figure 1. Compass Math Interval

As can be seen in Table 3, the results for Reading Interval were not statistically significant, $F(4, 452) = 2.994, p = .019$. This can be seen by examining Figure 2, which again demonstrates that the only consistent effect is that of the covariate, $F(1, 452) = 54.245, p < .001$. The conclusion from these data is that Socio-Economic Status rather than time spent in Compass Learning is a greater indicator of academic achievement.

Table 3

Tests of Between-Subjects Effects of Compass Reading Interval on ACT ASPIRE Reading Scores

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1901.256 ^a	5	380.251	11.544	.000	.113
Intercept	7413527.370	1	7413527.370	225062.020	.000	.998
Current Lunch Program	1786.840	1	1786.840	54.245	.000	.107
Reading Interval	113.042	4	28.260	.858	.489	.008
Error	14888.849	452	32.940			
Total	79524568.000	458				
Corrected Total	16790.105	457				

a. R Squared = .113 (Adjusted R Squared = .103)

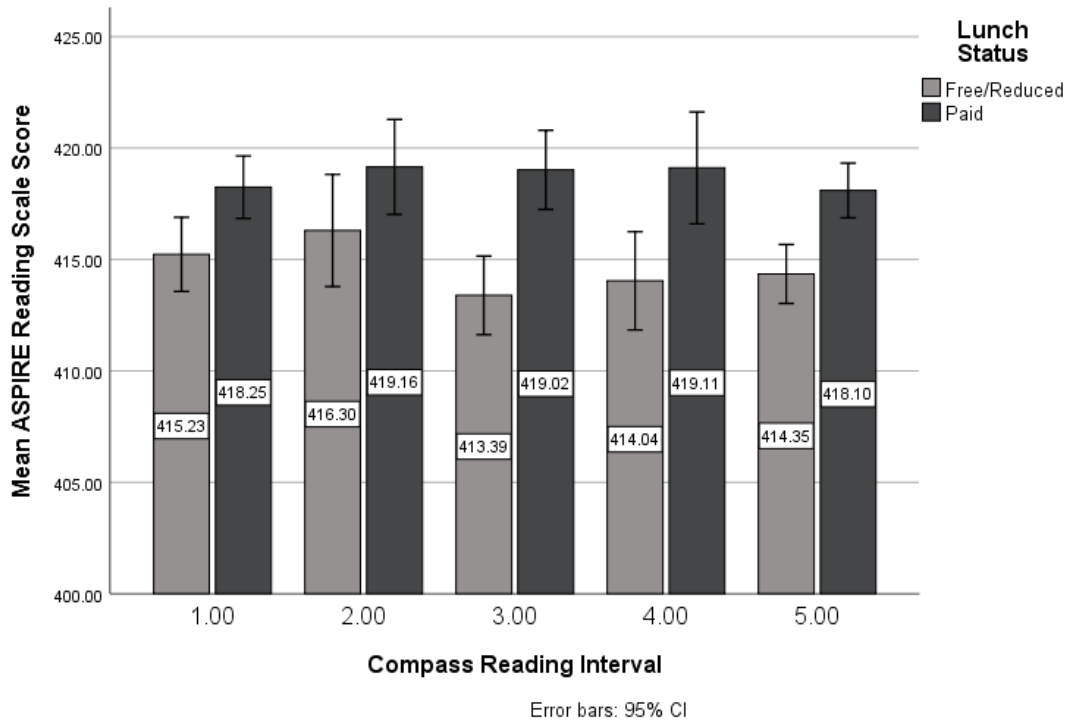


Figure 2. Compass Reading Interval

Summary

The quantitative data analyzed in this chapter addressed the following research questions:

- 1) What is relationship of time spent using the Compass Learning program related to mathematics achievement as measured by ACT ASPIRE and Socio-Economic Status (SES) level?
- 2) What is relationship of time spent using the Compass Learning program related to reading achievement as measured by ACT ASPIRE and Socio-Economic Status (SES) level?

The results of the ANCOVA used for research question one yielded that the time spent (Math Interval) on the Compass Learning program was found to be statistically significant. However, these results have to be interpreted cautiously as a result of the small effect size, and the effect was not consistent across the five levels of the independent variable of Math Interval. Despite the significant finding, the results were not in the direction predicted; therefore, no post hoc tests were performed. In short, longer intervals did not consistently produce higher scores. The only consistent effect found was that of the covariate, $F(1,452) = 81.781, p < .001$. In conclusion, the covariate (Socio-Economic Status) is a greater indicator of academic achievement than time spent in the Compass Learning program.

The results of the ANCOVA used for research question two yielded that the time spent (Reading Interval) on the Compass Learning program was not found to be statistically significant. Even if the results were found to be statistically significant, there was no obvious pattern which derived from the results. Just as in question one, the only

consistent effect of these results is that of the covariate, $F(1,452) = 54.245, p < .001$.

Again, the covariate (Socio-Economic Status) is a greater indicator of academic achievement than time spent in the Compass Learning program.

CHAPTER V: SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Introduction

Chapter V provides the purpose of the study and the research questions. A summary of the research questions' results is also provided. In addition to the summary, the conclusions and implications of the study, followed by the recommendations of the researcher are addressed.

Purpose of the Study

The purpose of this study was to examine the extent to which the use of a Computer Assisted Learning program, specifically the Compass Learning program, is related to achievement in fourth grade reading and mathematics in a 7A school district in southeastern Alabama as measured by the reading and mathematics portion of the ACT ASPIRE.

Research Questions

The following research questions were addressed in this study:

- 1) What is relationship of time spent using the Compass Learning program related to mathematics achievement as measured by ACT ASPIRE and Socio-Economic Status (SES) level?
- 2) What is relationship of time spent using the Compass Learning program related to reading achievement as measured by ACT ASPIRE and Socio-Economic Status (SES) level?

Summary

The effectiveness of the Compass Learning program in this limited study displayed inconclusive results as to the effectiveness in improving ACT ASPIRE test scores in the area of reading as a result of time spent on the program in this particular setting. Results, specific to each question are summarized below.

Research Question 1

Was the Compass Learning program effective at increasing mathematics achievement in the population studied, as measured by ACT ASPIRE and Socio-Status (SES) level? The results for Math Interval were found to be statistically significant, $F(4, 452) = 2.994, p = .019$. However, these results were interpreted cautiously for two reasons. First, the effect size, partial $\eta^2 = .026$, was small. Second, the effect was not consistent across the five levels of the independent variable. Figure 1 demonstrates that the only consistent effect was that of the covariate, $p < .001$. Because the results did not show that time spent on Compass Learning was a factor in academic improvement, no post hoc tests were performed. That is, longer intervals did not consistently produce higher scores on the ACT ASPIRE. Therefore, despite the significant finding, the effectiveness of the Compass Learning program in this limited study displayed inconclusive results as to the effectiveness of improving ACT ASPIRE test scores in the area of mathematics based upon time spent on the program in this particular setting.

Research Question 2

Was the Compass Learning program effective at increasing reading achievement in the population studied, as measured by ACT ASPIRE and Socio-Status (SES) level?

The results for Reading Interval were not statistically significant, $F(4, 452) = 2.994$, $p = .019$. Figure 2 again demonstrates that the only consistent effect is that of the covariate, $F(1, 452) = 54.245$, $p < .001$. The covariate (Socio-Economic Status), again, proved to be a greater indicator of academic achievement than time spent in the Compass Learning program.

Conclusions

Analysis of the data resulted in the following conclusions specific to each research question:

Research Question 1

This study has shown that the Compass Learning program was not effective in the area of mathematics, with respect to student scores on the mathematics portion of ACT ASPIRE. The only clear pattern found as a result of this study was that the students who were not identified as low Socio-Economic Status, consistently outperformed their lower Socio-Economic Status peers. This result further indicates that in this study the Compass Learning program was not effective in closing the achievement gap generally associated with low Socio-Economic Status, despite efforts to control for the SES.

Research Question 2

Beyond the fact there were no statistical findings for this question, the results for the reading assessment yielded very similar results to the mathematics results. This study has shown that the Compass Learning program was not effective in the area of reading, with respect to student scores on the reading portion of ACT ASPIRE. The only clear pattern found as a result of this study was that the students who were not identified as low

Socio-Economic Status, consistently outperformed their lower Socio-Economic Status peers. This result further indicates that in this study the Compass Learning program was not effective in closing the achievement gap generally associated with low Socio-Economic Status, despite efforts to control for the SES. This information further verifies research discussed in Chapter II regarding Socio-Economic Status and its relationship to academic achievement gaps.

Implications

The results of this study indicated that the Compass Learning program did not effectively meet the desired and expected outcome of increasing student achievement on the ACT ASPIRE in the areas of reading and mathematics for the respective fourth graders. It is imperative for teachers to find additional resources to assist them in their efforts to effectively close the achievement gap of students impacted by low Socio-Economic Status. This gap proves to be pervasive throughout a student's formal education in grades K-12, as indicated by *The Condition of College and Career Readiness National 2018*, a study by the ACT that assessed the results of the more than 1.9 million graduates, representing 55% of the graduating class of 2018 in America. Graduates from 28 states took the ACT during the 2018 school year, including 19 states which used the ACT as an accountability measure, including Alabama (ACT, 2018).

Of the students assessed, only 38% were deemed ready to take college coursework. An even more disturbing aspect is that 35% of the students tested did not meet any of the four benchmark college readiness parameters used by colleges as indicators for college success and to determine a student's conditional or unconditional

acceptance. A student accepted on a conditional status will need to take remedial courses prior to attempting standard college curriculum standards.

ACT results from the year 2018, further indicated that underserved students, including low-income, minority, and/or first generation college students, make up 43% of all graduates that take the ACT. Of these underserved, fewer than a fourth showed overall readiness for college coursework. It is imperative that elementary educators continue to search for methods to help close the gap of achievement early on in a student's educational process, which includes assessments such as the ACT Aspire, a predictor of a student's success on the ACT upon its administration in high school.

A level of accountability is placed upon public schools and educators as a whole to be the great equalizer when it comes to closing the documented academic disparities between high and low Socio-Economic Status levels (Reardon, 2013). Therefore, finding effective interventions such as computer assisted programs which improve the educational achievement of disadvantaged children is of considerable importance and a high priority for society as a whole (Dietrichson, et. al. 2017; Sirin, 2005; UNESCO, 1994).

The outcome of this research study confirms that the administrative teams at schools/systems who mirror this particular school system's demographics should take a deeper look at whether or not Compass Learning is the best use of resources, including monetary funding and time, for the purpose of improving academic achievement in reading and mathematics for students in the fourth grade. The results of this study provide recommendations to continue the use of computer based instructional techniques as it is imperative for administrative teams to seek out curriculum resources and tools that

have been proven to be effective at increasing academic achievement in the area of reading and mathematics.

The value of this study is that in this instance it was found that the Compass Learning program was not successful in assisting in closing the respective achievement gaps relative to low Socio-Economic Status. This information is informative and beneficial to teachers who are seeking resources which effectively and specifically address the noted academic achievement gap associated with low Socio-Economic Status, which not only impacts select students, but our society and communities as a whole. It is well documented that there is a strong correlation between education, wealth and good health in the United States. This noted gap could also impact a teacher's employment status in this age of accountability; therefore, knowing what tools work and which do not is of vital importance not only for student achievement, but for an educator's success as well.

Recommendations for Future Research

As a result of the findings of this study, the researcher would recommend that in the schools studied, a similar analysis be performed for all other grades using the Compass Learning program to determine its effectiveness and whether or not resources should continue to be devoted towards its use. Furthermore, a similar study including at least three years should be conducted to validate the information found in this one year study. Additionally, it could prove beneficial to conduct a mix methods qualitative and quantitative study which would include feedback from the stakeholders, the students and teachers, who are charged with using the program. It may also be beneficial to run similar studies in schools/school systems with like demographic backgrounds to further

validate the research found in this study. Additionally, further research should be done regarding the impact of Computer Assisted Learning/Computer Assisted Instruction and its relationship specifically with those students of differing Socio-Economic Status groups. It also needs to be investigated as to whether or not the program studied aligns with the curriculum being taught within the district.

It is further recommended that the school district in question really look at these results along with other data sources to determine if there are any correlations which can assist in the district's decision making moving forward in regard to what is or is not working to reach the academic goals they desire for the students they serve. The results of this study are merely one piece of data, which needs to be viewed in a holistic manner to impact student achievement.

It may be beneficial for the district to seek out immediate student and teacher feedback concerning this particular program to get their sentiments concerning the program. This could help determine if whatever feelings they have in regards to the program impacted the effectiveness of the program in any manner. If the program is not held in high regard and is not being efficiently and effectively used, the district should consider ending the funding along with researching to implement a better program or manner to help effectively and efficiently close the achievement gap existence between the SES groups within the district.

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APPENDIX A

Permission Letter



ENTERPRISE CITY SCHOOLS

OFFICE OF THE SUPERINTENDENT
220 Hutchinson Street
Enterprise, Alabama 36331-1790
(334) 347-9531

Gregory S. Faight
Superintendent of Education

January 8, 2018

To Whom It May Concern:

Zel E. Thomas has been granted permission to use requested de-identified existing data sets from Compass Learning and ACT Aspire coupled with Socio-Economic Status (SES) to complete his study for Auburn University in pursuit of his doctoral degree.

If you have any questions or concerns, please feel free to contact me.

Respectfully,

Greg S. Faight
Superintendent
Enterprise City Schools

APPENDIX B

Auburn University Institutional Review Board Approval

**AUBURN UNIVERSITY INSTITUTIONAL REVIEW BOARD for RESEARCH INVOLVING HUMAN SUBJECTS
REQUEST FOR EXEMPT CATEGORY RESEARCH**

For Information or help completing this form, contact: THE OFFICE OF RESEARCH COMPLIANCE, 115 Ramsay Hall
Phone: 334-844-5966 e-mail: IRBAdmin@auburn.edu Web Address: http://www.auburn.edu/research/vpr/ohs/index.htm

Revised 2/1/2014 Submit completed form to IRBsubmit@auburn.edu or 115 Ramsay Hall, Auburn University 36849.
Form must be populated using Adobe Acrobat / Pro 9 or greater standalone program (do not fill out in browser). Hand written forms will not be accepted.

Project activities may not begin until you have received approval from the Auburn University IRB.

1. PROJECT PERSONNEL & TRAINING

PRINCIPAL INVESTIGATOR (PI):

Name Zel Thomas Title Doctoral Student Dept./School Adult Education
Address 456 Private Road 1703 AU Email zet0001@tigermail.auburn.edu
Phone 334-718-3821 Dept. Head Dr. Sherida Downer

FACULTY ADVISOR (if applicable):

Name Dr. James Witte Title Program Coordinator Dept./School Adult Education
Address Auburn University 4036 Haley Center Auburn, AL 36849
Phone 334-844-3054 AU Email witteje@auburn.edu

KEY PERSONNEL: List Key Personnel (other than PI and FA). Additional personnel may be listed in an attachment.

Name	Title	Institution	Responsibilities
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

KEY PERSONNEL TRAINING: Have all Key Personnel completed CITI Human Research Training (including elective modules related to this research) within the last 3 years? YES NO

TRAINING CERTIFICATES: Please attach CITI completion certificates for all Key Personnel.

2. PROJECT INFORMATION

Title: Effects of Compass Learning's Computer Assistive Instruction Program Effectiveness in Fourth Grade Mathematics and Reading

Source of Funding: Investigator Internal External

List External Agency & Grant Number: N/A

List any contractors, sub-contractors, or other entities associate with this project.

N/A

List any other IRBs associated with this project (including those involved with reviewing, deferring, or determinations).

N/A

FOR ORC OFFICE USE ONLY			
DATE RECEIVED IN ORC:	_____ by _____	APPROVAL	The Auburn University Institutional Review Board has approved this Document for use from <u>02/05/2018</u> to <u>---</u> Protocol # <u>17-442 EX 1802</u>
DATE OF IRB REVIEW:	_____ by _____	APPROVAL C	
DATE OF ORC REVIEW:	_____ by _____	INTERVAL FC	
DATE OF APPROVAL:	_____ by _____		
COMMENTS:			

3. **PROJECT SUMMARY**

a. Does the research involve any special populations?

- YES NO Minors (under age 19)
 YES NO Pregnant women, fetuses, or any products of conception
 YES NO Prisoners or Wards
 YES NO Individuals with compromised autonomy and/or decisional capacity

b. Does the research pose more than minimal risk to participants? YES NO

Minimal risk means that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests. 42 CFR 46.102(j)

c. Does the study involve any of the following?

- YES NO Procedures subject to FDA Regulation Ex. Drugs, biological products, medical devices, etc.
 YES NO Use of school records of identifiable students or information from instructors about specific students
 YES NO Protected health or medical information when there is a direct or indirect link that could identify the participant
 YES NO Collection of sensitive aspects of the participant's own behavior, such as illegal conduct, drug use, sexual behavior or use of alcohol
 YES NO Deception of participants

If you checked "YES" to any response in Question #3 STOP. It is likely that your study does not meet the "EXEMPT" requirements. Please complete a PROTOCOL FORM for Expedited or Full Board Review. You may contact IRB Administration for more information. (Phone: 334-844-5966 or Email: IRBAdmin@auburn.edu)

4. **PROJECT DESCRIPTION**

a. **Subject Population** (Describe, include age, special population characteristics, etc.)

The subject population is limited to fourth grade students within an age range of 8-11 years in a southeastern school district consisting of five elementary schools serving approximately five hundred students collectively.

b. Describe, step by step, all procedures and methods that will be used to consent participants.

- N/A (Existing data will be used)

- c. **Brief summary of project.** (Include the research question(s) and a brief description of the methodology, including recruitment and how data will be collected and protected.)

The research questions for this study are as follows:

- What is the relationship between the Compass supplemental instructional program and Mathematics and Reading achievement?
- What is the relationship between the time spent in Compass and Mathematics and Reading achievement?
- What is the relationship between free/reduced students Compass usage and fourth-grade achievement in Math and Reading as measured by ACT Aspire?

The methods of this study will be quantitative with the data being analyzed via analysis of variances process. The data sources selected for this study are all existing data, which does not involve any direct interaction with the participants to acquire said data. The data sources include student standardized test scores shared with the school district along with time logged on the supplemental instructional program. No names or other identifying variables will be utilized or discussed in the research beyond being in fourth grade and SES as a collective group as the data source will come via a de-identified dataset provided by the school district.

- d. **Waivers.** Check any waivers that apply and describe how the project meets the criteria for the waiver.

- Waiver of Consent (Including existing de-identified data)
- Waiver of Documentation of Consent (Use of Information Letter)
- Waiver of Parental Permission (for college students)

Existing data will be used.

- e. **Attachments.** Please attach Informed Consents, Information Letters, data collection instrument(s), advertisements/recruiting materials, or permission letters/site authorizations as appropriate.

Signature of Investigator	<u>Zel Thomas</u> <small>Digitally signed by Zel Thomas Date: 2017.09.29 15:20:49 -05'00'</small>	Date	<u>September 29, 2017</u>
Signature of Faculty Advisor	<u>James F. Witte</u>	Date	<u>Sep 29, 2017</u>
Signature of Department Head	<u>Sherida Downer</u> <small>Digitally signed by Sherida Downer Date: 2017.10.11 16:07:06 -05'00'</small>	Date	_____