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A STUDY ON THE IMPACT OF KINDERGARTEN ON THE MATHEMATICAL
SKILLS OF AFRICAN AMERICAN STUDENTS

by

Aronda L. Green, M.Ed.

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Dedication

This dissertation is dedicated to my late grandparents—Elverine Rivers Hebert, Amos Deadrick, Mary Lee DeLoach, and David Green—who prayed for me, believed in me, and instilled a belief that I was capable of achieving anything I set out to accomplish. Even in their physical absence, their belief in me continues to encourage me to pursue my goals and assume my position within the family.

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ABSTRACT

A STUDY ON THE IMPACT OF KINDERGARTEN ON THE MATHEMATICAL SKILLS OF AFRICAN AMERICAN STUDENTS

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The specific purpose of this study was to add to the previous research using The Early Childhood Longitudinal Database to examine if there is a difference in the mathematics achievement growth trajectory of African American students based on racial-ethnicity, socioeconomic status, and kindergarten participation (attendance for the first time or repetition). Using a convenience sample, a nationally representative sample of children was identified from archival data that included mathematical assessment scores, student racial-ethnic identity, family socioeconomic status, and kindergarten participation. The researcher used a quantitative study method to test the effects of students' characteristics on their mathematical assessment scores. Data analysis showed math scores generally increased significantly from kindergarten to third grade for all students independent of their subgroup affiliation. However, math scores did not change at the same rate when disaggregated by student ethnicity. The rate of change in student math scores from year to year did not differ significantly relative to income. Overall, however, there was a

significant difference in math scores relative to income. Math scores did not change at the same rate when disaggregated by whether students attended kindergarten for the first time. Overall, however, there was no significant difference in math scores between students who had attended kindergarten for the first time and students who had attended kindergarten more than once.

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CHAPTER I: INTRODUCTION

Extensive evidence indicates that early academic skills are an indicator of later academic achievement; however, there is mixed evidence on the longevity of the impact of intervention on academic skills, with it being unclear if intervention provided in the early years improves later outcomes (Ribner, Willoughby, Blair, & The Family Life Project Key Investigators, 2017). As academic skills develop in the early years, researchers consistently find an academic gap between student ethnic and socioeconomic populations (Ansari, 2018; Hutchinson, Morrissey, & Burgess, 2014; Johnson, 2006; Magnuson, Ruhm, & Waldfogel, 2007). The academic achievement and opportunity gaps among minority students and their peers are an ever-present and increasing area of concern in the field of education despite decades of education reform initiatives. African American students' achievement outcomes differ from those of their White, non-Hispanic peers (Fair, 2018; Hutchinson et al., 2014). Recently, early childhood education is center stage in the discussion of student academic achievement. At no time in America's history has early childhood education ever gained this much attention (U.S. Department of Education, 2015).

For the present study, the researcher explored the achievement gaps between African American students and their peers, and she examined the role of kindergarten participation in predicting third grade mathematical skills. Kindergarten is considered the standard beginning-year of the public education system in the United States, and it is considered an integral part of children's early learning experiences. Historically, kindergarten has been viewed as a semi-structured transitional program for children from ages 4 to 5 years. Over the past two decades, children's experiences in kindergarten have fundamentally changed as a result of kindergarten becoming more of a formal academic

preparation program. Once in kindergarten, how children perform on reading, math, and social-emotional assessments provides insight into their later school achievement and chances for success in adult life (Brown, Englehardt, Barry, & Ku, 2019; Brown & Lan, 2015). Brown et al. (2019) found that gaps in children's academic and social achievement that begin in kindergarten tend to widen during their time in school. Subsequently, the focus of early education intensified on academic skills development and expectations of academic skills that kindergartners must master in to be deemed school ready.

Research Problem

Kindergarten is the most common entry point into public education for children in the United States. An increasing amount of research shows the connection between early childhood intervention and later academic achievement among students (Ansari, 2018; Hutchinson et al., 2014; Johnson, 2006; Magnuson et al., 2007). Research also indicates discrepancies in early childhood programs contribute to the achievement gap (Bassok, Finch, Lee, Reardon, & Waldfogel, 2016; Brown et al., 2019; Lawrence & Mollborn, 2017; Reardon & Portilla, 2016). Significant efforts have been made to level access to quality education once students enter school in kindergarten through the 12th grade; however, research shows a need to provide educational opportunities prior to kindergarten to address the gaps (Ansari, 2018; Johnson, 2006; Langham, 2009; Rosney, 2009; U.S. Department of Education, 2015).

These findings resulted in an increased focus on early childhood initiatives, policies, and reform. Bassok, Latham, and Rorem (2016) stated that there have been substantial increases in both public and private investments in early childhood education. Despite increasing efforts and funding to address the achievement gap, the gap has continued to widen over the years. Therefore, the federal policies addressing early

childhood education and the achievement gap that have been passed over the past 51 years are not enough. Despite the continued education reform and implementation of policies and programs, universal regulations and standards have not been addressed, the federal government still does not regulate kindergarten programs, and state regulations vary widely in both stringency and enforcement.

Public-school kindergarten programming has not been universally defined across the US. Thus, there are vast differences in programs across the states. Programs vary in class sizes, length of school day, eligibility requirements, funding, and so forth. Across the US, families have the option of half-day, full day, free, tuition-based, required, and optional programs. The definition of full-day, and the level at which the program is funded, varies considerably from state to state (Parker, Diffey, & Atchison, 2016).

Kelley, Weyer, McCann, Broom, and Keily (2020) reported 19 states and the District of Columbia require children to attend kindergarten, 17 states and the District of Columbia require full-day kindergarten, and 39 states plus the District of Columbia require districts to offer kindergarten either full or half day. Seventeen states and the District of Columbia require grade retention for non-proficient third graders, with good cause exemptions, and an additional 10 states allow for grade retention (Kelley et al., 2020). These documented program differences show that kindergarten programs fail to offer equitable and effective early childhood programming that can prepare students for future success. It is imperative that federal and state policymakers take an extensive view of kindergarten policies to provide coherent guidelines that serve as the foundation for program implementation, define programs, and outline program accessibility, equity, and quality.

Performance Data

Texas Education Code requires that students in third, fourth, fifth, sixth, seventh, or eighth grades must demonstrate satisfactory performance on the State Assessment of Academic Readiness (Texas Education Code, 2017). Each time a student fails to perform satisfactorily on an assessment instrument administered under Section 39.023(a) in the third, fourth, fifth, sixth, seventh, or eighth grade, the school district in which the student attends school shall provide to the student accelerated instruction in the applicable subject area. A student who fails to perform satisfactorily on an assessment instrument specified under Subsection (a) and who is promoted to the next grade level must complete accelerated instruction required under Subsection (a-1) before placement in the next grade level. A student who fails to complete required accelerated instruction may not be promoted.

Based on historical and current data, strides are needed to close the achievement gap and better prepare students for school. African American students across the United States consistently perform below Caucasian, Asian, and Latino students on standardized assessments. National Assessment of Education Progress score reports consistently show that Caucasian students outperform their non-White peers in achievement (Groenke, Bennett, & Hill, 2012). One could conclude that the majority of programs are not designed to meet the needs of African American students.

Significance of the Study

Children's success in schooling has long been a central focus of research, policy, and practice (Ribner et al., 2017). The media, without fail, reports the message of an ever increasing "gap" that exists between African American and Caucasian students. The focus of many research studies is on the academic achievement gap in the area of reading. Studies center on the subject area of reading due to an abundance of research identifying

reading as the most crucial academic skill because it is the foundation for learning. Without a strong foundation in reading, children are left behind at the beginning of their education journey. One of the most important predictors of graduating from high school is the ability to read proficiently by the end of third grade (Reardon, Valentino, & Shores, 2012; Walz, 2020). To tackle the reading achievement crisis, states implemented a variety of policies intended to help identify reading problems before they become established, and then guide children into instruction to change their academic course.

Students' level of reading and mathematics skills at school entry are strongly predictive of academic achievement in later grades. The database of research regarding the math academic achievement gap is not as extensive and policies do not address the significance of early math achievement on later trajectory. There is a growing body of research that indicates early intervention before and during kindergarten can eliminate the gap in later years (Ansari, 2018; Hutchinson et al., 2014; Johnson, 2006; Magnuson et al., 2007). According to the Texas Commission on Public School Finance (2018), only 58% of students begin their schooling ready for kindergarten. Enrollment in kindergarten exposes students to experiences that can lead to improved social, emotional, and cognitive abilities, with subsequent improvements in academic achievement (Elliott, 2019). A high-quality, developmentally appropriate kindergarten experience may offer the best way to ensure early school success for children who enter school with a wide range of readiness levels (Holloway, 2003). Additional funding, opportunity, and access to early childhood education are needed for families in the United States.

Purpose of the Study

The specific purpose of this study was to add to the previous research using The Early Childhood Longitudinal Database to examine if there is difference in the mathematics achievement growth trajectory of African American students based on

racial-ethnic identity, socioeconomic status, and kindergarten attendance for the first time versus kindergarten repetition. For this quantitative research study, the researcher (a) explored the influence of kindergarten programs on eliminating the achievement gap between African American students and their non-Black peers and (b) examined whether a difference in mathematical skills and school progress exists in third grade between African American students who attended a kindergarten for the first versus the second time. The focus of the study was on examining the impact of kindergarten in increasing African American students' school readiness and later development of mathematical skills in third grade. The researcher used archived data from a national database: Early Childhood Longitudinal Studies Study, Kindergarten (ECLS-K) Class of 2010–2011.

As with reading, the late elementary grades appear to be an important transition time for the development of mathematics ability: Children who fail a math course in sixth grade have a 60% chance of dropping out of high school (Ribner et al., 2017). Though there is extensive research to suggest early mathematical skills are an important predictor of later achievement, math in early elementary grades is often underemphasized in elementary schools (Ribner, 2020; Vanderbilt University, 2013). Claessens and Engel (2013) stated that the research focused specifically on early math skills shows continuity in math achievement over time. Number sense and counting measured in preschool or kindergarten predict later elementary school math achievement test scores (Galindo & Sonnenschein, 2015; Rittle-Johnson, Fyfe, Hofer, & Farran, 2017; Shanley et al., 2017).

Americans have long regarded education as the ticket out of poverty (Langham, 2009). Kindergarten attendance provides multiple benefits to all students, especially African American students. The achievement of African American subgroups is vital to a school's accountability rating. More importantly, it is crucial to their progress as contributing members of society. To meet state accountability standards and remain off

the lists of schools marked for improvement, campuses must meet the needs of African American students and increase their achievement levels. The ultimate goal of this study is to contribute to the research that will help identify which kindergarten practices provide African American students the best opportunities for later mathematics achievement.

As stated in Children's Defense Fund literature, education is the precondition for survival and achievement in America today; yet, every second of the day, a public school student is suspended, and every 11 seconds a high school student drops out. Investing in children is not a luxury or choice—it is a national necessity and a top priority. As stakeholders, we must demand that all children receive a quality education and have safe and loving places to go after school and during the summer (Groenke et al., 2012).

The education system must address the educational needs of all learners. African American students need access to quality early education and specific, individualized instruction aimed at (a) increasing their level of academic success and (b) closing the achievement gap (Jarretta & Coba-Rodriguez, 2019). The gap is more difficult to close than it is to prevent (Barnett, Carolan, & Johns, 2013). Studies show that while there were gaps in kindergarten entry-level reading and math scores between African American students and their peers, this gap increased over a 4-year period (Fair, 2018; Hutchison et al., 2014; Scammacca, Fall, Capin, Roberts, & Swanson, 2020). The problem is the need to (a) close the gap among African American students and their non-Black peers and (b) identify the factors that contribute to the academic success of African American students so that these elements can be developed to provide other students greater opportunities for success.

Research Questions

The researcher reviewed national database archived data on student participation in kindergarten programs and student achievement scores. The analyzed data included student data from kindergarten through their third-grade year. The following are the research questions used to guide this study:

1. Is there a difference in the math scores of students in kindergarten through third grade based on the students' ethnicity?
2. Is there a difference in math scores for African American students in kindergarten through third grade based on their socioeconomic status?
3. Is there a difference in the math scores of students in kindergarten through third grade based on their kindergarten status (i.e., whether they attended kindergarten for the first time or repeated kindergarten)?

Definition of Key Terms

Achievement Gap

The term *achievement gap* refers to the lagging academic performance of one group of students compared to another. Usually, the term is used to refer to the lower scores of Black and Hispanic students compared to White students, the lower scores of low-income students compared to upper- or middle-class students on standardized tests, and other measures of educational achievement (Achievement Gap, 2013; Langham, 2009).

At-Risk Student

At-risk students are students who, through no fault of their own, are at risk of low academic achievement and dropping out before completing high school. The related risk factors include, but are not limited to, disability, poverty, limited English proficiency,

race and/or ethnicity, urbanicity, single-parent status, and low parental educational attainment (Vesely, 2010).

Age-Appropriate Kindergarten Entry

A child's initial entry into formal schooling marks an important developmental transition. The compulsory school entry age is determined according to a child's birthdate relative to a country-specific cut-off date that indicates the start of the academic year (Jaekel, Strauss, Johnson, Gilmore, & Wolke, 2015).

Educationally Disadvantaged Student

Students who are eligible to participate in the National Free or Reduced Price Lunch Program are considered *educationally disadvantaged*. The family income level is determined by household size and income or through categorical eligibility, which serves as a proxy for income data (Hoffman, 2012).

Kindergarten Program

The year kindergarten students spend in kindergarten is a critical year, widely considered a "bridge year," between early learning programs and primary school. Kindergarten programs are intended to enhance children's cognitive, physical, and social development to smooth the transition into formal schooling (Kauerz, 2005).

Kindergarten Student

Students who attend kindergarten (a) are 5 or 6 years of age, (b) meet the state's eligibility requirements, and (c) have participated in a program. As previously stated, the age requirement is based off of the student's age by a specified cut-off date established by the state; the cut-off date typically corresponds to the start of the academic year.

No Child Left Behind (NCLB)

The No Child Left Behind Act of 2001 (known colloquially as NCLB) was signed into law by President George W. Bush on January 8, 2002. NCLB gave U.S. schools

historical education reform based on stronger accountability for results, more freedom for states and communities, proven education methods, and higher parent involvement requirements (NCLB, 2002).

Opportunity Gap

The term *opportunity gap* is used to represent the disparities in opportunities available to children of different racial, ethnic, socioeconomic, and cultural backgrounds for whom engaging, culturally relevant instruction is lacking; expectations are minimal; and resources are scarce. Students from disadvantaged groups tend to underperform compared to their more privileged counterparts (Ladson-Billings, Welner, & Carter, 2013).

School Readiness

In 1991, the National Education Goals Panel adopted as its first goal that “by the year 2000, all children [would] enter school ready to learn” (Kagan, Moore, & Bredekamp, 1995, p. 2). School readiness includes the readiness of the individual child, the school’s abstract readiness for children, and the ability of the family and community to support optimal early child development (Williams, Lerner, American Academy of Pediatrics Council on Early Childhood, & American Academy of Pediatrics Council on School Health, 2019).

Conclusion

To address the ever-increasing achievement gap, it is necessary to review research on successful programs and replicate the findings with larger numbers of students to ensure states provide the best early childhood programming to African American students. The researcher reviews such research in the next chapter.

CHAPTER II:

REVIEW OF THE LITERATURE

The review of literature begins with a review of reform initiatives in the United States that impacted the education system and African American students. The review continues with the body of research on critical race theory (CRT) and the achievement gap in the education system. The primary research question explored in this research study related to whether a difference exists in students' math scores from kindergarten through third grade based on demographic variables. Therefore, the focus of the review of literature is the impact of systemic practices on kindergarten programs and African American students. The topics included in the literature review are the history of kindergarten, the achievement gap, education reform, CRT, and inequality.

History of Kindergarten

Early research credits Friedrich Wilhelm August Froebel, a 19th-century German educator, as the founder of the kindergarten movement and a pioneer of early childhood education (Allen, 2006; Manning, 2005; Tovey, 2016). According to Tovey (2016), Froebel argued that the earliest years of a child's life are the most important as they lay the foundation for all later learning. Froebel established the first kindergarten: a garden where young children could develop at their own pace while nurtured by sensible and supportive adults. Further, Tovey explained that Friedrich Froebel had an enormous influence on early childhood education in the United States.

Kindergarten was transported to the United States by German emigrants. Allen (2006) documented that Margarethe Meyer Schurz emigrated to Wisconsin and set up the first American kindergarten for her own children and those of other German American families in 1855. Kindergarten grew roots in the United States under the leadership of the American kindergarten pioneer, Elizabeth Peabody (Manning, 2005; Russell, 2011).

The kindergarten movement expanded with the first public-school kindergartens being established in St. Louis, and by 1914, most urban school systems incorporated kindergarten on a voluntary basis (Allen, 2006). The American kindergarten became the first class of the elementary school, which was open to 5-year-olds on an optional basis (Allen, 2006).

The turn of the 20th century marked a departure from Frobelian methods, which emphasized theoretical learning, toward a revised pedagogy that stressed practical skills (Allen, 2006; Russell, 2011). Le, Schaack, Neishi, Hernandez, and Blank (2019) noted that kindergarten historically has focused on developing the whole child, and the role of kindergarten in recent years has shifted from a semi-structured transitional program to a formal academic preparation program. Kindergarten is a critical year because it is widely considered a "bridge year" between early learning programs and primary school, intended to enhance children's cognitive, physical, and social development to smooth the transition into formal schooling (Parker et al., 2016). Le et al. (2019) further explained that in recent years, there has been an increased focus on academic skills development as well as increases in the expectations of academic skills that kindergartners need to have to be considered "school ready." Bassok, Finch, et al. (2016) warned that kindergarten in the United States fundamentally transformed over the past two decades in that developmentally appropriate learning practices centered on play, exploration, and social interactions were replaced with highly prescriptive curricula, test preparation, and an explicit focus on academic skill building.

Early childhood is a uniquely formative period in the life span, and research indicates that policy interventions targeted at young children have immense potential to yield high returns (Bassok, Finch, et al., 2016). Parker et al. (2016) reported that kindergarten has been delivered primarily as a half-day program since the Great

Depression, and fundamental changes in American society and education over the past 20 years have supported a greater emphasis on full-day kindergarten. Parker et al. further explained that results of empirical research on the effects of full- versus half-day kindergarten generally show full-day programs have no detrimental effects on children who attend and children who attend full-day kindergarten make significantly stronger academic gains in reading and math over the course of the kindergarten year than their peers in half-day kindergarten. Research shows that longer school days enable children to receive more individualized, academically focused, and meaningful instruction from teachers as well as more time interacting with their peers—both of which can lead to long-term benefits and increased scores in third grade assessments (Cooper, Allen, Patall, & Dent, 2010; Kauerz, 2005; Parker et al., 2016). Consequently, Parker et al. (2016) reported that full-day kindergarten can help to close achievement gaps early on in a child's education.

Kindergarten in the United States has fundamentally changed. Brown et al. (2019) investigated the issue of kindergarten instructional changes through increased academic content and standardized testing by examining how local, state, and national education stakeholders interpreted the changes. Findings indicated that context and connection to kindergarten play an important role in how stakeholders define the purpose and function of kindergarten. The researchers noted that kindergarten is the “new first grade” where children are taught increased academic content through teacher-directed instruction and experience more standardized testing (Brown, Barry, & Ku, 2021; Brown et al., 2019). Brown et al. (2019) further explained that part of these academic and instructional intensifications are the result of the implementation of such standards-based accountability reforms as NCLB. Le et al. (2019) reported that NCLB created an accountability overhaul that changed teachers' instruction in the early grades, despite

these grades' exclusion from the state accountability systems, and led to kindergarten instruction becoming focused more on advanced content. Although NCLB did not require testing for children before the third grade, some researchers argue that the intense pressures that principals and teachers feel about their students' performance on high-stakes assessments led to an emphasis on accountability and the educationalization of early care and education (Bassok, Latham, & Rorem, 2016).

In the United States, NCLB initiated a series of systematic changes for educators prior to kindergarten entry at the national, state, and local levels (Brown & Lan, 2015). Nationwide, the Bush Administration implemented the *Good Start, Grow Smart* initiative shortly after the passage of NCLB, and a segment of the initiative focused on early childhood stakeholders at the state level to define and align a set of knowledge and skills with the content and performance standards that define their state's kindergarten through Grade 12 (K–12) education system (Brown & Lan, 2015). The implementation of early learning standards resulted in states launching kindergarten-readiness assessments, which are used to quantify children's school readiness skills (Brown & Lan, 2015). As a result, both federal and state policymakers continued to make concerted efforts to develop rigorous academic standards and use standardized testing as a primary vehicle to improve children's learning outcomes (Im, Kwon, Jeon, & McGuire, 2019). The importance of the issue resulted in federal funding competitions to ensure the development and enhancement of comprehensive early childhood assessment systems and a level of uniformity to kindergarten entry assessments across the nation (Goldstein & Flake, 2015). Federal investments were the result of a national need for developmentally appropriate, psychometrically sound instruments to monitor young children's learning and development and evaluate the effectiveness of their early childhood learning programs (Goldstein & Flake, 2015). Subsequently, the emphasis of public schools

shifted to the mastery of academic skills, the achievement of predetermined learning outcomes, and the need for accountability (Briggs, Russell, & Wanless, 2018).

As academic standards and accountability expectations increased for schools and teachers, the increased stakes of kindergarten success were passed on to students and families. These increased accountability expectations left schools searching for alternatives to current remediation and intervention practices such as tutoring, summer programs, and transitional kindergarten programs. The result was an increase in kindergarten grade retention. During the last few decades, grade retention has gained increased attention in educational practice and policy. Peixoto et al. (2016) defined grade retention as the practice of requiring a student to repeat a particular grade when he or she does not meet the academic standards of his or her current grade level. Grade retention is commonly considered as an intervention when students experience academic failure, unsatisfactory academic progress, age, poor school attendance, and insufficient examination marks for grade promotion (Anastasiou, Papachristou, & Diakidoy, 2017).

There are differing arguments regarding grade retention and the effects on students. The argument underlying the remedial practice is to provide low-achieving students with an additional opportunity to improve their achievement and meet those standards (Anastasiou et al., 2017; Peixoto et al., 2016). The counter argument to retention is for social promotion. Supporters of social promotion maintain that students fare better academically if they are not retained. The evidence concerning the effectiveness of early grade retention in meeting student's needs is inconclusive, causing the practice of retention to be a controversial topic in education. A consideration for the characteristics of retained students provides cause for concern due to children being described as academically at-risk; younger in age than their classmates; and from a

minority background, lower socio-economic background, or both (Anastasiou et al., 2017; Hwang & Capella, 2018).

Despite the controversy of retention, the practice of grade retention continues to be a response to underachievement. The potential failure of retention to address the needs of at-risk or disadvantaged students effectively renders the practice at odds with proclamations of equal opportunity and education for all (Anastasiou et al., 2017). The National Association of Early Childhood Specialists in State Departments of Education (2000) responded to the changes in kindergarten standards and expectations with a position statement regarding entry and placement in kindergarten. They asserted that retention is “rejected as a viable option for young children . . . [because] it is not perpetuated on the basis of false assumptions as to its educational benefit” (p. 5). The lack of irrefutable research to support the practice of kindergarten retention indicates the need to explore educational responses to underachievement in kindergarten systematically.

State achievement data for third through 12th grades on the State of Texas Assessments of Academic Readiness for the 2017–2018 academic year still indicate an achievement gap between subpopulations such as economically disadvantaged families and non-disadvantaged families, minority students and their peers, and English language learners and native English speakers (Texas Education Agency, 2018). The *2018–2019 State Accountability Report* indicated that for Grades 3–12, academic achievement in math, 34% African American students met or exceeded grade-level standards while their counterparts scored higher; specifically, 44% of Hispanic students, 61% of White students, and 83% of Asian students met or exceeded grade-level standards. Regarding socioeconomic status, 40% of economically disadvantaged students met or exceeded standards. In the area of academic growth for math, 66% of African Americans students

approached grade level progress while, again, their counterparts scored higher: 69% of Hispanic students, 72% of White students, 85% of Asian students, and 68% of economically disadvantaged students approached grade level progress (Texas Education Agency, 2018).

Legislators continue to trend toward high-stakes testing and accountability demands, which affects early childhood education. Policymakers focus on the early childhood years as a critical point in developing the essential knowledge and skills that form the foundation of future academic success. This alignment places additional focus on school readiness by ensuring children are prepared for kindergarten and equipped with the abilities for future academic achievement.

Research shows that there is no single definition of school readiness. Most commonly, school readiness is regarded in terms of children's development (e.g., physical, cognitive, linguistic, academic, social-emotional) upon school entry. Another definition involves seeing school readiness as an "interactional relational" model in which readiness is "the product of a set of educational decisions that are differentially shaped by the skills, experiences and learning opportunities the child has had and the perspectives and goals of the community, classroom and teacher" (Williams et al., 2019, p. 4). Most schools in the United States rely on age alone to determine when a child is ready to enter kindergarten. This enrollment criterion does not place a focus on the physical, social, emotional, and cognitive development of children nor does it consider that these competencies vary greatly in 4- and 5-year-olds. The National Association for the Education of Young Children (NAEYC; 2009) supports the idea that kindergarten entry should be based on age, not on mastery of skills.

"Readiness" implies the mastery of certain basic skills and developments that serve as a baseline for a child's school success. One of the most widely recognized risk

factors for school readiness is poverty. Fewer than half (48%) of poor children are ready for school at 5 years of age as compared with 75% of children from moderate- or high-income households. Poverty affects school readiness across racial and ethnic divisions, likely because of a lack of financial resources, parents having less education, higher rates of single and teenage parenthood, poorer health, and so on (Williams et al., 2019). The National Education Goals Panel (as cited in Maxwell & Clifford, 2004) leads the charge with defining

school readiness and broadening the understanding of school readiness beyond baseline assessments. School readiness, in the broadest sense, is about children, families, early environments, schools, and communities. Children are not innately “ready” or “not ready” for school; rather, their skills and development are strongly influenced by their families and through their interactions with other people and environments before coming to school. (p. 42)

Children’s readiness for kindergarten should become an outcome measure for a coordinated system of community-based programs and supports for the healthy development of young children (Williams et al., 2019).

The NAEYC (2009) argued it is the responsibility of schools to meet the needs of children as they enter school and to provide whatever services are needed to help each child reach his or her fullest potential. The NAEYC reaffirmed its position on school readiness in 2009 by asserting that a commitment to promoting universal school readiness requires

1. giving all children access to the opportunities that promote school success,
2. recognizing and supporting children’s individual differences, and
3. establishing reasonable and appropriate expectations for what children should be able to do when they enter school (NAEYC, 2009, p. 1).

The early years of a child's life lay the foundation for future academic and social success (Brown et al., 2021; Brown & Lan, 2015; Burchinal et al., 2019). Despite the attention and focus on school readiness in recent years, research still shows a gap between the academic abilities of high- and low-income, and Black and White children before they enter kindergarten (Galindo & Sonnenschein, 2015; Henry, Cortes, & Votruba-Drzal, 2020; Hutchison et al., 2014; Presser, Celements, Ginsburg, & Ertle, 2015; Rittle-Johnson et al., 2017).

The Achievement Gap

The White–Black Achievement Gap

Closing the White–Black test score gap is a persistent challenge in the American educational landscape as it has long existed within schools. There has been extensive research into the White–Black achievement gap over the last few decades. Reardon and Portilla (2016) examined income and racial–ethnic achievement gaps as well as trends in multiple dimensions of school readiness of children born from the early 1990s to the 2000–2010. Merolla and Jackson (2019) reviewed studies from the past 10 years under the broad headings of the effects of socioeconomic status and family cultural resources, residential and school segregation, and bias and discrimination in schools on the academic achievement gap using primarily quantitative methods and national data. Reardon and Portilla reported that the White–Black and White–Hispanic academic achievement gaps narrowed over the last decade or more while Merolla and Jackson reported that the achievement gap is ever present; moreover, Merolla and Jackson argued that the fundamental cause of the gaps is structural racism—that is, a system of social organization that privileges White Americans and disadvantages Americans of color. Lawrence and Mollborn (2017) found that racial–ethnic identity is a major factor in the

US's social stratification and educational inequity. Quinn (2015) described that the increasingly larger role that education plays in social stratification brings additional urgency to understanding the sources of achievement gaps. Therefore, it is imperative to identify the mechanisms that can explain why Black students continue to achieve at lower levels than their White counterparts and examine educational practices to minimize this long-standing gap.

The correlation between socioeconomic status and educational achievement is well known and documented. Reardon and Portilla (2016) expressed that racial, ethnic, and income disparities in performance on standardized tests of academic achievement are a stubborn feature of the American educational landscape. Galindo and Sonnenschein (2015) used data from the ECLS-K cohort to investigate two factors that could be associated with the math achievement gap in kindergarten related to socioeconomic status. The two potential factors were (a) starting kindergarten with age-appropriate math skills and (b) children's home learning environments. Galino and Sonnenschein stated that children from low socioeconomic status families are more likely to start school with lower academic skills, and differences between low socioeconomic status children and their higher-status peers continue or expand as children proceed through school (Henry et al., 2020; Hutchison et al., 2014; Presser et al., 2015; Rittle-Johnson et al., 2017). Yeh (2019) further explained that the conventional view of the Black–White student achievement gap is that the origin can be traced to sociocultural and socioeconomic factors. For example, Black and Hispanic family incomes and wealth are lower, on average, compared to the income and wealth of White households. According to Yeh (2019),

These differences in income and wealth are associated with differences in educational opportunities that are available to Black and Hispanic children, versus

White children, and these differences in opportunities are associated with differences in achievement that exist when children enter kindergarten. (p. 1)

If stakeholders expect to close the achievement gap between advantaged and disadvantaged students, a more cohesive national plan recognizing the role of early childhood education is required (Barnett, 2005).

History of Educational Reform

Merolla and Jackson (2019) explained that in the six decades since the Supreme Court ruled that all American children have the right to a high-quality education, the academic achievement gap remained an important social problem. Fair (2018) stated that despite the *Brown v. Board of Education* statement that education "is a right which must be available to all on equal terms" (p. 31), the reality of "equal terms" does not yet exist. In 1954, the *Brown v. Board of Education of Topeka* case involved the four states of Kansas, South Carolina, Virginia, and Delaware and the battle over the constitutionality of the segregation of children based solely on race. The state of education deprived Black children of the equal protection of the laws as guaranteed by the Fourteenth Amendment of the U.S. Constitution (Gooden & Dorsey, 2014). The plaintiffs argued not only that black schools were unequal to White schools in terms of buildings, books, resources, and other tangible factors, but also that the Black schools would never be equal so long as there was state-mandated segregation (Onwuachi-Willig, 2019). The U.S. Supreme Court held that state-mandated racial segregation in public schools violated the Equal Protection Clause of the Constitution (Onwuachi-Willig, 2019). The ruling reversed *Plessy v. Ferguson* and held that "separate but equal" as a practice was unconstitutional in the case of education and led to dramatic changes in schools throughout the country. The decision provided an important stimulus for the civil rights movement, not only for African Americans but also for other marginalized groups

(Weinstein, Gregory, & Strambler, 2004). Fair (2018) further explained that historical analysis of the years following *Brown v. Board of Education* shows that the United States has failed in creating equity in education for African Americans.

1954–1964: Civil Rights and Legal Remedies for Desegregation

Racial integration of schools proved not to be readily attainable (Weinstein et al., 2004). On September 4, 1957, nine black students attempted to desegregate Central High School in the Arkansas state capital (Roberts, 2017). Governor Orval Faubus ordered the Arkansas National Guard to surround Central High and keep the students from entering. On September 20, a federal judge ordered the removal of the troops and 3 days later, the students entered Central High. This was met with massive resistance and rioting that prompted President Eisenhower to send federal armed troops to Arkansas. On September 26, 1957, Central High School was integrated under orders from President Eisenhower for federal troops to escort the “Little Rock Nine” into the school. Access to integrated schools did not ensure a quality education for all children or freedom from prejudicial treatment (Weinstein et al., 2004). Desegregation of schools through forced busing was undermined over the long haul by public resistance, White flight, implementation delays, and successive court rulings that diminished the teeth of the mandate (Weinstein et al., 2004).

Despite widespread resistance to desegregation in the South, President Lyndon Johnson signed into law the Civil Rights Act of 1964 on July 2, 1964. The act prohibited discrimination in public places, provided for the integration of schools and other public facilities, and made employment discrimination illegal (Center for Legislative Archives, 2019). The Civil Rights Act also provided measures by which the federal government could enforce desegregation with Title IV (Fair, 2018).

On April 11, 1965, President Johnson passed the Elementary and Secondary Education Act (ESEA), which provided additional resources for vulnerable students and, with Title I of the Act, provided the necessary provisions to allocate this funding. Title I of the act directed funding at improving the education of poor students (Langham, 2009). The funding of state early childhood programs was put into place by the Title I of ESEA. The law also provided federal grants to state educational agencies that serve areas with high concentrations of children from low-income families to expand and improve the quality of elementary and secondary education. The purpose of this act was to ensure that all children have a fair, equal, and significant opportunity to obtain a high-quality education and reach, at a minimum, proficiency on challenging state academic achievement standards and state academic assessments (United States Department of Education, Office of State Support, 2015). Although the general idea behind the ESEA was widely accepted, its expansion of the federal role in education had its share of critics (Thomas & Brady, 2005).

1980–2000: Educational Reform and Reduction of Federal Involvement

While desegregation efforts continued and the federal role in education increased with the passing of the ESEA, the election of President Ronald Reagan in 1980 continued the trend established by President Nixon. On August 13, 1981, President Reagan signed the Education Consolidation and Improvement Act into law. The act eliminated federal interference in the nation's schools and education fiscal policy (Thomas & Brady, 2005). Under the new legislation, 43 elementary and secondary categorical aid programs were repealed and consolidated into a single block grant (Verstegen, 1985), which led to decreased funding and greater local control over educational decision making.

President George H. W. Bush's election in 1988 continued the agenda of reducing the federal government's role in education and fiscal ownership and responsibility within

education. In 1989, President Bush developed *America 2000: An Education Strategy* with the intent to increase state accountability and raise academic standards. The foundation for *America 2000* planted under Bush was continued by President William J. Clinton, who served on the Governors Committee as Governor of Arkansas (Fair, 2018).

2000–Present: More Reform and Accountability

Building on the Bush administration’s work, The Goals 2000: Educate America Act was sent to Congress by President Clinton (Council for Exceptional Children, 1994). It provided resources to states and communities to ensure that all students reach their full potential. The Goals 2000 legislation codified the national education goals and offered grants to states that committed to specific plans for systematic reform of K–12 education. Goals 2000 included testing of reading and mathematics skills to ensure such students met these standards (Council for Exceptional Children, 1994). It reflected the nation's increased awareness that early childhood experiences influence school performance and included eight goals:

1. By the year 2000, all children in America will start school ready to learn.
2. By the year 2000, the high school graduation rate will increase to at least 90 percent.
3. By the year 2000, all students will leave grades 4, 8, and 12 having demonstrated competency over challenging subject matter including English, mathematics, science, foreign languages, civics and government, economics, arts, history, and geography, and every school in America will ensure that all students learn to use their minds well, so they may be prepared for responsible citizenship, further learning, and productive employment in our Nation’s modern economy.

4. By the year 2000, the Nation's teaching force will have access to programs for the continued improvement of their professional skills and the opportunity to acquire the knowledge and skills needed to instruct and prepare all American students for the next century.
5. By the year 2000, United States students will be first in the world in mathematics and science achievement.
6. By the year 2000, every adult American will be literate and will possess the knowledge and skills necessary to compete in a global economy and exercise the rights and responsibilities of citizenship.
7. By the year 2000, every school in the United States will be free of drugs, violence, and the unauthorized presence of firearms and alcohol and will offer a disciplined environment conducive to learning.
8. By the year 2000, every school will promote partnerships that will increase parental involvement and participation in promoting the social, emotional, and academic growth of children (Council for Exceptional Children, 1994).

In 2002, President George W. Bush signed the NCLB, which reauthorized the ESEA. The NCLB focused on improving the academic achievement of the disadvantaged by implementing academic standards and more accountability via standardized assessments. The NCLB also addressed early childhood education and supported local efforts to (a) enhance the early language, literacy, and pre-reading development of preschool age children, particularly those from low-income families, and (b) provide preschool-aged children with cognitive learning opportunities in high-quality language and literature-rich environments; this was to ensure the children attain the fundamental knowledge and skills necessary for optimal reading development in kindergarten and beyond (NCLB, 2002). The subparts' sole purpose was to help break the cycle of poverty and illiteracy by

improving the educational opportunities of the nation's low-income families (NCLB, 2002).

Congress did not reauthorize the NCLB after 2001 and did not reauthorize the ESEA until 2015. The Every Student Succeeds Act was signed by President Obama on December 10, 2015 to reauthorize the 50-year-old ESEA. President Obama's Early Learning Initiative is the most recent federal plan to address early childhood intervention and attempt to expand access to services (Rosney, 2009; U.S. Department of Health and Human Services, Office of Early Childhood Development, 2013). This plan provided access to high-quality infant and toddler care through Early Head Start–child care partnerships; expanded voluntary, evidence-based home visiting to support the country's most vulnerable families; and developed a new partnership with states to provide voluntary, high-quality, full-day preschool for all 4-year-olds from families at or below 200% of the federal poverty line (U.S. Department of Health and Human Services, Office of Early Childhood Development, 2013). The Early Learning Initiative continued to receive funding under President Trump's administration.

There is an extensive history of education reform in the country. It is evident that the disparities created by decades of policy are tremendous. Subsequently, there is no speedy solution. Rothstein (2014) noted that stakeholders cannot substantially improve the performance of the poorest African American students—the truly disadvantaged—by efforts focused on school reform alone. Rather, Rothstein (2014) argued “It must be addressed primarily by improving the social and economic conditions that bring too many children to school unprepared to take advantage of what even the best schools have to offer” (p. 21).

Educational Inequality (Racial, Social, and Economic Disadvantage)

The achievement gap denotes a lack of educational inequality that is neither unknown nor uncommunicated. Yet, almost 55 years after the Coleman *Equality of Educational Opportunity* report published in 1966, and 12 years after the *Brown v. Board of Education* decision, educational researchers are discussing the same educational inequities. Reardon (2015) explained that the position of the Coleman Report was to evaluate the scope to which Black and White students attended schools of different quality and the relationship between measures of material school quality and academic achievement. Reardon (2015) interpreted Coleman's findings and further clarified that "the negative association of segregation with academic achievement disparities appears to have been largely driven by differences in the socioeconomic composition of the schools where black and white students were enrolled" (p. 35). Reardon (2015) further expressed that additional research showed both the racial and socioeconomic composition of schools are strongly related to student outcomes. Merolla and Jackson (2019) reaffirmed what previous researchers found and stated that, given that race is a potent predictor of socioeconomic status in American society and that minority students are more likely to hail from families that are disadvantaged on essentially all indicators of socioeconomic status, the centrality of socioeconomic disadvantage to educational disparities is difficult to overstate (Merolla & Jackson, 2019, p. 4). Education can serve as the societal "gateway" for students of color. Noguera, Pierce, and Ahram (2015) explained that education can either serve as the ultimate guardian and guarantor of the American Dream or as the means through which existing inequities are reproduced over time (Noguera et al., 2015, p. 3). Therefore, it is the duty of stakeholders to act using the research and tools available, one of which is the composition of schools.

Mathematics Achievement

Proficiency in mathematics is critical to academic, economic, and life success (Rittle-Johnson et al., 2017). Studies indicate that early elementary mathematics achievement is an important prerequisite for future math learning and academic achievement (Claessens & Engel, 2013; Presser et al., 2015; Rittle-Johnson et al., 2017; Shanley et al., 2017). Math proficiency at kindergarten is defined as proficient at aspects of number sense skills. Early number skills, composed of both informal and formal skills, are essential building blocks and are an important predictor of more advanced math skills and later mathematics achievement (Claessens & Engel, 2013; Galindo & Sonnenschein, 2015; Shanley et al., 2017). Thus, the development of foundational early number skills is an important aspect of early mathematics instruction. Shanley et al. (2017) measured gains in early number skills and explored relationships between early number skills gains and global mathematics achievement for students at risk for mathematics difficulties in kindergarten intervention. Results indicated strong relationships between formal number skills gains and mathematics achievements across kindergarten and showed that formal and informal number skills gains may be necessary components of later mathematics achievement for all learners. Shanley et al. (2017) stated that early number skills, which are often introduced prior to school entry, are linked to future mathematics achievement, and students enter kindergarten with a range of preschool experiences and widely variable academic skills. Thus, kindergarten is an especially critical time for establishing strong conceptual foundations and setting students up for success. Children who start school with a limited number sense continue to have difficulties as they proceed through elementary school (Galindo & Sonnenschein, 2015). The need for effective, research-based instruction has also been reiterated by national organizations. The NAEYC and the National Council of Teachers of Mathematics

(2010) recommended that early childhood programs include a challenging, research-based, developmentally appropriate mathematics curriculum to support effective mathematics learning. Given the critical role of early number skills in mathematics development, a focus on early number skills in kindergarten is crucial to closing achievement gaps.

At school entry, Black children tend to be behind White children in reading skills and even further behind in math skills, and these gaps widen further by fifth grade (Hutchison et al., 2014). American children's performance on mathematics assessments is lower than that of children from several other developed countries and below what experts deem proficient (Presser et al., 2015). This finding has been consistently documented on national achievement assessments such as the National Assessment of Educational Progress and the Programme for International Student Assessment. Galindo and Sonnenschein (2015) stated that many children in the US, particularly from low socioeconomic status backgrounds, do not develop sufficient math skills to be competitive in today's technological world, and children from low socioeconomic status backgrounds generally enter kindergarten with more limited math skills than their middle-income peers. Rittle-Johnson et al. (2017) proposed and evaluated within a longitudinal study of low-income American children from ages 4 to 11 an early math trajectories model that focuses on time points when individual differences in knowledge of a particular topic are sufficient to predict later mathematics knowledge, as indicated by prior knowledge. Their research findings support the early math trajectories model among low-income children. As a result of research indicating a decline in mathematics achievement, there is growing recognition of the importance of early childhood education and the significant investment that accompanied the recognition. Educators, researchers, and policymakers increased their attention to the quality of early childhood mathematics

education in light of growing concerns about young children's early mathematics knowledge (Presser et al., 2015).

Theoretical Framework: Critical Race Theory, History of Educational Reform, & Inequality

The theoretical framework for this research study was CRT (Ducir & Dixon, 2004). CRT took off in the mid-1970s with the realization that the Civil Rights Movement of the 1960s had stalled and that many of its gains were being rolled back (Delgado & Stefancic, 1993). The pioneers of CRT believed that new tactics and theories were needed to understand and approach the complex interplay among race, racism, and American law (Delgado & Stefancic, 1993). The foundation of CRT is racism and racial inequality (Ducir & Dixon, 2004; Howard & Navarro, 2016; Reece, 2019). The tenets of CRT are the intractability of racism and racial inequality and the structure in place that reproduces and maintains inequality (Ducir & Dixon, 2004; Howard & Navarro, 2016; Reece, 2019).

In the early 1990s, educational scholars Gloria Ladson-Billings and William Tate applied multicultural education theory, research, and practice with CRT to the discourse in the field of education. Their work on CRT and education provided a spotlight on the prominence of race, school, and educational outcomes (Howard & Navarro, 2016). Howard and Navarro (2016) stated that Gloria Ladson-Billings and William Tate built on the work of multicultural scholars and critical race scholars in the legal field by suggesting that social inequity in education was based on three central propositions: (a) race continues to be a significant factor in determining inequity in the United States, (b) U.S. society is based on property rights, and (c) the intersection of race and property creates an analytical tool through which citizens and scholars can understand social and school inequity.

Ladson-Billings and Tate, along with other multicultural scholars, offered frameworks to show that the students who were silenced were not the sole sources for disparate outcomes; rather, institutional practices and curriculum were also involved in creating conditions that were not often sensitive to, or inclusive of, the needs of non-White students (Howard & Navarro, 2016). The premise of this study is that the “gap” among African American students and their non-White peers is continuously influenced by education reform policies and the marginalization of racially and culturally inclusive approaches to teaching (Howard & Navarro, 2016).

CRT focuses on the relationship between race, racism, and power within American society. Fair (2018) and DeCuir and Dixson (2004) noted that the use of CRT in education began with court cases that directly and indirectly affected the famous *Brown v. Board of Education* decision. As legal researchers and scholars used the CRT perspective to examine such cases, educators realized the breadth of CRT could be applied to other educational issues that affected students of color. Howard and Navarro (2016) clarified that CRT within the field of education has since become an evolving methodological, conceptual, and theoretical construct used to disrupt race and racism in educational theory and practice.

In 2016, Howard and Navarro outlined and described five basic tenets of CRT to guide research and inquiry on educational equity and racial justice:

1. The centrality of race and racism—that is, all CRT research within education must centralize race and racism, including intersections with other forms of subordination such as gender, class, and citizenship;
2. Challenging the dominant perspective—that is, CRT research works to challenge dominant narratives and re-center marginalized perspectives;

3. Commitment to social justice—that is, CRT research must always be motivated by social justice agenda;
4. Valuing experiential knowledge—that is, CRT builds on the oral traditions of many indigenous communities of color around the world and CRT research centers the narratives of people of color when attempting to understand social inequity; and
5. Being interdisciplinary—that is, CRT scholars believe that the world is multidimensional and, similarly, research about the world should reflect multiple perspectives.

Fair (2018) found that each of these CRT tenets are critical components of a race-conscious lens used to analyze the policies, procedures, and practices adopted in education.

This study used CRT as the lens for interpreting data from the ECLS-K (2011 cohort) and to address possible sources of the achievement gap in student math outcomes among African American students during early elementary school. This is an appropriate theory to use, as the basis of CRT is the belief that racism continues to play a significant role in conditioning current American society. Fair (2018) argued that critical race theorists acknowledge progress has been made, but they argue that changes in education are too incremental and do not address race directly enough to be effective. Fair further explained that CRT highlights the prominent role of racism in society and, in this case, the public institution of education. Mansfield and Thachik (2016) described that in CRT, researchers place race at the center of their analyses, which enabled a fuller understanding of whether educational policy adequately addresses the concerns of minority populations to bring about effectual change. The use of CRT to examine education involves exploring the insights and concerns related to students of color and

their educational experiences. If stakeholders are to eliminate the opportunity gap and perceived achievement gap, they must review educational policy and evaluate the system.

Conclusion

In this chapter, some history of kindergarten was presented and discussed, along with the changing instructional expectations of the program, which are a result of education reform policies. Increasing academic standards, years of policy change, and the implementation of standardized testing initiatives have not proven to be sufficient in closing the achievement gap. Next, the researcher reviewed studies of the racial and income achievement gaps between African American students and their peers. As long as inequality is present in the U.S. education system, the achievement gap will remain. Following this discussion, the researcher reviewed studies on early numeracy skills and mathematics achievement to illustrate the importance of developing these skills early in students' academic careers. Lastly, the researcher introduced CRT as the theoretical framework of the study.

CHAPTER III: METHODOLOGY

Overview of the Research Problem

The goal of this study was to help identify which kindergarten practices provide African American students the best opportunities for later mathematics achievement. The researcher focused on the impact of kindergarten and later development of mathematical skills as well as the critical elements that should be considered when focusing on the achievement gap. The literature review included the history of kindergarten, the achievement gap, mathematics achievement, and education inequities.

Operationalization of Student Achievement

The researcher focused on the measure of African American students' later development of mathematical skills. Development was operationalized using scores on the mathematical thinking portion of the assessment. The assessment was designed to measure skills in conceptual knowledge, procedural knowledge, and problem solving. Assessment questions were developed to address skills in the areas of number sense, properties, and operations; measurement; geometry and spatial sense; data analysis, statistics, and probability; and patterns, algebra, and functions.

Research Purpose and Questions

The purpose of this study was to examine whether a difference in development of mathematical skills exists in third grade between African American students based on racial-ethnic identity, socioeconomic status, and who attended a kindergarten program for the first time or repeated kindergarten. To address the achievement gap between African American students and their Caucasian counterparts in the third grade, it is critical to determine whether kindergarten programs provide African American students the

mathematics skills they need. The results of the study provide additional information regarding the effectiveness of kindergarten programs in closing the achievement gap.

This quantitative analysis created a means to investigate three research questions. The three research questions examined throughout the research process were as follows:

1. Is there a difference in the math scores of kindergarten through third-grade students by ethnic identity?
2. Is there a difference in kindergarten through third-grade African American students' math scores by socioeconomic status?
3. Is there a difference in the kindergarten through third-grade students' math scores by kindergarten status (i.e., whether he or she attended kindergarten for the first time or repeated kindergarten)?

Research Design

To evaluate the effectiveness of kindergarten programs on later development of mathematical skills, the researcher used a quantitative study design. A non-experimental, causal-comparative research design was used to assess the relationship between student kindergarten participation and later development of mathematical skills in third grade. The independent variables are the students' first or repeated participation in a kindergarten program, racial-ethnic identity, and socioeconomic status. The dependent variable is students' performance on mathematical assessments. To answer the research questions, the researcher collected and analyzed archived student performance data from their kindergarten through third-grade years.

Population and Sample

The population of this study is African American students in kindergarten through Grade 3 who participated in the Early Childhood Longitudinal Studies Study; specifically, this study involved students who were included in the 2011 cohort of the

ECLS-K. The convenience sample included a nationally representative sample of children from kindergarten through their elementary school years during the school years spanning from 2010–2016. Data were taken from the ECLS-K Class of 2010–11 Database, which stores data on students in schools that submit voluntary kindergarten data. The ECLS-K study is sponsored by the National Center for Education Statistics within the Institute of Education Sciences of the U.S. Department of Education.

Instrumentation

The ECLS-K math assessment contained items designed to measure children's conceptual knowledge, procedural knowledge, and problem-solving skills. Specifically, the test items were developed to assess children's skills in number sense, properties, and operations; measurement; geometry and spatial sense; data analysis, statistics, and probability; and patterns, algebra, and functions. All children included in the study completed a set of 18 routing items and the children's score on these items determined which second-stage test (low, middle, or high difficulty) the child received. For the mathematics assessment, students received paper and a pencil and students were reminded of their availability as part of the protocol. Each of the second-stage mathematics assessment tests also contained items for which wooden blocks were available, but not required, for children to use in solving the problems (Tourangeau et al., 2015).

The student cognitive assessments given in math by the ECLS-K staff members are copyrighted; therefore, examples are not included in this dissertation. Students began with a language screening. After the language screening, students completed a series of tests to determine their cognitive ability in math. For kindergarten through third grade, students completed the assessments in a one-on-one setting with trained evaluators for the untimed cognitive assessments. The evaluators administered the assessment on an easel

so participants could see stimuli, and they read aloud the text presented to participants on the page to reduce the likelihood that the students' reading skills affected their math assessment performance. Detailed descriptions and examples of the assessments, or the questions included, are not available for various parts of the student assessments and questionnaire items. The advantage of using the ECLS-K is that the assessment tools have already been tested for validity and reliability by researchers with the United States Department of Education; thus, they are considered sound instruments for the study. Reliability and validity of this measure were reported in the *User's Manual for the ECLS-K:2011 Kindergarten Data File and Electronic Codebook, Public Version* (Tourangeau et al., 2015).

Data Collection Procedures

ECLS_K Dataset

During the 2010–2011 school year, the experimenters collected data from approximately 18,000 kindergartners from approximately 970 schools during the fall and spring semesters. They also collected data from the participating students' parents, teachers, school administrators, and before- and after-school care providers. The participating students completed various assessments containing age- and grade-appropriate items designed to measure cognitive skills and knowledge students should have learned during the fall and spring. A trained assessor administered the assessments directly to the sampled children, one-on-one, via computer-assisted personal interviewing and did not include time restrictions. The experimenters also used telephone and in-person computer-assisted interviews to collect information from parents during each data collection round. Finally, data collection included self-report assessments completed by participating students' general classroom teachers (both in fall and spring), school

administrators (during spring data collection), and before- and after-school care providers (during spring data collection).

Study Data Collection

Data for the 2011 cohort of the ECLS-K were released in a public-use version. The ECLS-K data are available in an electronic codebook that permits analysts to extract files for analysis. Data retrieved from the public file included the students' racial–ethnic identity, socioeconomic status, mathematical scale scores, and kindergarten participation—all of which were used for the study. The sample included White, African American, and Hispanic students, while American Indian, Asian, Hawaiian, and mixed-race categories were omitted. Once the researcher determined each student's socioeconomic status, she placed students in one of three categories: low, medium, and high. The researcher then identified the African American students included in the ECLS-K dataset and isolated their archived kindergarten, first, second, and third grade math assessment data, which were collected from 2010–2014. During the fall and spring data collections, each participating student completed an assessment in kindergarten (fall 2010 and spring 2011), first (fall 2011 and spring 2012), and second (fall 2012 and spring 2013) grades to determine their mathematics level. For third grade, participating students completed only one assessment, which was during spring data collection (spring 2014).

The experimenters who collected the data used the assessment to establish an initial mathematics level and establish a baseline for measuring future growth in conceptual knowledge, procedural knowledge, and problem solving. The assessment consisted of questions on number sense, properties, and operations; measurement; geometry and spatial sense; data analysis, statistics, and probability; and patterns, algebra, and functions. The researcher used the archived scores from 2010–2014 for the

purposes of measuring growth in those three areas of conceptual knowledge, procedural knowledge, and problem solving.

Data Analysis

The researcher used correlations analysis to compare cognitive assessment, race and ethnicity, as well as socioeconomic status across subpopulations of students. To answer the three research questions, the researcher analyzed the data using a repeated measures ANOVA in SPSS. Specifically, the goal for analysis was to determine the impact of participation in kindergarten programs on students' later development of mathematical skills in third grade. This analysis was conducted on the publicly accessible ECLS-K data for the 2011 cohort.

After analyzing the data, the researcher determined whether to reject or fail to reject the following hypotheses:

1. The difference in students' mathematics assessment scores from kindergarten through third grade will increase when disaggregated by racial–ethnic identity.
2. The difference in African American students' mathematics assessment scores from kindergarten through third grade will increase when disaggregated by socioeconomic status.
3. The difference in students' mathematics assessment scores from kindergarten through third grade will increase when disaggregated by kindergarten status (i.e., whether they attended kindergarten for the first time or repeated).

Privacy and Ethical Considerations

The researcher fulfilled all requirements of the University of Houston-Clear Lake's Committee for the Protection of Human Subjects. Since the study included archived data, the researcher did not need to collect forms, participant student assents, parental consent, or principal informed consent. Committee for the Protection of Human

Subjects permission was obtained prior to initiating the study. The researcher did not need to take special steps to protect participant confidentiality as the publicly available data file did not include identifying information.

Conclusion

The gap in standardized test scores between African American students and their peers is well documented and has been extensively studied (Hanushek, Peterson, Talpey, & Woessmann, 2019; Walz, 2020). It has been more than 60 years since the *Brown v. Board of Education* decision, and many Americans believed the United States would be a land of educational opportunity for all. The historical overview in the beginning of this dissertation included multiple attempts by the US government to address disparities in the educational system. Regardless of intent, the attempts fell short, and the failing education system still does not meet the needs of a large sector of society. The systematic attempts to provide equity failed in part, if not wholly, because the research (and, therefore, the plans based on the research) is grounded in a deficit framework.

CHAPTER IV:

RESULTS

Introduction

The purpose of this study was to add to the previous research using the 2011 cohort of the ECLS-K by identifying the factors and attributes that contribute to academically successful African American students' later development of mathematical skills in third grade. In this quantitative research study, the researcher explored (a) the influence of kindergarten programs on eliminating the achievement gap between African American students and their non-Black peers and (b) whether African American students' mathematical skills and school progress in third grade differed based on whether they attended a kindergarten program for the first time or repeated kindergarten. The researcher focused on examining the impact of attending kindergarten on African American students' school readiness and later development of mathematical skills in third grade. The research questions and associated hypotheses were as follows:

1. When disaggregated by racial–ethnic identity, does the difference in students' mathematics assessment scores increase from their kindergarten to third grade years?

H₀. From kindergarten through third grade, the difference in students' mathematics assessment scores will not increase significantly when disaggregated by racial–ethnic identity.

H_A. From kindergarten through third grade, the difference in students' mathematics assessment scores will increase significantly when disaggregated by racial–ethnic identity.

2. When disaggregated by socioeconomic status (i.e., low, medium, high), does the difference in African American students' mathematics assessment scores increase from their kindergarten to third grade years?

H₀. From kindergarten through third grade, the difference in African American students' mathematics assessment scores will not increase significantly when disaggregated by socioeconomic status.

H_A. From kindergarten through third grade, the difference in African American students' mathematics assessment scores will increase significantly when disaggregated by socioeconomic status.

3. Is there a difference in students' kindergarten through third-grade math scores from by kindergarten status (i.e., whether they attended kindergarten)?

H₀. From kindergarten through third grade, the difference in the students' mathematics assessment scores will not increase significantly when disaggregated by kindergarten status (i.e., whether the student attended kindergarten).

H_A. From kindergarten through third grade, the difference in the mathematics assessment scores will increase significantly when disaggregated by kindergarten status (i.e., whether the student attended kindergarten).

Chapter IV is organized by a discussion of the sample demographics, descriptive statistics, research questions and hypotheses testing, and a summary of the results. The researcher analyzed data with SPSS 23 for Windows. The following section includes a discussion of the sample demographics.

Sample Demographics

The researcher extracted the variables of interest from the dataset, which initially consisted of data from 18,174 students. Regarding racial–ethnic identity, 56.2% ($n = 8,488$) of the sample identified as White (non-Hispanic), 15.9% ($n = 2,396$) as Black/African American (non-Hispanic), and 27.9% ($n = 4,207$) as Hispanic. The researcher categorized each participant based on their reported parental income status; specifically, the categories consisted of low income (\$45,000 or less), medium income (\$45,001 to \$60,000), and high income (\$60,001 or higher). Thus, 46.1% ($n = 6,235$) of students were classified as of low socioeconomic status, 9.9% ($n = 1,339$) as of medium socioeconomic status, and 44.0% ($n = 5,956$) as of high socioeconomic status. Most students attended kindergarten once whereas 5.3% ($n = 835$) attended kindergarten more than once. Table 1 represents a summary of the sample demographics.

Table 1
Sample Demographics

Variable	Description	n	%
Racial–Ethnic Identity	White (Non-Hispanic)	8,488	56.2
	Black/African American (Non-Hispanic)	2,396	15.9
	Hispanic	4,207	27.9
	Total	15,091	100.0
Income	Low (\$45,000 or less)	6,235	46.1
	Medium (\$45,001 - \$60,000)	1,339	9.9
	High (\$60,001 or higher)	5,956	44.0
	Total	13,530	100.0
Kindergarten Status	No	835	5.3
	Yes	15,042	94.7
	Total	15,877	100.0

Descriptive Statistics

For kindergarten, math scores ranged from 11.96 to 132.66 ($M = 35.56$, $SD = 11.64$) for fall 2010 and ranged from 11.75 to 112.54 ($M = 49.86$, $SD = 13.34$) for spring 2011. First grade math scores ranged from 14.46 to 140.01 ($M = 57.71$, $SD = 14.44$) for fall 2011 and ranged from 12.27 to 138.92 ($M = 72.25$, $SD = 15.73$) for spring 2012. Second grade math scores ranged from 13.63 to 139.96 ($M = 76.64$, $SD = 16.41$) for fall 2012 and ranged from 18.24 to 139.10 ($M = 89.86$, $SD = 18.24$) for spring 2013. Third grade math scores for Spring 2014 ranged from 43.41 to 147.89 ($M = 103.69$, $SD = 18.04$). Table 2 represents a summary of the descriptive statistics for the math scores.

Table 2
Descriptive Statistics

Math Score	<i>n</i>	<i>Minimum</i>	<i>Maximum</i>	<i>M</i>	<i>SD</i>
Kindergarten Fall 2010	15,595	11.96	132.66	35.56	11.64
Kindergarten Spring 2011	17,143	11.75	112.54	49.86	13.34
1st Grade Fall 2011	5,222	14.46	140.01	57.71	14.44
1st Grade Spring 2012	15,103	12.27	138.92	72.25	15.73
2nd Grade Fall 2012	4,729	13.63	139.96	76.64	16.41
2nd Grade Spring 2013	13,830	18.24	139.10	89.86	18.24
3rd Grade Spring 2014	12,866	43.41	147.89	103.69	18.04
Valid N (listwise)	3,663				

Research Question 1

Research Question 1 related to whether there was a difference in students' math scores from kindergarten through third grade based on their reported racial–ethnic identity. The researcher used a mixed design ANOVA, which is a combination of a repeated measures ANOVA and a between-subjects ANOVA. The repeated measures were the students' math scores from kindergarten to third grade. The between-subjects

variables were the students' reported racial–ethnic groups (i.e., White, Black or African American, or Hispanic). Group means for math scores by racial–ethnic identity from kindergarten to third grade are presented in Table 3.

Table 3
Group Means for Math Scores by Ethnicity from Kindergarten to Third Grade

Math Score	Race/Ethnicity	<i>M</i>	<i>SD</i>	<i>n</i>
Kindergarten Fall 2010	White	39.36	11.92	1,436
	Black/African American	32.24	9.16	341
	Hispanic	30.79	9.98	1,338
	Total	34.90	11.60	3,115
Kindergarten Spring 2011	White	53.51	12.76	1,436
	Black/African American	44.26	11.20	341
	Hispanic	45.05	11.88	1,338
	Total	48.87	12.96	3,115
1st Grade Fall 2011	White	62.34	14.24	1,436
	Black/African American	52.88	12.69	341
	Hispanic	53.61	12.48	1,338
	Total	57.55	14.05	3,115
1st Grade Spring 2012	White	77.22	14.77	1,436
	Black/African American	65.26	13.10	341
	Hispanic	66.00	13.53	1,338
	Total	71.09	15.17	3,115
2nd Grade Fall 2012	White	82.55	15.64	1,436
	Black/African American	69.86	13.25	341
	Hispanic	71.01	14.04	1,338
	Total	76.20	15.85	3,115
2nd Grade Spring 2013	White	95.35	16.37	1,436
	Black/African American	79.75	16.27	341
	Hispanic	82.72	15.89	1,338
	Total	88.22	17.47	3,115
3rd Grade Spring 2014	White	109.03	15.66	1,436
	Black/African American	92.64	17.17	341
	Hispanic	97.23	16.88	1,338
	Total	102.17	17.60	3,115

Levene's test for equality of error variances indicated that the assumption was not violated for two out of seven distributions. However, the assumption was violated for five out of seven distributions. Therefore, the results should be interpreted with caution. The full results from the Levene's test are reported in Table 4.

In addition, the researcher tested the assumption of sphericity with Mauchly's test of sphericity, which indicated that the assumption was violated, $W(20) = 2981.37, p < .001$. This was signified by having a p -values of less than .05. When this assumption is violated, SPSS automatically corrects for it by adjusting the degrees of freedom. Based on the values provided for the Greenhouse-Geisser estimates of sphericity, when epsilon (ϵ) is greater than .75, the Huynh-Feldt correction should be used. When epsilon (ϵ) is less than .75, the Greenhouse-Geisser correction should be used. As shown in the results of the analysis, there was a significant within-subjects effect, $F(4.24, 13185.67) = 21987.86, p < .001$; partial $\eta^2 = .88$, observed power = 1.00. This is illustrated in Figure 1. There was a significant within and between-subjects interaction, $F(8.47, 13185.67) = 45.23, p < .001$; partial $\eta^2 = .03$, observed power = 1.00. This is illustrated in Figure 2.

Table 4
Levene's Test for Equality of Error Variances for Math Score by Racial–Ethnic Identity

Math Score	F	df_1	df_2	p
Kindergarten Fall 2010	20.91	2	3112	.000
Kindergarten Spring 2011	1.68	2	3112	.187
1st Grade Fall 2011	13.90	2	3112	.000
1st Grade Spring 2012	20.73	2	3112	.000
2nd Grade Fall 2012	27.34	2	3112	.000
2nd Grade Spring 2013	.58	2	3112	.562
3rd Grade Spring 2014	11.76	2	3112	.000

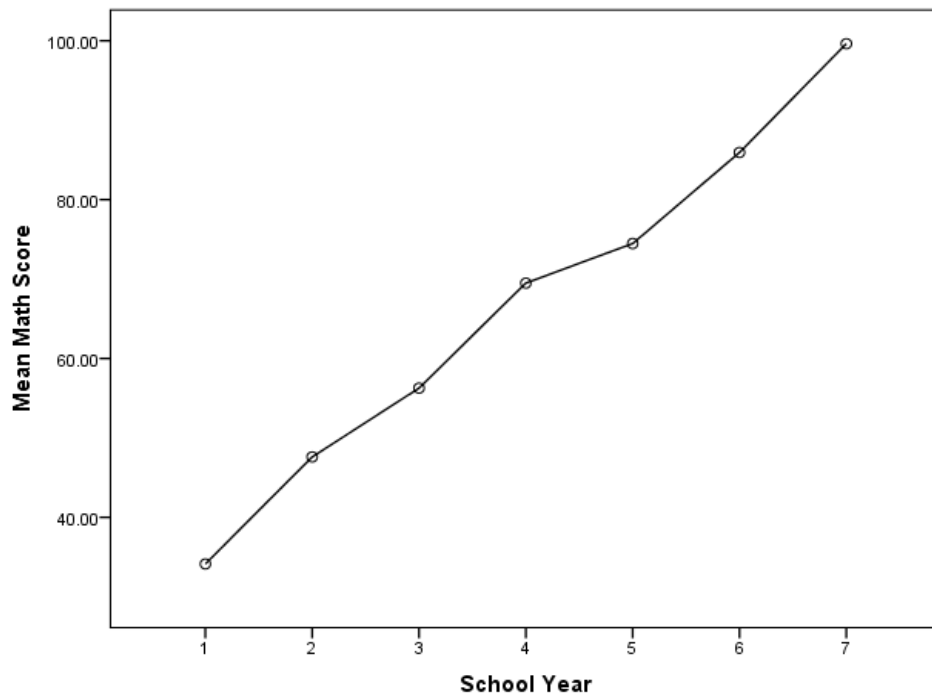


Figure 1. Math scores by school year.

The numbers on the x-axis correspond with the assessment administrations, with 1 and 2 representing the fall 2010 and spring 2011 kindergarten administrations, respectively; 3 and 4 representing the fall 2011 and spring 2012 first-grade administrations, respectively; 5 and 6 representing the fall 2012 and spring 2013 second-grade administrations, respectively; and 7 representing the spring 2014 third-grade administration.

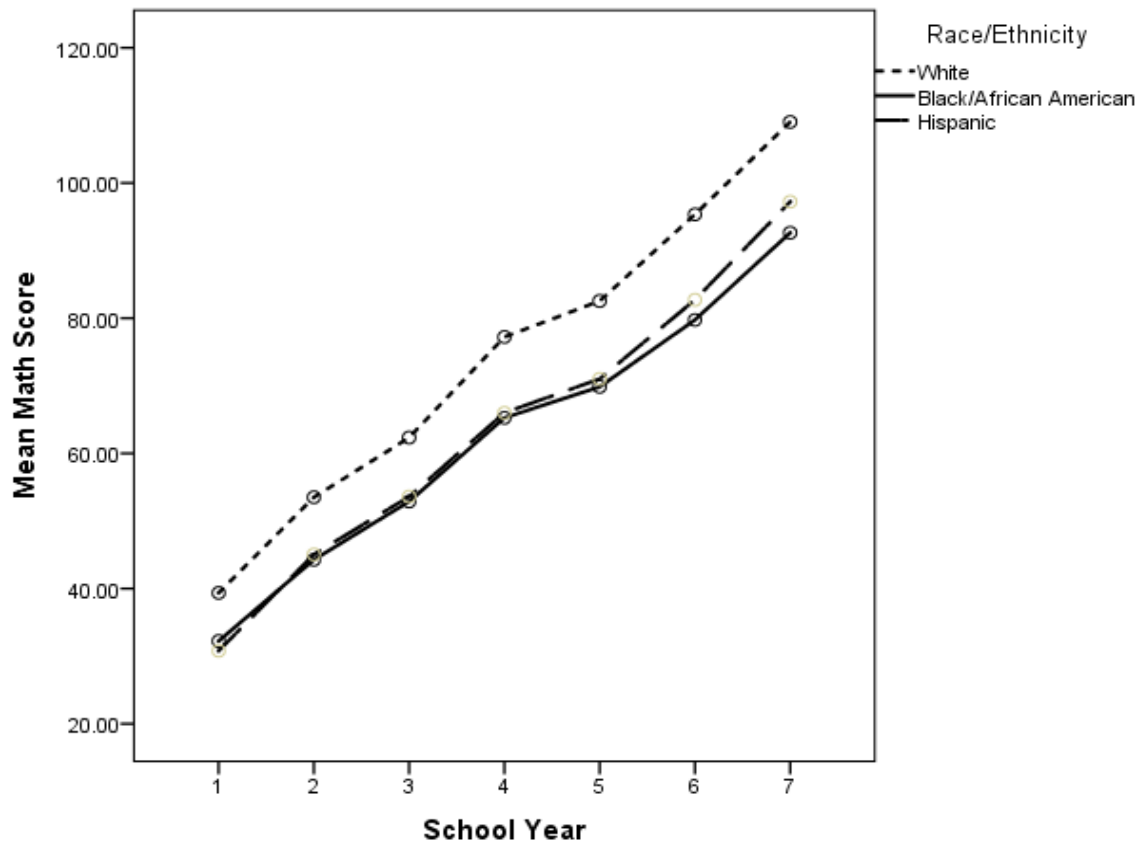


Figure 2. Math scores by school year and ethnicity.

The numbers on the x-axis correspond with the assessment administrations, with 1 and 2 representing the fall 2010 and spring 2011 kindergarten administrations, respectively; 3 and 4 representing the fall 2011 and spring 2012 first-grade administrations, respectively; 5 and 6 representing the fall 2012 and spring 2013 second-grade administrations, respectively; and 7 representing the spring 2014 third-grade administration.

There was a significant between-subjects effect, $F(2, 3112) = 282.86, p < .001$; partial $\eta^2 = .15$, observed power = 1.00. Scheffe post hoc comparisons revealed significant math score differences between White students and African American students ($p < .001$) and between White students and Hispanic students ($p < .001$). However, there was no significant difference between Hispanic students and African American students relative to their math scores ($p = .202$). This is illustrated in Figure 3.

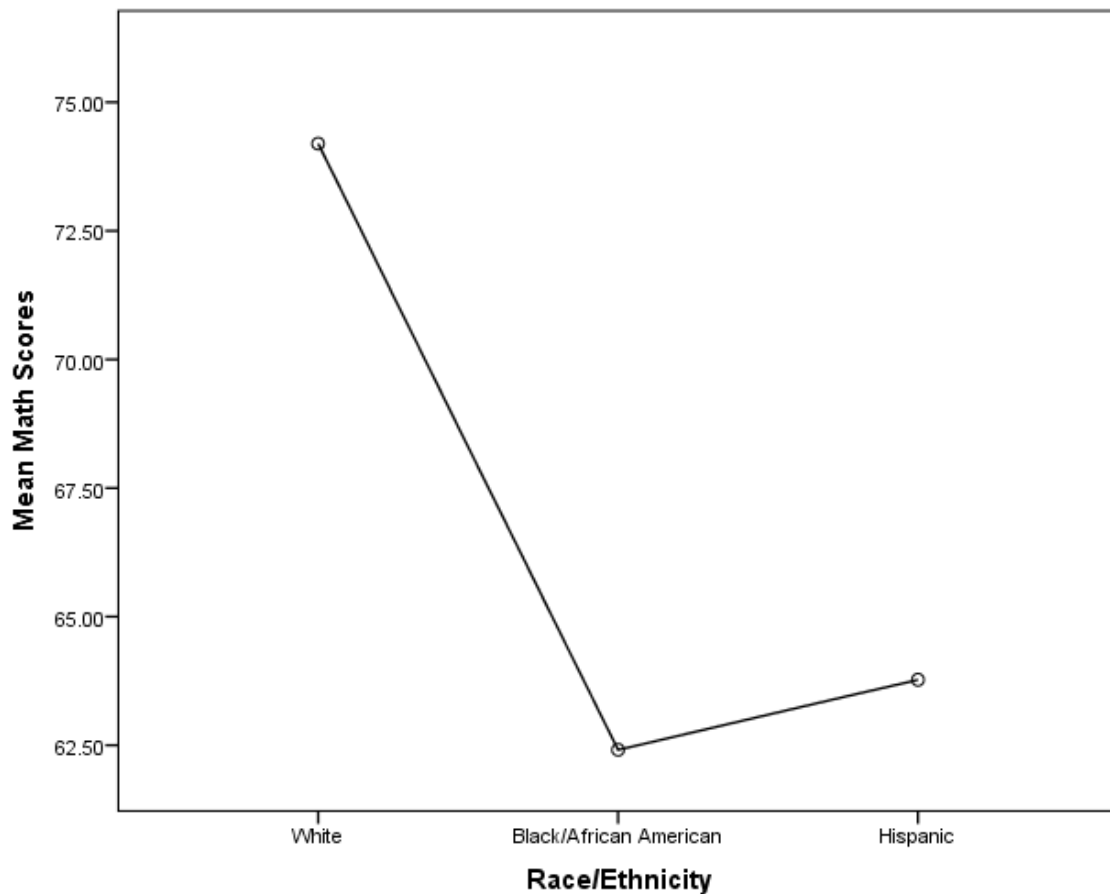


Figure 3. Math score by racial–ethnic identity.

The null hypothesis related to Research Question 1 stated that from kindergarten through third grade, the difference in students’ mathematics assessment scores did not increase significantly when disaggregated by racial–ethnic identity. However, there was a significant within and between-subjects interaction, $F(8.47, 13185.67) = 45.23, p < .001$; partial $\eta^2 = .03$, observed power = 1.00; that is, the math scores increased significantly across school years, but they did not increase at the same rate relative to racial–ethnic identity. Therefore, the null hypothesis was rejected.

Research Question 2

For Research Question 2, the researcher aimed to determine whether there is a difference in African American students’ kindergarten through third-grade math scores

by socioeconomic status. To accomplish this, the researcher used a mixed design ANOVA. The repeated measures were the students' math scores from kindergarten to third grade. The between-subjects variable was the reported level of income (low, medium, and high) of students' parents. Group means for math scores by income from kindergarten to third grade are presented in Table 5.

Levene's test for equality of error variances indicated that the assumption was met for six out of seven distributions. However, the assumption was violated for one out of seven distributions. Therefore, this assumption does not influence how the findings should be interpreted. The full results for the Levene's test are reported in Table 6.

Table 5
Group Means for Math Scores by Income from Kindergarten to Third Grade

Math Score	Income	<i>M</i>	<i>SD</i>	<i>n</i>
Kindergarten Fall 2010	Low	31.15	8.74	171
	Medium	33.08	10.33	24
	High	38.07	9.92	59
	Total	32.94	9.59	254
Kindergarten Spring 2011	Low	42.74	11.22	171
	Medium	44.84	12.18	24
	High	50.19	11.13	59
	Total	44.67	11.66	254
1st Grade Fall 2011	Low	51.24	12.84	171
	Medium	53.21	12.32	24
	High	59.44	13.67	59
	Total	53.33	13.38	254
1st Grade Spring 2012	Low	63.93	14.01	171
	Medium	66.14	14.03	24
	High	70.85	12.75	59
	Total	65.75	13.97	254
2nd Grade Fall 2012	Low	68.47	13.69	171
	Medium	69.33	13.93	24
	High	76.35	13.36	59
	Total	70.38	13.98	254
2nd Grade Spring 2013	Low	77.65	16.93	171
	Medium	83.76	18.50	24
	High	86.36	14.81	59
	Total	80.25	16.98	254
3rd Grade Spring 2014	Low	91.08	17.72	171
	Medium	96.47	18.39	24
	High	99.64	14.32	59
	Total	93.58	17.38	254

Note. Low-income households make \$45,000 annually or less, medium-income households make from \$45,001 to \$60,000 annually, and high-income households make \$60,001 annually or more.

Table 6

Levene's Test for Equality of Error Variances for Math Scores by Income

Math Score	<i>F</i>	<i>df</i> ₁	<i>df</i> ₂	<i>p</i>
Kindergarten Fall 2010	2.08	2	251	.128
Kindergarten Spring 2011	0.20	2	251	.822
1st Grade Fall 2011	0.05	2	251	.952
1st Grade Spring 2012	0.06	2	251	.938
2nd Grade Fall 2012	0.30	2	251	.740
2nd Grade Spring 2013	0.81	2	251	.447
3rd Grade Spring 2014	3.21	2	251	.042

There was no significant interaction between income and assessment administration, $F(7.67, 962.87) = 1.11, p = .351$; partial $\eta^2 = .009$, observed power = .51. This is illustrated in Figure 4. There was a significant effect of income on math assessment scores, $F(2, 251) = 8.92, p < .001$; partial $\eta^2 = .07$, observed power = .97. Scheffe post hoc comparisons revealed significant math score differences between low- and high-income students ($p < .001$). That was the only significant pairwise comparison. There was no significant difference in math scores between medium-income and high-income students ($p = .264$) or between medium-income and low-income students ($p = .548$). This is illustrated in Figure 5.

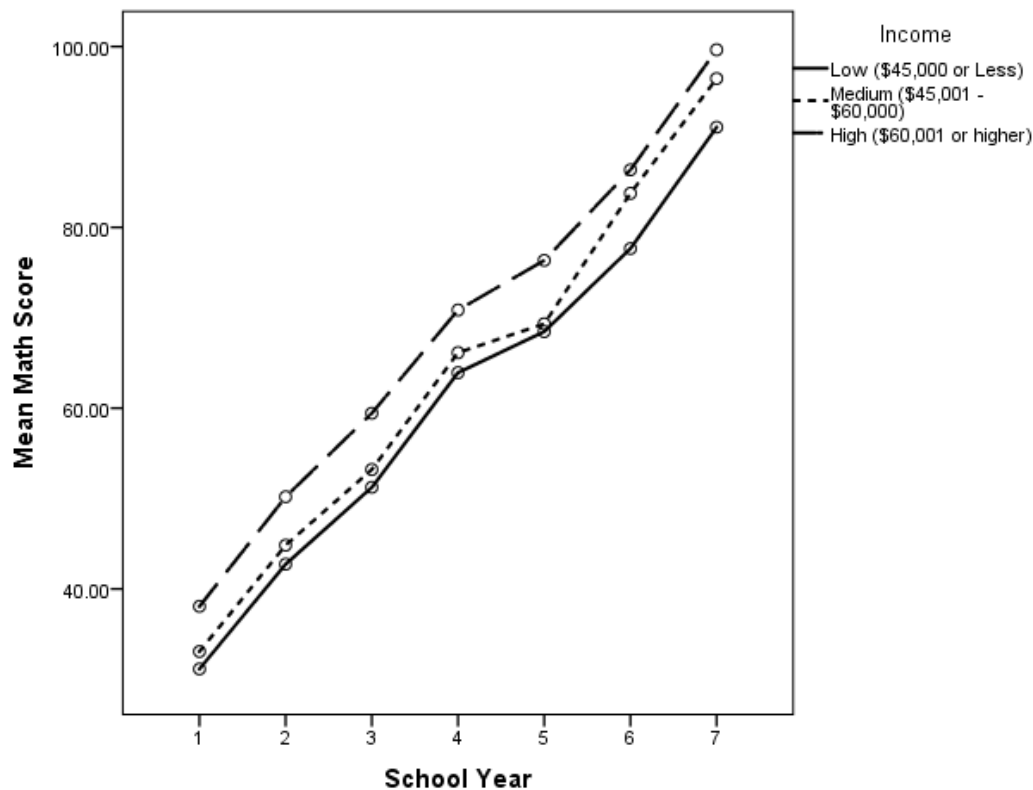


Figure 4. Math scores by school year and income.

The numbers on the x-axis correspond with the assessment administrations, with 1 and 2 representing the fall 2010 and spring 2011 kindergarten administrations, respectively; 3 and 4 representing the fall 2011 and spring 2012 first-grade administrations, respectively; 5 and 6 representing the fall 2012 and spring 2013 second-grade administrations, respectively; and 7 representing the spring 2014 third-grade administration.

The null hypothesis related to Research Question 2 stated that from kindergarten through third grade, the difference in African American students' mathematics assessment scores would not increase significantly when disaggregated by socioeconomic status. There was no significant interaction between household income and assessment administration, $F(7.67, 962.87) = 1.11, p = .351$; partial $\eta^2 = .009$, observed power = .51. Therefore, the null hypothesis was not rejected. While the scores increased significantly for all income groups, they did not increase significantly when disaggregated by income. In other words, they increased at the same rate.

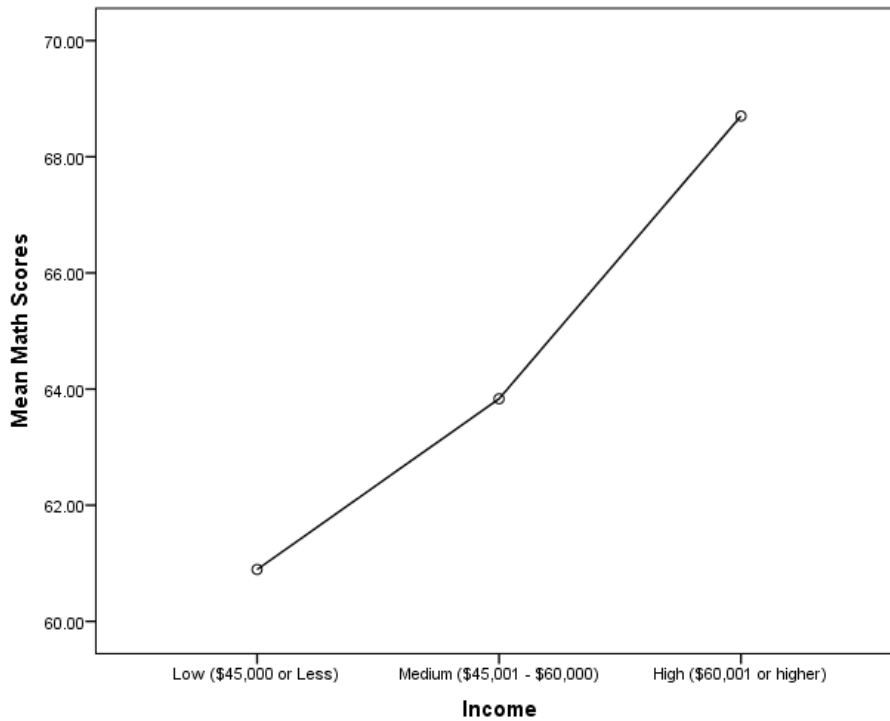


Figure 5. Math scores by income.

Research Question 3

Research Question 3 relates to whether there is a difference in students' math scores from kindergarten through third grade by kindergarten status (i.e., whether the student attended kindergarten for the first time or repeated). The researcher answered this question using a mixed design ANOVA. The repeated measure was the students' math scores from kindergarten to third grade. The between subjects variable was whether the student attended kindergarten for the first time (yes or no). Group means for math scores by kindergarten status from kindergarten to third grade are presented in Table 7.

Table 7
Group Means for Math Scores by Kindergarten Status from Kindergarten to Third Grade

Math Score	Kindergarten Status	<i>M</i>	<i>SD</i>	<i>n</i>
Kindergarten Fall 2010	No	37.47	13.23	143
	Yes	35.35	11.73	3,453
	Total	35.43	11.79	3,596
Kindergarten Spring 2011	No	51.02	14.48	143
	Yes	49.36	13.03	3,453
	Total	49.42	13.10	3,596
1st Grade Fall 2011	No	58.23	15.34	143
	Yes	58.12	14.04	3,453
	Total	58.12	14.09	3,596
1st Grade Spring 2012	No	70.80	16.61	143
	Yes	71.87	15.19	3,453
	Total	71.83	15.25	3,596
2nd Grade Fall 2012	No	74.90	17.28	143
	Yes	77.16	15.97	3,453
	Total	77.07	16.02	3,596
2nd Grade Spring 2013	No	86.27	19.57	143
	Yes	89.35	17.48	3,453
	Total	89.23	17.57	3,596
3rd Grade Spring 2014	No	97.74	19.85	143
	Yes	103.32	17.46	3,453
	Total	103.10	17.60	3,596

Levene's test for equality of error variances indicated that the assumption was not violated for five out of seven distributions. However, the assumption had been violated for two out of seven distributions. Since only two out of seven distributions did not meet the equality of error variances assumption, the violation of this assumption was not deemed problematic. See Table 8.

Table 8

Levene's Test for Equality of Error Variances for Math Score by Kindergarten Status

Math Score	<i>F</i>	<i>df</i> ₁	<i>df</i> ₂	<i>p</i>
Kindergarten Fall 2010	3.75	1	3594	.053
Kindergarten Spring 2011	3.80	1	3594	.051
1st Grade Fall 2011	3.61	1	3594	.058
1st Grade Spring 2012	1.07	1	3594	.301
2nd Grade Fall 2012	1.91	1	3594	.167
2nd Grade Spring 2013	4.38	1	3594	.036
3rd Grade Spring 2014	12.85	1	3594	.000

The assumption of sphericity was examined with Mauchly's test of sphericity, which indicated that the assumption was violated, $W(20) = 3765.54, p < .001$. This was signified by having *p*-values of less than .05. Based on guidance when this assumption is violated, SPSS automatically corrects for it by adjusting the degrees of freedom. As stated previously, when epsilon (ϵ) is greater than .75, the Huynh-Feldt correction should be used and when it is less than .75, the Greenhouse-Geisser correction should be used. Therefore, SPSS used the Greenhouse-Geisser correction. As stated previously, there was a significant effect of school year, $F(4.07, 14643.32) = 5511.57, p < .001$; partial $\eta^2 = .61$, observed power = 1.00. This means that on average, students' math scores increased as they progressed from kindergarten to third grade (see Figure 6). There was a significant interaction between kindergarten status and school year, $F(4.07, 14643.32) = 21.04, p < .001$; partial $\eta^2 = .006$, observed power = 1.00. This is illustrated in Figure 7. There was no significant effect of kindergarten status, $F(1, 3594) = 0.97, p = .324$; partial $\eta^2 = 0$, observed power = .17. This means that kindergarten status alone did not influence students' math assessment scores across time.

The null hypothesis related to Research Question 3 stated that from kindergarten through third grade, the difference in the mathematics assessment scores would not

increase significantly when disaggregated by kindergarten status (i.e., whether the student attended kindergarten). There was a significant interaction between kindergarten status and school year, $F(4.07, 14643.32) = 21.04, p < .001$; partial $\eta^2 = .006$, observed power = 1.00. This means that scores did not increase at the same rate relative to whether students attended kindergarten. The hypotheses tested by the researcher and the outcomes are summarized in Table 9.

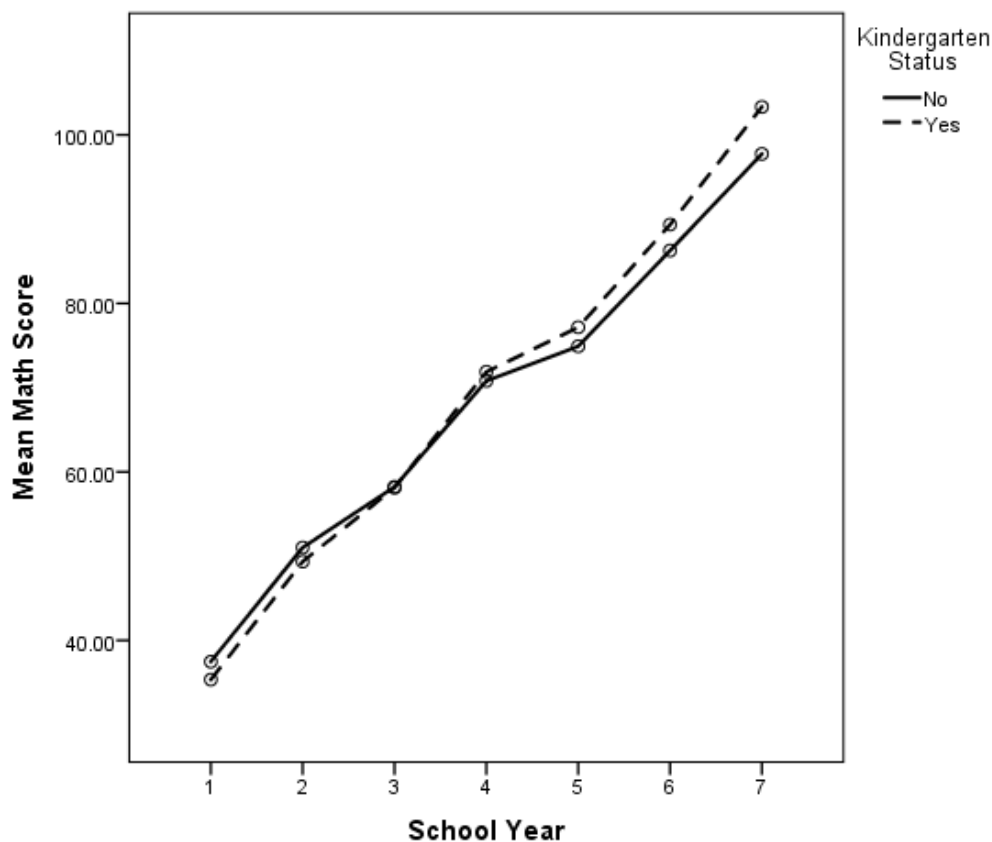


Figure 6. Math scores by school year and kindergarten status.

The numbers on the x-axis correspond with the assessment administrations, with 1 and 2 representing the fall 2010 and spring 2011 kindergarten administrations, respectively; 3 and 4 representing the fall 2011 and spring 2012 first-grade administrations, respectively; 5 and 6 representing the fall 2012 and spring 2013 second-grade administrations, respectively; and 7 representing the spring 2014 third-grade administration.

Table 9
Hypothesis Summary and Outcomes

No.	Hypothesis	<i>p</i>	Outcome
1	From kindergarten through third grade, the difference in students' mathematics assessment scores will not increase significantly when disaggregated by race/ethnicity.	< .001	Null rejected
2	From kindergarten through third grade, the difference in African American students' mathematics assessment scores will not increase significantly when disaggregated by socioeconomic status.	.351	Null not rejected
3	From kindergarten through third grade, the difference in the mathematics assessment scores will not increase significantly when disaggregated by kindergarten status (i.e., whether they attended kindergarten for the first time).	< .001	Null rejected

Note. The hypothesis number corresponds to the research question to which the hypothesis is related.

Summary

Three research questions and hypotheses were formulated for investigation. Math scores generally increased significantly from kindergarten to third grade for all students independent of their subgroup affiliation. However, math scores did not change at the same rate when disaggregated by student ethnicity. For White students, scores improved more dramatically from the second to the third grade than for Hispanic and African American students. For Hispanic and African American students, the change in math scores appeared to be remarkably similar. Overall, math scores for White students were significantly higher than scores for African American and Hispanic students. However, math scores for African American and Hispanic students did not differ significantly.

The rate of change in student math scores from year to year did not differ significantly relative to their parents' income. Overall, however, there was a significant difference in math scores relative to income. Specifically, higher-income students had significantly higher math scores than lower-income students. Math scores did not change

at the same rate when disaggregated by whether students attended kindergarten for the first time. Scores increased more dramatically from the first to the third grade for students who had attended kindergarten for the first time than for students who had attended kindergarten more than once. Overall, however, there was no significant difference in math scores between students who attended kindergarten once and students who had attended kindergarten more than once. Recommendations and limitations are discussed in Chapter 5.

CHAPTER V: SUMMARY, DISCUSSION OF FINDINGS, IMPLICATIONS, AND RECOMMENDATIONS

In this chapter, the researcher provides a summary of the study, a discussion of the findings of the analysis presented in Chapter 4, and conclusions based on the findings. Additionally, the researcher provides recommendations for future research studies to investigate early childhood mathematics skill development.

Summary of Findings

The purpose of this study was to provide an analysis of how kindergarten participation impacts African American students' school readiness and later development of mathematical skills from kindergarten through the end of third grade. In addition, the researcher examined whether a difference in mathematical skills and school progress exists in third grade between African American students who attended a kindergarten program for the first time or those who repeated kindergarten. Lastly, the researcher explored the influence of kindergarten program attendance on eliminating the achievement gap between African American students and their non-Black peers. The study provided information regarding the effectiveness of kindergarten programs in closing the achievement gap. The researcher designed this study to employ a non-experimental, causal-comparative research methodology using archival data.

The first of the three research questions is as follows: Is there a difference in the math scores of kindergarten through third-grade students by racial-ethnic identity? The researcher answered this question; specifically, the results from the analysis indicated that there was a significant within and between-subjects effect on students' math scores based on their reported racial-ethnic identity. The Scheffe post hoc comparison showed significant math score differences between White and African American students and

between White and Hispanic students. White students had higher math theta scores than their African American and Hispanic peers upon entering kindergarten. By the end of third grade, this gap increased. There was no significant difference between Hispanic and African American students' math scores. Math scores significantly increased across school years; however, the same rate of increase was not recorded by racial-ethnic identity. These results are consistent with many other studies that showed a gap between the academic abilities of Black and White children before entering kindergarten (Galindo & Sonnenschein, 2015; Henry et al., 2020; Hutchison et al., 2014; Presser et al., 2015; Rittle-Johnson et al., 2017). These results differ from those of Reardon and Portilla (2016), who found, through comparative analysis, that the White–Black and White–Hispanic achievement gaps declined from 1998–2010 based on data from the ECLS-K, 1998 cohort, to the ECLS-K, 2010 cohort. These results are, however, consistent with Merolla and Jackson (2019), who found that the academic achievement gap is ever present.

The second of the research questions is as follows: Is there a difference in kindergarten through third-grade African American students' math scores by socioeconomic status? The researcher answered and there was a significant within and between-subjects effect of socioeconomic status on student math scores. The Scheffe post hoc comparisons showed significant math score differences between low-income students and high-income students. There was no significant difference in math scores between medium-income and high-income students and between medium-income and low-income students. The subgroup sample sizes were very different among the three groups: the low-income group was the largest ($n = 171$), the medium-income group was the smallest group ($n = 24$), and the high-income group was next to the largest group ($n = 59$).

The effect size of poverty was small; however, when comparing across the three financial categories, results indicated that African American low-income students were equivalent to their African American peers living at a medium income. African American medium-income student scores were equivalent with their African American peers living at a high income. Poverty had a greater effect size on African American low-income students and African American high-income students. Math scores increased significantly for all income groups; however, they did not increase significantly when disaggregated by income.

Many studies have shown the connection between socioeconomic status and academic achievement, and how the academic achievement gap widens over time between low-income and high-income students (Henry et al., 2020; Hutchison et al., 2014; Presser et al., 2015; Rittle-Johnson et al., 2017). Reardon and Portilla (2016) had differing results when they compared income achievement gaps from fall to spring of the kindergarten year in ECLS-K cohorts from 1998 and 2010. This researcher found the high- and low-income achievement gap narrowed from fall to spring. Contrarily, Galindo and Sonnenschein (2015) found that (a) children from low-income families are more likely to start school with lower academic skills, (b) differences between low- and high-income students continue or grow as children proceed through school, and (c) there are significant achievement gaps at the end of kindergarten based on students' socioeconomic status.

The third and final research question was as follows: Is there a difference in the kindergarten through third-grade students' math scores by kindergarten status (i.e., whether he or she attended kindergarten for the first time or repeated kindergarten)? This question was answered because the analysis of data showed a significant within-subjects effect. There was no significant between-subjects effect. Math scores did not increase at

the same rate relative to whether students attended kindergarten for the first time. Students who attended kindergarten for the first time were the largest group ($n = 3,453$) and students who repeated kindergarten were the smallest ($n = 143$). Scores increased more dramatically for students who had attended kindergarten for the first time than students who had attended kindergarten more than once. Overall, there was no significant difference in scores between the two groups.

These findings align with those of the NAEYC (2009) and the National Association of Early Childhood Specialists in State Departments of Education findings regarding school readiness. Both national organizations asserted that children are ready to enter kindergarten when they reach the legal chronological age of entry and that practices such as discouragement of or denying entry for eligible children, developing segregated transitional classes for children deemed unready for the next traditional level of school, and increasing use of retention will not ensure that students are more ready for kindergarten or have future academic advantages.

Discussion of Findings and Implications

The research questions for this research were framed to analyze the ECLS-K (2011 cohort) data to determine the relationship between specific variables on the mathematical outcomes for African American students from kindergarten through third grade. Research Questions 1 and 2 were developed to focus on African American students' math scores by racial–ethnic identity and socioeconomic status. Research indicates that, at later ages, African American students do not fare as well as their White, non-Hispanic peers (Merolla & Jackson, 2019). The results of this study demonstrate that poverty continues to play a role in student achievement. The findings show that race alone is not nearly as strong an indicator for math performance as are race and poverty combined. The validity of poverty as an important variable is undeniable.

The results of Research Question 1 support CRT with race but when looking within the racial–ethnic groups, socioeconomic status is also a difference maker in student performance in Research Question 2. This is aligned with CRT because more African American students are disproportionately living in poverty than their non-White peers due to systematic racism within the United States. CRT is used to show how systematic racism in housing, lending, and employment contribute to high poverty rates among African Americans (Decuir & Dixon, 2004; Howard & Navarro, 2016; Reece, 2019). Research Question 3 centered on African American students’ math scores by kindergarten status. Scores increased at a more rapid rate for students who had attended kindergarten for the first time than students who had attended kindergarten more than once, though there was no significant difference in scores between the two groups. Overall, the study findings show that while a small gap in math scores existed at kindergarten entry for African American students, over the first 4 years of schooling, this gap increased between White, non-Hispanic students and their African American peers.

The results of this study of the academic achievement gap, kindergarten participation, and mathematics performance can inform school policymakers and practitioners well. Given the statistically significant difference in math scores between White and African American students and between White and Hispanic students, as well as the statistically significant math score differences between low-income students and high-income students, the results from the study indicate that lower-performing students benefit from implementing early educational programs and interventions with developmentally appropriate standards so that children enter kindergarten sufficiently prepared to learn. Schools should examine their expectations, screening, progress measures, and intervention for incoming kindergarteners, especially those students who are deemed at-risk upon entry. Schools that serve at-risk students should operate from a

space of building on students' skills already in place rather than a deficit mindset or model focused on deficiencies.

Kindergarten entry is an especially important time for those students identified as being educationally at-risk, specifically in early math skills (Claessens & Engel, 2013; Presser et al., 2015; Rittle-Johnson et al., 2017; Shanley, et al., 2017). Students who enter kindergarten with lower mathematics ability continue to remain behind their higher-achieving peers throughout elementary school (Brown et al., 2019; Galindo & Sonnenschein, 2015; Hutchison et al., 2014). Thus, results from this study add to the current evidence on (a) the importance of offering universal, high-quality early childhood programs from birth to age 5 to all students; (b) the need for federal and state policymakers to implement national policies and high-quality standards for kindergarten classrooms, which include legal age of entry, compulsory attendance, and guidance regarding the length of the school day for programming; and (c) the need for federal policymakers to review funding sources for early childhood programming and reevaluating the income eligibility guidelines that have been established in order for families to qualify for some early childhood programs.

Retention is a heavily researched area of education, and the research indicates that there are no long-term advantages for retaining students. Despite an abundance of research in the area, SB 1697 went into effect on June 16, 2021. SB 1697 amended Texas state law to allow parents and guardians to elect for a student to repeat a grade or retake a high school course, per Texas Education Code (TEC) §28.02124 (Texas Education Agency, 2021). The new law has the potential to impact many students. Research has shown that retention does not have long-term implications for students, so the practice of holding African American students is not beneficial. Unfortunately, implementation of laws like SB 1697 sheds light on the notion that CRT tenets are

critical components of a race-conscious lens used to analyze the policies adopted in education. SB 1697 is yet another example of an education policy that perpetuates the gap among African American students and their non-White peers, and it is an example of how the achievement gap is continuously influenced by education reform policies.

Limitations

This study is limited by its exclusively quantitative approach and by its purpose to answer each specific research question; further, the researcher is limited by the information available in the existing dataset. There may be findings that could be enriched and deepened by a mixed-methods approach or a qualitative study. Assumptions of equality of variance and covariance matrices were met; however, the equal variances assumption was violated.

This study is limited to a convenience sample with varying sample sizes across all subgroups. The African American and other minority subgroups are smaller in size, which limits the generalizability of the study. Unequal sample sizes are a limitation in the study. Unequal sample sizes became evident in analyses for Research Question 1; specifically, the analysis showed unequal samples among racial-ethnic groups ($n_{\text{White}} = 1,436$, $n_{\text{Black}} = 341$, and $n_{\text{Hispanic}} = 1,338$). Similarly, the analysis for Research Question 2 showed sample size differences among socioeconomic groups ($n_{\text{low}} = 171$, $n_{\text{medium}} = 24$, and $n_{\text{high}} = 59$), and the analysis for Research Question 3 showed sample size discrepancies between students who attended kindergarten for the first time ($n = 3,453$) and those who repeated kindergarten ($n = 143$).

Another limitation of the study is that the majority of students within the ECLS-K (2011 cohort) database are predominantly White; the minority of students are Hispanic and African American. Another limitation is that students with identified disabilities were included in the research. This should be taken into consideration when reviewing

mathematics assessment performance. The researcher was limited to information available in the existing national database. In addition, the research was limited to examining the later development of mathematical skills of African American students enrolled in kindergarten through third grade. Multiple data collection instruments were used in the ECLS-K (2011 cohort), which included fourth and fifth grades. These data were available, but they were not incorporated into the study. Additional longitudinal data analysis including fourth and fifth grades could yield additional data points and discussion.

Recommendations for Future Research

This study included a small number of African American students who participated in the ECLS-K study from 2010–2014. To extend the research, the researcher suggests for future research to incorporate the findings of this study with a larger African American sample size to validate or amend the research. The math achievement scores among low-, medium-, and high-income students increased from kindergarten to third grade; yet the gap between African American low- and high-income students did not decrease. The researcher recommends a mixed methods or qualitative study incorporating the experiences of African American students in math that might result in this outcome.

The researcher focused solely on the later academic trajectory of students who participated in a kindergarten program. Kindergarten is considered the critical “bridge” between life prior to and the start of formal schooling; but kindergarten is an optional grade level in the state of Texas and other states across the US. Future research could examine the academic trajectory of first grade students who did not participate in a kindergarten program. Another possibility for future research might be a study to determine if there are statistically significant relationships between participation in

kindergarten and students' fourth- through fifth-grade math assessment scores. The present study did not include students who completed fourth and fifth grades. In addition, a future study could include exploration of the relationship between other domains of mathematics, such as geometry and measurement, and later academic achievement beyond elementary.

Conclusion

The academic achievement gap between African American students and their White, non-Hispanic peers is well documented and researched (Fair, 2018; Hutchinson et al., 2014). The historical overview in the beginning of this dissertation outlines repeated attempts by the U.S. government to address racial and economic disparities in the educational system. In this dissertation, the researcher documents the connection between early childhood performance and later academic achievement (Ansari, 2018; Hutchinson et al., 2014; Johnson, 2006; Magnuson et al., 2007) as well as how programs such as kindergarten have the potential to help students enter school ready to learn and minimize the academic achievement gap (Ansari, 2018; Johnson, 2006; Langham, 2009; Rosney, 2009; U.S. Department of Education, 2015).

The foundation of CRT is racism and racial inequality. The basis of CRT is the belief that racism continues to play a significant role in conditioning current American society. The past work of multicultural education pioneers Gloria Ladson-Billings and William Tate provided a spotlight on the prominence of race, school, and educational outcomes. The current work of education researchers including Tyrone Howard, Oscar Navarro, Jessica DeCuir, and Adrienne Dixson continue to illuminate that racism, classism, and inequality continue to be strands of the intricate DNA of the United States education system. Using a CRT framework to analyze the research findings exemplifies ways in which race and racism can be highlighted in public education. Moreover,

through uncovering disguised and undisguised education practices and policies, researchers can devise actions to halt practice and policy effects on African American students.

The attempts made by the U.S. government have fallen short and at-risk students have suffered from the failings of the education system; in general, the system successfully meets the needs of White and higher-middle class students, but leaves non-White and lower-class students behind. The findings of the study emphasize the continued presence of the racial and income academic achievement gap in the U.S. education system, particularly between African American and White students and higher- and lower-income students.

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