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An Investigation Examining the Closing of the Achievement Gap in Louisiana with the NGSS

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AN INVESTIGATION EXAMINING THE CLOSING OF THE ACHIEVEMENT GAP IN LOUISIANA WITH THE NGSS

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ABSTRACT

The purpose of this study was to investigate the Next Generation Science Standards (NGSS) and its implications of being a curricular and pedagogical intervention in terms of narrowing the achievement gap in science education for Children of Color. In using the explanatory mixed methods design, standardized test data and one-on-one interviews were examined to assess the effectiveness and impact of the NGSS' implementation in the state of Louisiana. This study utilized student performance results from the LEAP 2025 to conduct a statistical analysis that measured trends in performance by Children of Color, specifically Black students, before and after the implementation of the NGSS. Additionally, educators' perceptions were used to offer a plethora of additional insight regarding the factors that positively and negatively affected student performance, in a manner of explaining the necessary conditions for effective implementation of the NGSS. Results were that the implementation of the NGSS had a positive impact on student achievement. Through the emergence of the following themes, The Home Environment, The Classroom Environment, Resources, Student Needs, Teacher Needs, and Greater Emphasis on Science, key findings identified what factors negatively and positively contributed to student achievement, thus, informing the necessary conditions for successful implementation of the NGSS.

CHAPTER ONE. INTRODUCTION

In the United States (U.S.), the Next Generation Science Standards (NGSS) were created with the intent of connecting science to everyday life, and furthermore, in providing opportunities for student exploration of the field of engineering as a potential career. Additionally, the NGSS offer a vision of science teaching and learning that presents both learning opportunities and demands for all students and particular student groups that have traditionally been underserved in science classrooms (Lee, Miller, & Januszyk, 2014). Currently, 44 states (representing over 61% of U.S. students) have either adopted the NGSS or developed their standards based on recommendations in the NGSS Framework for K-12 Science Education (National Science Teaching Association, n.d.), anticipating that implementation of the standards would increase academic achievement in science. Prior to the NGSS, science education has not only lagged behind other core subjects but faced the existence of an alarming achievement gap that plagues specifically Children of Color as measured by standardized tests. Table 1.1 contains national and state (Louisiana) standardized test results showing an existing science scale score gap during years 2009 and 2011 on the National Assessment of Educational Progress (NAEP). While Children of Color underperform on standardized tests as compared to their White peers, these new common standards were created with the implication of revitalizing science education and potentially closing the problematic achievement gap in science education.

Table 1.1. The Average National and LA Subgroup Science Scale Score on the National Assessment of Educational Progress (NAEP) in 2009 and 2011

Race/Ethnicity	**2009**				**2011**			
	Grade 4		Grade 8		Grade 4		Grade 8	
	National	LA	National	LA	National	LA	National	LA
White	163	159	162	155	X	X	163	156
Black	127	123	126	120	X	X	129	125
Hispanic	131	144	132	NR	X	X	137	142

Average Score: 0-300
X: Assessment was omitted
NR: Data not reported

1.1. The Aim and Purpose of the NGSS

During the time period of 2009 to 2012, a disparity of performance was apparent among students in the U.S. public. Policymakers believed that K-12 science education in the U.S. failed to achieve acceptable outcomes, in part because it emphasized discrete facts with a focus on breadth over depth, not organized systematically across multiple years of school, and it did not provide students with engaging opportunities to experience how science is actually done (National Research Council, 2012). In response, new standards emerged that were slated to reform science education in the U.S. in grades kindergarten through 12th grade. The shift in science swept across the U.S., as many states adopted this new common set of standards, called the Next Generation Science Standards (NGSS, 2013). The focus of these standards involved three dimensions of teaching science: content, science and engineering skills, and crosscutting concepts, all of which were intended to connect science to everyday life. Additionally, the NGSS were developed as standards that offered promises of science teaching and learning that present learning opportunities and demands for all students and particular student groups that have traditionally been underserved in science classrooms (Lee, Miller, & Januszyk, 2014). Hence, the writers and policymakers viewed it as the “saving grace” for students who historically underperform on standardized assessments, such as Children of Color, as it potentially offers higher academic and equitable opportunities in science learning.

1.2. Science Education Before the NGSS

In the 1980s and 1990s, years before the development of NGSS, educational policymakers in the U.S. used standard-based reforms to influence instructional practices (Hardy & Campbell, 2020). This movement of standards-based reform resulted from a report called, *A Nation at Risk: The Imperative for Educational Reform* (National Commission on Excellence in

Education, 1983). Although considered controversial and politically motivated, this report is deemed to be substantial and is often cited as proof that educational reform was warranted. Regardless of the politics and influences surrounding *A Nation at Risk*, the report addressed performance differences among the U.S.'s public school children, and the report's release garnered much attention. Close, et al. (1996) reported during this timeframe, "educators and legislators at the state and local levels acknowledged the need to reform science education and design curricula to help students understand essential concepts to become prepared to play a part in national and global economies" (p.5). This high level of attention, scrutiny, and increasing pressure to reform education were very apparent. Science educators responded by examining their field for the rigor and cohesiveness of science teaching. Moulding et al. (2018) stated, "Several national science education reform documents identified broad goals for science education that were eventually reflected in many state curricula as subject area learning standards" (p.27).

The first of these documents was the *Science for All Americans* (American Association for the Advancement of Science [AAAS], 1990). The report highlighted science literacy and provided the groundwork for national science-education standards that outlined what students should know and do in science by high school graduation (Jackson & Ash, 2012, p.724). Next, the *Benchmarks for Science Literacy* report was released (AAAS, 1993), which further shaped the foundational groundwork for national science education standards. The *Benchmarks for Science Literacy* specifically provided educators with sequences of expected competencies at specific grade bands (Moulding et al., 2018).

Both the *Science for all Americans* and *Benchmarks for Science Literacy* reports were not curriculums or standards; however, they were recommendations that influenced and aided the

state departments of education and/or instruction and school districts in designing their core curriculums. Later, the first set of national science standards for the US, the *National Science Education Standards* (National Research Council [NRC], 1996), emerged with implications of promoting scientific literacy for all in the 21st century. Much like previous documents, the *National Science Education Standards* [NSES] were written only as an outline to create coherent state and local curriculums. The content standards in *National Science Education Standards* outlined what students should know, understand, and be able to do in science at the end of specific grade bands (NRC, 1996). The content standards were grouped and labeled into the following categories: science as inquiry, physical science, life science, Earth and space science, science and technology, science in personal and social perspectives, and history and nature of science. The *National Science Education Standards* were used as the guidelines for developing state standards in K-12 science education in United States schools until the development of its successor, the NGSS.

1.3. The Development of the NGSS

After approximately 15 years under a standards-based movement which yielded the *Science for all Americans* and *Benchmarks for Science Literacy* reports as well as the *National Science Education Standards*, The Carnegie Corporation of New York, together with the Institute for Advanced Study, called for reform in science education with the development of U.S. common science standards in a report called, *The Opportunity Equation* (National Research Council, 2012). The Carnegie Corporation of New York, a grant-making foundation, and the Institute for Advanced Study, a group of assembled scientists and pupils, united as a joint commission with a commitment to advancing education with focusing on K-12 level instruction for subject areas, science and math. As a joint commission, they were responsible for assessing

the current state of science and math teaching, recognizing successes and failures, and offering recommendations for improvement to K-12 science, math, and technology education (Carnegie Corporation Of New York And Institute for Advanced Study Establish Joint Commission on Math and Science Education, 2007).

The Opportunity Equation was in conjunction with an educational initiative with an added economic driver, the Science, Technology, Engineering, and Math (STEM) movement (Bybee, 2010; Capraro, Capraro, & Morgan, 2013; Kennedy & Smolinsky, 2016; Wen & Kennedy, 2016), which also stressed the need for reform in science education. The STEM movement was characterized by the integration of all the STEM disciplines to address the challenges of the 21st century while shedding light on the necessary need for racial and ethnic diversity in STEM professions (Bybee, 2010; Next Generation Science Standards, n.d.). With these demands for shifts in science education, the development of the NGSS process started in the 2010s.

Several prominent educational organizations, which included the National Research Council (NRC), the National Science Teachers Association (NSTA), the AAAS, and Achieve, attributed to the development of the NGSS (Next Generation Science Standards, n.d.). While Achieve oversaw the overall process of developing the new standards, the NRC, with secondary partners, the NSTA and the AAAS were responsible for the first step in the development process.

The first step consisted of developing the framework by “Getting the Science Right”, which indentifies what the students should know in K-12 Education. To develop the framework, the NRC assembled a committee of 18 individuals who were practicing scientists (including two Nobel laureates), cognitive scientists, science education researchers, and individuals with science education standards and policy expertise. These individuals were nationally and internationally

known and respected in their respective fields. In the framework, *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*, the writers argued that improvement was needed in K-12 science education (National Research Council, 2012). Therefore, the writers of the framework offered a newly existing and growing body of research on learning and teaching in science, which also outlined the expectations for students in K-12 in science education and informed a revision of the standards.

Figure 1.1 The writing timeline and process of creating the NGSS (Simpson et al., 2017, p.1).

Being that this framework outlined the expectations of the student expectations in K-12 science, it was used for the second step in the development of the standards, which was writing

the NGSS. This step was a process managed by Achieve, where states coherently arranged the K–12 science standards across disciplines and grades to provide all students an internationally benchmarked science education. After going through a critical writing process *(see Figure 1.1),* the final product was released in April 2013 by the multiple stakeholders and a diverse writing team, who all strived towards the common goal of providing standards that would allow all students to have an internationally benchmarked science education (Simpson et al., 2017).

1.4. The Innovative Shifts of the NGSS

Unlike in previous science education reform initiatives, the innovations in the NGSS necessitated significant transformations and shifts in practice (Stiles et al., 2017). According to *The Next Generation Science Standards Appendix A*, the following conceptual shifts in the NGSS highlighted and distinguished the differences between the NGSS and NSES:

- K-12 science education should reflect the interconnected nature of science as it is practiced and experienced in the real world.
- The NGSS are student performance expectations – NOT curriculum.
- The science concepts in the NGSS build coherently from K–12.
- The NGSS focus on deeper understanding of content as well as application of content.
- Science and engineering are integrated in the NGSS, from K–12.
- The NGSS are designed to prepare students for college, career, and citizenship.
- The NGSS and Common Core State Standards (English Language Arts and Mathematics) are Aligned (2013, p.1-8).

Moreover, the NGSS required shifts in what is taught, how content is taught, and how students engage in learning (Stiles et al., 2017). As the standards were written as language-intensive three-dimensional performance expectations, explaining what a student should be able

to do in science, every student has an equal chance for the opportunity to learn the language of science while at the same time learning core ideas and crosscutting concepts (Miller, Januszyk, & Lee, 2015). Therefore, this was an example of a significant shift in the NGSS from previous iterations, specifically how students would be exposed to science content and processes and how the standards would be operationalized.

1.5. The NGSS Organizational Structure

The standards were organized into three dimensions of learning: Science and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas. These three dimensions of learning were written to allow students to build models, design investigations, share ideas, develop explanations, and argue using evidence, in which they develop important 21st century skills such as problem-solving, critical thinking, communication, collaboration, and self-management (Krajcik, J. 2015).

Science and Engineering Practices

The first of the three dimensions, Science and Engineering Practices, consist of eight applicable practices that were written to help students understand how scientific knowledge develops; such direct involvement could give students an appreciation of the wide range of approaches that are used to investigate, model, and explain the world (National Research Council, 2012). The eight practices are:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking

6. Constructing explanations (for science) and designing solutions (for engineering)

7. Engaging in argument from evidence

8. Obtaining, evaluating, and communicating information (National Research Council, 2012).

The Crosscutting Concepts

The second of the three dimensions was "The Framework", which identified seven crosscutting concepts that were written to bridge disciplinary boundaries, uniting core ideas throughout the fields of science and engineering (NGSS Appendix G, 2013). These concepts were designed to provide students with a deep organizational framework for building knowledge, thinking about knowledge, and connecting knowledge from the various disciplines into a coherent and scientifically-based view of the world (National Research Council, 2012).

Disciplinary Core Ideas

The third of the three dimensions was the disciplinary core ideas, which provided a K-12 progression for framework as performance expectations at individual grade levels. The disciplinary core ideas are a wide range of concepts that connect to a specific discipline (Cooper, Posey, & Underwood, 2017). With the formation of discipline core ideas, students would see connections between important science concepts as they progress from grade to grade (Duncan, Krajcik, & Rivet, 2017). The disciplinary core ideas were grouped four disciplines of science: identified as life sciences, earth and space sciences, physical sciences, engineering, technology, and applications of science (National Research Council, 2012). The following crosscutting concepts were listed:

1. Patterns: Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

2. Cause and effect (Mechanism and explanation). Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

3. Scale, proportion, and quantity. In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

4. Systems and system models. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

5. Energy and matter: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

6. Structure and function. The way in which an object or living thing is shaped and its substructures determine many of its properties and functions.

7. Stability and change. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study. (National Research Council, 2012).

1.6. The NGSS Focus on Equity

The framework of NGSS acknowledged and identified that profound differences existed among the specific demographic groups in their educational achievements and patterns of science learning, as in other subject matter areas. The NGSS identified the reasoning as an

inequity focus which attributed to approaches in the instruction being not inclusive and motivating for diverse student populations and/or differences in achievement to the differences in opportunities to learn because of inherent inequities across schools, districts, and communities in the U.S. (National Research Council, 2012). Therefore, the NGSS Diversity and Equity Team were composed to oversee equitable opportunity during the development of the NGSS.

The NGSS Diversity and Equity Team was responsible for ensuring that the standards were made accessible to all students, especially those who have traditionally been underserved in science classrooms, hence its reference ‘‘All Standards, All Students’’ (Lee, Miller, & Januszyk, 2014). NGSS coined the term for the targeted population as non-dominant groups, which are groups identified as economically disadvantaged students, students from Minority racial and ethnic groups, students with disabilities (or exceptionalities), and students with limited English proficiency (LEP). Further, considerations of student diversity extended by adding three groups: girls, students in alternative education programs, and gifted and talented students.

The NGSS Diversity and Equity Team provided oversight, ensuring that the NGSS presented both learning opportunities and challenges for all students to attain rigorous standards. The NGSS addressed best classroom practice by presenting case studies and identifying key findings in research literature on student diversity and equity for seven demographic groups of students in science education (Lee, Miller, & Januszyk, 2014). The overall goal was a comprehensive yet “open” set of standards, including content, processes, and expectations in science teaching and learning K-12 in the U.S public school arena.

Implication of Addressing Inequalities

The NGSS provided an increase of expectations to all students without excluding those who have been identified as having traditionally struggled to demonstrate mastery even in the

previous generation of less cognitively demanding standards (NGSS Appendix D, 2013, p.1). Therefore, NGSS followed themes that emerged, according to Lee and Buxton (2010), in a manner that provided equitable learning opportunities for students. Firstly, it implied that the instructor was "to value and respect the experiences that all students bring from their backgrounds, it is essential to make diversity visible (NGSS Appendix D, 2013, p.6). This notion of teaching and learning accessing a student's prior knowledge was built on the principle that students should have exposure to their norms and norms outside of their cultural background. This kind of pedagogical practice involved teachers providing real-world concepts that are relatable to various populations. Therefore, this kind of teaching allowed teachers to bridge diverse students' background knowledge and experiences to scientific knowledge and practices (NGSS Appendix D, 2013).

Secondly, the NGSS were designed for instructors to build on students' background knowledge with disciplinary knowledge of science, capitalizing on Moll's conceptualization of 'funds of knowledge (González, Moll, & Amanti, 2006; NGSS Appendix D, 2013). For example, this kind of teaching was characterized as when the teachers strategically use what students bring to schooling as life experiences, essentially unlocking the students' acquired knowledge, also referred to as prior knowledge. As well, in this kind of teaching, an instructor capitalizes on students' cultural frames of reference, referred to in the literature and the NGSS as the classic "funds of knowledge", wherein students' backgrounds, experiences, and culturally familiar ways of knowing are accessed to the advantage of communicating important concepts (González, Moll, & Amanti, 2006). This method of teaching seeks to connect new knowledge to assimilated knowledge consistently.

Lastly, the themes by Lee and Buxton (2010) conveyed recommendations that school resources would constitute important elements of a school's organizational context for teaching and learning (NGSS Appendix D, 2013, pg. 7). Since material and resources support learning, special provisions were suggested to support non-dominant students who have traditionally been underserved in science education.

To further apply equitable opportunity, NGSS Appendix H stated, "NGSS diminishes the stigma that scientists are not just limited to White individuals, as it is usually portrayed in media. Men and women from different social, cultural, and ethnic backgrounds work as scientists and engineers" (2013, p. 6). When facing challenges in the 21st century in the science and technology sector, students must be equipped with the necessary skills to ensure their competitiveness in the globalization era (Turiman, Omar, Daud, & Osman, 2012).

Hence, equitable opportunity was strategically embedded in standards so that students could explore methods that would allow them to study the world or phenomena from their own social context, as well as from the perspective of other cultures or groups. Inherent in the NGSS is the premise that relative tasks and coursework should reduce the gap in education between the poor and rich neighborhoods as well as eliminate the likelihood of gender or race-based biases and/or stereotype threat" (Asowayan, Ashreef, & Omar, 2017). As an example, the NGSS recommended that technology innovations be consciously introduced in a globally-minded manner, by typifying the use of individuals from different cultures/backgrounds. Therefore, students can make connections to their own social context and be exposed to material outside their own social context. This approach by the NGSS embraces diverse levels of students' previous knowledge and skills and thoroughly covers their expectations regarding learning outcomes (Asowayan, Ashreef, & Omar, 2017).

1.7. The Adoption of the NGSS Among States

With a high demand to address inequalities and increase overall academic achievement, states did not hesitate to adopt standards. Within just three years of the NGSS emergence, 17 states and the District of Columbia (Washington DC) adopted the NGSS, which accounted for an estimated 35% of public-school students nationwide (Simpson et al., 2017). In the current year, 2021, forty-four states (representing over 61% of U.S. students) are implementing the NGSS or developed their own standards based on recommendations in the NGSS Framework for K-12 Science Education (National Science Teaching Association, n.d.).

Years prior to adopting the NGSS, Louisiana used NSES (1996), which were adopted in May 1997. This was their first set of standards based on national science education standards. As mentioned earlier in this chapter, those standards were in grade bands: kindergarten to grade three, grade four to grade six, and six to eight nine to 12. Seven years later in 2004, the Grade Level Expectation (GLE) were written and authorized for science instruction. The GLE's were an adjustment of NSES (1996). Instead of standards being in grade bans, the GLE's outlined specific standards for each grade level. Additionally, each grade focus on one the six science disciplines. For instance, 9th grade focused on physical science, while 10th grade focused on life science. The GLEs also provided a means for holding grade levels accountable for ensuring that their students master specific content by the end of the school year.

On March 8, 2017, the Louisiana Board of Elementary and Secondary Education (BESE) recommended for approval for Louisiana to adopt standards based on the framework of the NGSS as the new Louisiana Student Standards for Science. This state adoption was approximately five years after the completion of the NGSS. To specifically tailor the NGSS for

students in Louisiana, a committee was comprised of classroom teachers, administrators, and college professors (Hinton, 2017).

1.8. The Integral Role of Data

During its emergence, the NGSS represented a popular wave of change in science education. Some school districts choose to adopt the standards even before the state education department or legislatures signaled approval. (Simpson et al., 2017). This dire need for change and reform in science education was student performance on science test administrations on the national, state, and local level. With standardized test results from National Assessment of Educational Progress (NAEP) having long-existing history in revealing intense deficits in science prior to NGSS (Snyder et al., 2019), the NGSS seemed to offer an available solution as the standards were slated to provide to students better academic and equitable opportunity.

Historically, standardized testing has been vital towards the decision-making of policy and stakeholders. Since its emergence, standardized testing has been the accepted and often debated as an important tool for overall summative assessment of student knowledge. Initially, standardized tests were designed to measure the outcomes of students, attainment of information, and their mastery level of skills and concepts (Dunbar, Kortez, & Hoover, 1991; Feldt, 1972; Lindquist, 1970; Stroud, & Lindquist, 1942). However, standardized tests' usage can potentially determine a plethora of factors for students. Hence, it is often referred to as "high stakes testing".

The High Stakes Testing Culture Under NCLB

The high stakes testing culture emergence dated back to 2001, when President George W. Bush signed NCLB into law. Under NCLB (2001), states were mandated to create accountability systems by formulating standards, testing students regularly, defining a baseline, and setting a level of proficiency from 2001 performance levels, and attain adequate yearly progress (AYP)

towards proficiency (Mintrop & Trujillo, 2005). Among the many provisions of the NCLB act, schools were required to give standardized tests to students for proficiency each year in grades 3–8, then once during high school. One of NCLB's implications was for states to monitor and diminish achievement gaps between White students and students who were minorities. The standardized tests served as the means to offer the comparable data across the different regions in the nation.

The High Stakes Testing Culture Under ESSA

While one of NCLB's intended implications was to diminish the achievement gap, it minimally attained its goal as the gap still persisted during the years the law was in place (2001-2014). In 2015, ESSA replaced the NCLB, passed by Congress, and signed into law in December 2015 by President Barack Obama. Prior to ESSA, a majority of states had recently adopted the Common Core State Standards (CCSS) for state-specific college- and career-ready standards (reading and math), with more than 40 states choosing to adopt the CCSS (Achieve, 2013). Therefore, ESSA carried much of the market-driven, standards-based school reform policies from NCLB, as well as the high-stakes standardized testing (Dee, Jacob, & Schwartz, 2013). ESSA ended "the federal requirements for Adequate Yearly Progress and permitted each state to design its own accountability system to meet minimum federal requirements, such as ensuring that measures include all students and student subgroups" (Flory, 2017, p.1). These measures were designed to ensure that the states commit to supporting all students equitably. Additionally, district waivers were permitted that allowed high-capacity districts' the ability to innovate and test new approaches depending on their state (Loeb et al., 2016). Overall, the key differences between ESSA and NCLB was "greater attention on equity and excellence (that can be represented globally) with a focus on closing the achievement and opportunity gaps among

students within and between schools and districts, especially students who have been historically underserved in terms of educational achievement" (Chu, 2019, p.3).

Currently, the achievement gap and trends among subgroup performance are closely monitored by states from standardized test results as required by ESSA. Dating back as far as 2016, the Louisiana State Department of Education provides public data school, district, and state-level data on their website, www.louisianabelieves.com, as well as subgroup performance trends on the state administered standardized tests. This proposed research study will specifically explore Louisiana and its past achievement results, as well as subgroup data for the state and local school district regarding science from the years of 2009 to 2019. However, it is paramount to contextualize Louisiana student performance within a national context.

1.9. National Trends in Science Achievement

The National Assessment of Educational Progress (NAEP) is a national standardized exam. It is administered to a randomly selected sample of students in enrolled in a specific grade that is assessed in each school (National Center for Education Statistics, 2020). NAEP reports student achievement using the standardized test data from grades 4, 8, and 12 in the nation's private and public schools. It measures what US students know and do in various subjects across the nation. Table 1.2 highlights scores from U.S. NAEP.

Table 1.2. Average U.S. NAEP scores from 2009-2015

U.S. NAEP Scores			
Subject	**2009**	**2015**	**+/-**
Science	149	153	+4
Math	239	240	+1
Reading	220	221	+1

In 2015, NAEP reported the nation's average performance in science scores of 4th graders as a 153, which was a four-point increase from the last computed score or 149 in 2009 (NAEP, 2019). However, there were large difference in the scores when compared to the nation's average math and reading scores of 4th graders. In 2015, NAEP reported the nation's average 4th grade score in reading as a 221 and 240 in math. Although there was a slight increase, data in science continued to be troublesome for the nation.

The achievement gap among subgroups in science was even more alarming when compared to the gap between science and other subjects. In the *Digest of Education Statistics 2014*, Snyder et al. (2016) provided a snapshot of NAEP's test data from years, 2009-2015 with the purpose of monitoring student achievement among different groups. The data reported several key findings for science achievement. Table 1.3 highlights the gaps among Children of Color when compared to White counterparts in the U.S. (the * indicate that the highest gap was among science).

Table 1.3. U.S. NAEP Subgroup Differences by Subject and Grade from 2015

Gaps among Children of Color when compared to White counterparts in the U.S.			
Subject	**Grade**	**Difference of Points Between White and African American Students**	**Difference of Points Between White and Hispanic Students**
Science	4th	33*	27*
Reading	4th	26	24
Math	4th	24	18
Science	8th	34*	26*
Reading	8th	26	21
Math	8th	32	22
Science	12th	36*	24*
Reading	12th	30	20
Math	12th	30	22

In all in science White students scored higher than counterpart. In 2015 scores indicated a point difference of 33 (Grade 4), 34 (Grade 8) and 36 (Grade 12) between White and African American students; and a difference of 27 (Grade 4), 26 (Grade 8) and 24 (Grade 12) between White and Hispanic students (Snyder et al., 2016). They were also noticeable gaps in reading and math, however, these two subjects did not have as large a gap as science. In math, 2015 scores indicated a difference of 24 (Grade 4), 32 (Grade 8), and 30 (Grade 12) between White and African American students; and a difference of 18 (Grade 4), 22 (Grade 8) and 22 (Grade 12) between White and Hispanic students (Snyder et al., 2016). In reading, 2015 scores indicated a point difference of 26 (Grade 4 and 8) and 30 (Grade 12) between White and African American students; and a difference of 24 (Grade 4), 21 (Grade 8) and 20 (Grade 12) between White and Hispanic students (Snyder et al., 2016). Hence, the data proved that the achievement gap in science was more of a concern than reading and math.

1.10. Louisiana Trends in Science Achievement

The Louisiana Department of Education (LDOE) has long allowed data from standardized data to be available for viewing. The data for science is dated back to 1999. Prior to 2018, the science assessments were aligned to the Grade Level Expectations (GLE's; 2004), which were the standards that proceeded NSES. The following scores are an average for Grade 3-8 students on LEAP test. LEAP is a statewide test given in Louisiana for measuring student proficiency in subject's English language arts, math, science, and social studies. In 2015, Louisiana had 22% of students scoring at or above proficiency in science (LDOE, 2015). However, reading and math had higher proficiency percentages. In reading, 37% of students scoring at or above proficiency (LDOE, 2015). In math, 30% of students scoring at or above proficiency (LDOE, add website or source). In 2016, Louisiana had 24% of students scoring at or

above proficiency in science (LDOE, 2016). However, reading and math had a higher proficiency percentage. Reading had 41% of students scoring at or above proficiency (LDOE, 2016). Math had 34% of students scoring at or above proficiency (LDOE, 2016). Although the science achievement was higher, its growth rate could not be matched to the growth rate of math and reading. In 2017, Louisiana had 24% of students scoring at or above proficiency in science (LDOE, 2017). However, reading and math continued to exceed higher proficiency percentage. Reading had 42% of students scoring at or above proficiency (LDOE, 2017). Math had 32% of students scoring at or above proficiency (LDOE, 2017). Hence, science proficiency percentages remained stagnant when compared to reading and math.

In 2018, students were administered a field test aligned to NGSS, therefore, the science data was not reported to LDOE. In 2019, Louisiana continued the administration of a science assessment aligned to NGSS. In the 2019 administration, Louisiana had 29% of students scoring at or above proficiency in science (LDOE, 2019). However, reading and math continued to exceed higher proficiency percentage. Reading had 34% of students scoring at or above proficiency (LDOE, 2019). Math had 44% of students scoring at or above proficiency (LDOE, 2019). In 2020, the school year abruptly ended due to detrimental effects of COVID-19. Therefore, BESE approved to waive statewide testing for that school year. Statewide testing resumed in 2021 with school districts across the state implementing different learning modes, such as virtual, hybrid, or in house learning throughout the school year. With teachers, students and all other education personnel being subjected to surviving in a pandemic, the impact of COVID-19 brought many challenges to students effectively learning the expected grade level school content. In addition, there was a loss in learning from the 2019-2020 year due to the abrupt ending of school in March. The 2021 administration reported that Louisiana had 25% of

students scoring at or above proficiency in science (LDOE, 2021). However, reading and math continued to exceed higher proficiency percentage. Reading had 39% of students scoring at or above proficiency (LDOE, 2021). Math had 26% of students scoring at or above proficiency (LDOE, 2021). To be noted, math had a huge drop, while reading increased from the 2019 administration. Science dropped 4% percentage points from 2019 administration. Table 1.4 highlights this information.

Table 1.4. Average Performance of Louisiana Students from 2015-2021

Louisiana students (Grades 3 through 8) scoring at or above proficiency historically proficiency, statewide percentages 2015-2021			
Year	Reading	Math	Science
2015	37%	30%	22%
2016	41%	34%	24%
2017	42%	32%	24%
2018	43%	32%	* Field Test
2019	34%	44%	29%
2020	*Testing Waived	*Testing Waived	*Testing Waived
2021	39%	26%	25%

When examining trends of students' scores throughout the span of recent years, there was evidence of gain in results have emerged. Louisiana attributed the steady gains in all subject areas to the implementation of the new standards-aligned tests as indicated in *Figure 2* as NEW LEAP 2025 (LDOE, 2019). Since standard implementation, Louisiana saw a steady increase in the percentage of students scoring "Mastery" and above statewide (Louisiana State Department of Education, 2019). Specifically, science went from 24% to 29% when changing from old standards-aligned tests to new standards-aligned tests. Figure 1.2 details the performance trends in all subjects for Louisiana students (Grades 3-8).

Overall, the LEAP data affirmed that science achievement falls behind other subjects in Louisiana, similarly to nation. During each LEAP administration, science was not weighted as

heavy as ELA and Math. When configuring numbers for assessment index and school performance scores, ELA and Math were weighted as two (each), while science and social studies are weighted as one (Title 28 EDUCATION Part XI, 2020). Therefore, with educators and administrators involved and aware, lagging scores should not have come to any surprise. Other subjects of ELA and Math would make a bigger in impact on overall school performance.

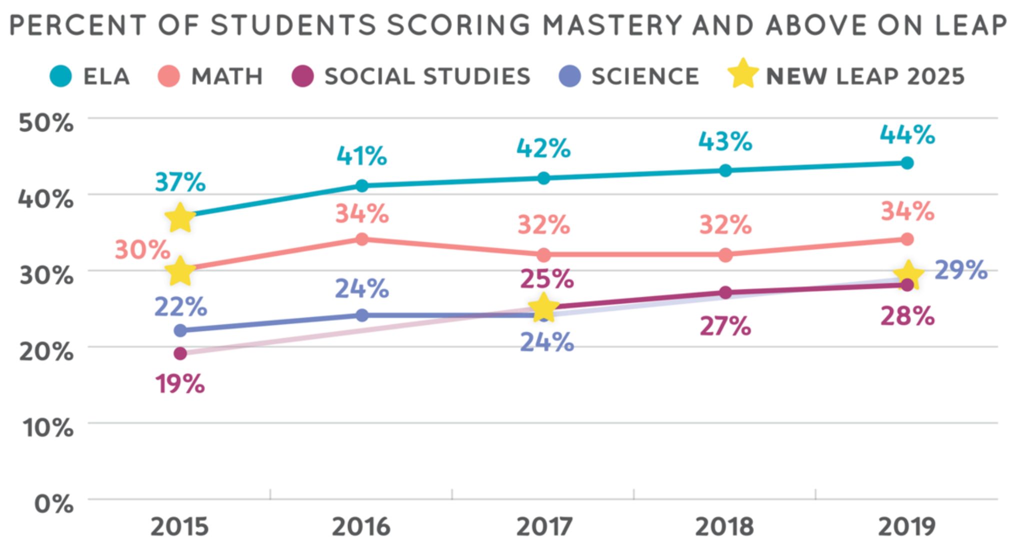

Figure 1.2. Overall performance in all subjects for Louisiana school children (Grades 3-8). (Louisiana State Department of Education, 2019)

Sub-group performance overtime signified several gaps among Louisiana students in respective to race. The Urban League of Louisiana (2019) insisted economically disadvantaged and Students of Color have a long existing history of being not just underperforming and lagging behind but being left behind in Louisiana when compared to other counterparts. During the emergence of ESSA in 2015, states were held accountable for monitoring and improving achievement outcomes for students and closing achievement gaps (Skinner, 2019). This required the state of Louisiana to disaggregate test data by subgroups to address student equity gaps. In supporting historically disadvantaged students, LDOE made the decision to institute an accountability model that recognized academic improvements toward the “Mastery” level, as

well as, report academic growth of students relative to their peers with similar characteristics and challenges (LDOE, 2017). LDOE displayed the effects of the accountable system in 2017.

Several subgroups were identified in the data from LDOE, including African American (Black) students, Hispanic, and White students. Table 1.5 indicate gaps among Louisiana students (Grades 3 through 8) on LEAP Science Administration.

Table 1.5. Louisiana Subgroup Differences from 2015-2021

Gaps among Louisiana students (Grades 3 through 8) on LEAP Science Administration		
Year	Difference of Percentages Between White and African American Students	Difference of Percentages Between White and Hispanic Students
2017	27	18
2019	35	25
2021	28	20

In science, the average amount of White students that scored proficient or higher was 36% (LDOE, 2017). However, the average amount of Black students that scored proficient or higher was 9% indicating a difference (gap) of 27% (LDOE, 2017). The average amount of Hispanic students that scored proficient or higher was 18% indicating a difference (gap) of 18% (LDOE, 2017). In 2018, students were given a field test for science, therefore no scores were available on LDOE website. In 2019, the average amount of White students that scored proficient or higher was 48% (LDOE, 2019). However, the average amount of Black students that scored proficient or higher was 13% indicating a difference (gap) of 35% (LDOE, 2019). The average amount of Hispanic students that scored proficient or higher was 23% indicating a difference (gap) of 25% (LDOE, 2019). In 2021, the impact of COVID-19 brought many challenges to students effectively learning the expected grade level school content. In addition,

there was a loss in learning from the 2019-2020 year due to the abrupt ending of school in March. In that year, the average amount of White students that scored proficient or higher was 38% (LDOE, 2021). However, the average amount of Black students that scored proficient or higher was 10% indicating a difference (gap) of 28% (LDOE, 2021). The average amount of Hispanic students that scored proficient or higher was 18% indicating a difference (gap) of 20% (LDOE, 2021). Historically, these were extremely large gaps in science achievement when comparing Children of Color to White students in Louisiana. In addition, the gaps increased over time among both subgroups, Blacks and Hispanics students, when compared to White students.

1.11. Local Trends in Science Achievement

Historically, the East Baton Rouge (EBR) Schools the largest subject has been Black students. In 2013, minority enrollment was 89% of the student body (majority Black), which is more than the Louisiana public school average of 55% (majority Black) (LDOE, 2013). In 2018, "Of students enrolled in public schools (all types) in Baton Rouge (October 2018), 82.4 percent were non- white; 75.5 percent were economically disadvantaged (eligible for free- or reduced-price lunch)" (Urban League, 2019, p. 7).

Louisiana Department of Education makes public standardized data for all districts including the EBR Public School District. The following scores are an average Grade 3-8 students. When examining 2015 science data, its revealed that 17% of students were at or above proficiency (LDOE, 2017). However, reading had 32% of students who were at or above proficiency (LDOE, 2017). Math had 25% students at or above proficiency (LDOE, 2017). When examining 2016 science data, its revealed that 19% of students were at or above proficiency (LDOE, 2017). However, reading had 37% of students who were at or above proficiency (LDOE, 2017). Math had 31% students at or above proficiency (LDOE, 2017).

When examining 2017 science data, its revealed that 19% of students were at or above proficiency (LDOE, 2017). However, reading had 34% of students who were at or above proficiency (LDOE, 2017). Math had 41% students at or above proficiency (LDOE, 2017). There is no data available for science in 2018 because students took a field test. When examining 2019 science data, a review revealed that 24% of students were at or above proficiency (LDOE, 2019). However, reading scores indicated 40% of students who were at or above proficiency (LDOE, 2019). Math scored revealed 31% students at or above proficiency (LDOE, 2019). As mentioned earlier, the pandemic crisis of 2020 created difficulties for learning, therefore severe impacts could explain the 2021 administration results. This data illustrated that science education fell far behind other subjects in EBR Schools, similarly to state and national data. The 2021 administration reported that Louisiana had 20% of students scoring at or above proficiency in science (LDOE, 2021). However, reading continued to exceed a higher proficiency percentage. Reading had 33% of students scoring at or above proficiency (LDOE, 2021). Math had a huge drop and had an even proficiency with science at 20% of students scoring at or above proficiency (LDOE, 2021). Table 1.6 highlights this information.

Table 1.6. Average Performance of Students in EBR Schools from 2015-2021

EBR Schools (Grades 3 through 8 students) scoring at or above proficiency historically			
Year	Reading	Math	Science
2015	32%	25%	17%
2016	37%	31%	19%
2017	34%	27%	19%
2018	38%	27%	*Field Test
2019	40%	31%	24%
2020	*Testing Waived	*Testing Waived	*Testing Waived
2021	33%	20%	20%

Additionally, LDOE offered to examine sub-groups in EBR Schools in all core subject areas. Several subgroups were identified in the data included African American (Black) students and White students. The following scores are an average Grade 3-8 students on science assessments. The average amount of White students that scored proficient or higher was 51% (LDOE, 2017). However, the average amount of Black students that scored proficient or higher was 11% indicating a difference (gap) of 40% LDOE, 2017). The average amount of Hispanic students that scored proficient or higher was 12% indicating a difference (gap) of 39% LDOE, 2017). This is an extremely large learning gap in science achievement, even exceeding the state of Louisiana gaps in science achievement in 2017. There is no data available for science in 2018 because students took a field test aligned to NGSS. In 2019, the average amount of White students that scored proficient or higher was 59% (LDOE, 2019). However, the average amount of Black students that scored proficient or higher was 16% indicating a difference (gap) of 43% LDOE, 2019). The average amount of Hispanic students that scored proficient or higher was 16% indicating a difference (gap) of 43% LDOE, 2019). In 2021, the impact of COVID-19 brought many challenges to students effectively learning the expected grade level school content. In addition, there was a loss in learning from the 2019-2020 year due to the abrupt ending of school in March. In that year, the average amount of White students that scored proficient or higher was 54% (LDOE, 2021). However, the average amount of Black students that scored proficient or higher was 12% indicating a difference (gap) of 43% LDOE, 2021). The average amount of Hispanic students that scored proficient or higher was 14% indicating a difference (gap) of 40% LDOE, 2021). Historically, these were extremely large learning gaps in science achievement when comparing Children of Color to White students in EBR Schools. Table 1.7 highlights this information.

Table 1.7. EBR Schools Subgroup Differences from 2015-2021

Gaps among students in EBR Schools (Grades 3 through 8) on LEAP Science Administration		
Year	Difference of Percentages Between White and African American Students	Difference of Percentages Between White and Hispanic Students
2017	40	39
2019	43	43
2021	42	40

1.12. The Purpose of this Study

The purpose of this study was to investigate the NGSS and its implications of being a curricular and pedagogical intervention in terms of narrowing the achievement gap in science education for Children of Color. Therefore, through use of standardized test results and the insight of educators, this study assessed the effectiveness and impact of the NGSS' implementation in the state of Louisiana. Standardized test results were used to examine the trends Children of Color, specifically Black students, before and after the implementation of the NGSS. Educators and their perceptions were used to offer a plethora of additional insight regarding the value of the NGSS to science education, such as identifying what factors positively and negatively affect the implementation of the NGSS. Topics regarding science education, such as shifts, demands, barriers and historical achievement were important to this study as it contextualized the development and implications of the NGSS. Important to the field of science and achievement, this study decided on the significance of the latest science standards as a provision for equitable opportunity in successful learning and achievement among Children of Color, who are often at a disadvantage in learning environments.

1.13. Research Questions

This investigation was driven by an overarching question in which is the central research question: Can the NGSS aid in narrowing gaps in the achievement gap in Louisiana? Specific sub questions were crafted:

RQ1: As measured by the LEAP 2025 administration, did the adoption of the NGSS have a positive impact on Black students in Louisiana?

RQ2: What are the factors that negatively impact student achievement among Black students in Louisiana?

RQ3: What are factors that determines student success with the implementation of the NGSS?

1.14. Summary

Respective to NGSS, science education in the U.S. has not been the top priority as its ELA and Math counterparts. Achievement in science falls far below other subjects when science ultimately is essential to the future, as well as the present economy. Additionally, historical data indicated the existence of an alarming achievement gap in science through an examining national, state, and local standardized test data. The gaps in achievement among Children of Color and Non-minority children in the U.S. represents one of the most pressing and challenging issues in the educational system (Wells, Griffith, & Kritsonis, 2007). More specifically, Black students tend to score significantly lower than their white peers on science standardized tests (Betancur, Votruba-Drzal, & Schunn, 2018). However, the NGSS suggest more equitable learning opportunity in science for all students regarding their race or socioeconomic background, therefore, offering an intervention for better achievement outcomes.

Chapter 1 addressed the issue of science performance on standardized tests and an overview of the NGSS was presented. In chapter 2, a review of literature regarding science achievement is presented.

CHAPTER TWO. LITERATURE REVIEW FROM THE FIELD OF SCIENCE ACHIEVEMENT FOR CHILDREN OF COLOR

This review of literature is from the field of science achievement for Children of Color (subgroups) for the last 10 years nationally, state-wide, and locally. Topics in this review of literature addresses areas such as: impact of poverty and socio-economic status (in terms of opportunity to engage in and experience science learning), exposure to science-related pedagogical practices and quality science teaching, access to science-based experiences with highlighting the recommendations and influence of the Next Generation Science Standards (NGSS). This research was comprised appropriately from the fields of educational testing, science education, and educational leadership or teacher education.

2.1. Overview

Children of Color struggle when compared to White students in science achievement on international, national, state, and local data (Buzick, 2019; Davis, 2019; Cervantes, Hemmer, & Kouzekanani, 2015; Clark & Fleming, 2019; Frey, 2015; Isaac, 2012; Hanselman, 2018; Morgan et al., 2016; Necochea & Cline; 1995; Regenstein et al., 2018; Ruby, 2006; Snyder et. al, 2019; Turiman, Omar, Daud, & Osman, 2012). Therefore, this review of literature focuses on investigating the factors and causations of the learning gap in science achievement, as well as, exploring the effective and ineffective measures in science pedagogy with using recommendations by the NGSS, but not limited to other successful implementations in science pedagogy. The following topics were examined to determine how the practices, influences, and limitations of the NGSS measure among Children of Color: access to science-based experiences, exposure to science-related pedagogical practices, the impact of poverty and socio-economic status in terms of opportunity to engage in and experience science learning, and the influence of quality science teaching as recommended by the NGSS.

Search Perimeters

The search strategy for this study started with establishing a literature review component outline, which guided the keywords used in search databases. Keywords included, but were not limited to *science, achievement, minority, gaps, STEM, project-based learning, exposure/assess, science pedagogical practices, poverty, socio-economic status, engagement, experience quality science teachers, support, funding,* and *the NGSS*. The ProQuest, ERIC, EBSCOHOST, LIBRARY REFERENCE CENTER, and SAGE databases were searched. Google Scholar and Academia.edu were also leveraged to search for information. Sources of information included peer-reviewed journal articles, reports, books, official publications, and government statistics. Research papers from experts in the field were also included in the review.

In the gathering of literature, there were identifiable research studies that surrounded the topic of science achievement among subgroup performance. The majority of studies used in this review of literature were published within the last 10 years (2010-2020). Older, seminal sources were included to provide the reader with a perspective of the longevity and history of the topic. In the last chapter, student performance on standardized national-level tests, state-level exams (NAEP and LEAP) were used heavily to illustrate the existence of an achievement gap. The majority of the studies in this review used other outcome academic measures of achievement in science. Several studies used data from an international test, Program for International Student Assessment (PISA). The PISA is an academic measure that "examines what students know in reading, mathematics and science, and what they can do with what they know" (Organization for Economic Cooperation and Development (OECD), 2019, p. 352). Other studies in this review of literature used local administrations, such as school and district performances, as an academic outcome measure. In the implications in the existing research on science achievement among

subgroups, key themes were found to be recurring: reform, barriers, successful measures, critiques of the NGSS, and limitations of common standards. These themes assisted in organizing literature and forming the headers for this study.

2.2. The Focus on Closing the Gaps in Achievement

Over a span of the last 20 years, from 2000 to 2020, policy, reform, and research were heavily focused on addressing educational equity with ensuring equal access to learning opportunities in the U.S. (Hanselman, 2018). Accordingly, those educational inequities were responsible for the U.S. lagging behind other countries in rankings (Frye, 2015). The 2001 No Child Left Behind (NCLB) Act was the first account of the ambitious goal of equitable opportunity, with ensuring that by 2014, “all children will reach, at a minimum, proficiency on challenging state academic achievement standards and state academic assessments” (Regenstein et al., 2018, p.3). In 2009, with further renewing the focus on the equitable distribution of educational opportunities for all students, the Federal Government then introduced the Race to the Top Initiative as a means to impact on a country's overall scores by providing incentives for innovation and reform on school systems (Frye, 2015). As a result of this initiative, states began adopting the new set of K–12 national standards in English language arts (ELA), literacy, and mathematics, which became known as the Common Core State Standards (2010). The standards were designed to “serve as an equalizer for high poverty students and the related achievement disparity” (Buzick, 2019; Davis, 2019, p.1). Next, after the federal government replaced NCLB with Every Student Succeeds Act (ESSA) (2015), states were held accountable for improving achievement outcomes for all students by monitoring the subgroup data from standardized exams (Regenstein et al., 2018). Through the continuation of a quest for equitable achievement outcomes, NGSS was developed in 2013. While the NGSS was purposely crafted to increase

overall science achievement in the U.S. and revitalize science education, it was also designed to address educational inequality of traditionally "underserved" students.

2.3 Causations of the Achievement Gap in Science Among Children of Color

In chapter one, public data showed the existence of large gaps between Children of Color and their White counterparts on assessments on standardized tests, such as LEAP and NAEP. In the data, science held tremendous gaps among other core subjects before and during the implementation of the NGSS. The gaps are completely despairing, as science drives us into the twenty-first century and overcome challenges and topics in the technology sector during the current age of globalization (Turiman, Omar, Daud, & Osman, 2012). By examining literature surrounding science achievement among Children of Color, the research provided several factors that were identified as causations for the gaps in science achievement. The key topics that emerged in the review of research were Children of Colors' access to science-based experiences, exposure to science-related pedagogical practices, impact of poverty and socioeconomic status in terms of opportunity to engage in and experience science learning, and influence of quality science teaching. Through synthetization of these topics, barriers were identified in the home and school environment that ultimately influences the achievement of the subgroup, Children of Color. Barriers in the home environment included the impact of poverty and exposure to academic experiences that link to academic achievement. These Barriers in the home environment are also known as nonacademic barriers. Barriers in the school environment included the impact of resources such as funding and quality teachers and instructional practices. These barriers were presented in this review as underlying, existing long before and during the adoption of the NGSS.

2.4. Barriers in the Home Environment: The Impact of Poverty

Historically, the vast majority of Black and Hispanic families are considered economically disadvantaged and/or prone to experience life in poverty-stricken environments. DeNavas-Walt & Proctor BD (2015) supports this notion in a population report, Income and Poverty in the United States. In the study, the purpose was to examine poverty in the U.S. The data was gathered from a household survey, Current Population Survey Annual Social and Economic Supplements (CPS ASEC). The CPS ASEC was administered in the 50 states and the District of Columbia by sampling the resident civilian noninstitutionalized population of the U.S. In the study, DeNavas-Walt & Proctor (2015) used the variance of CPS ASEC estimates to calculate the standard errors and confidence intervals. In their findings, data revealed that Children of Color were indeed more likely to live in poverty. Specifically, Black children historically had the highest child poverty rate, with more than one in three (37.2%) Black children living in poverty (DeNavas-Walt & Proctor BD., 2015, p.53). In 2015, Latinx children came in second, with nearly 1 in 3 (28.6%) living in poverty (DeNavas-Walt & Proctor BD., 2015 p.55). Over the years, EBR schools have historically served high numbers of Minority (Children of Color) students in the economically disadvantaged population (Urban League, 2019). In 2018, “Of students enrolled in public schools (all types) in Baton Rouge, 82.4 percent were non- white; 75.5 percent were economically disadvantaged (eligible for free- or reduced-price lunch)” (Urban League, 2019, p. 7).

To further prove that Minority racial groups are more likely to experience multidimensional poverty, Reeves, Rodrigue, & Kneebone, (2016) conducted a study called *The Five Evils: Multidimensional Poverty and Race in America*. The purpose of the study was to examine the clustering of 5 dimensions of poverty: low income, lack of education, no health

insurance, low-income area, and unemployment (Reeves, Rodrigue, & Kneebone, 2016, pg.3). The study used 2014 data from the American Community Survey, which sampled resident adults (aged 25 to 61). Calculations of the percentages of demographics were used to identify groups that fell below poverty levels. Their data revealed, "Most Blacks and Hispanics were disadvantaged on at least one dimension; most Whites are not" (Reeves, Rodrigue, & Kneebone, 2016, p.7).

As poverty is more prone to impact significant numbers of Children of Color, poverty is the root cause of gaps in science achievement. Dating back to 2006, the administering of PISA brought attention to poverty being a factor in science achievement (Cavanagh, 2007). The data from PISA showed that the U.S. "socioeconomic variation was more than twice as high as that of several of the highest-performing countries in science, such as Finland and Canada, where it hovered at about 8 percent" (Cavanagh, 2007, p.1). Therefore, the results indicated that U.S. students' academic achievement in science was more likely affected by their wealth or poverty and family background than their peers in higher-scoring nations.

Additionally, poverty was linked to the causation of gaps in science achievement in the study *Science Achievement Gaps Begin Very Early, Persist, and Are Largely Explained by Modifiable Factors* by Morgan, Farakas, Hillemeier, and Maczuga (2016). Morgan et al. (2016) investigated "the early onset and over-time dynamics of science achievement gaps as well as potentially modifiable factors that may explain these gaps" (p. 21). The study was an analysis of "the public-use file of the Early Childhood Longitudinal Study, Kindergarten Class of 1998-1999" (p. 21), which is a sample of "a nationally representative cohort of children who entered kindergarten in 1998" (Morgan et al., 2016, p. 21). The 7,757 students in the study varied by race and ethnicity, including Black, White, American Indian, Asian, Hispanic, and other. In the

study, researchers “used multilevel growth modeling to identify factors associated with or predictive of science achievement growth trajectories across third, fifth and eighth grades and to relate first-grade general knowledge to subsequent science achievement” (Morgan et al., 2016, p. 21). The findings section in the study presented that “Black children often follow a cumulative trajectory in that they experience both initially lower and then somewhat slower science achievement growth” (Morgan et al., 2016, p.31). More importantly, the study concluded that socioeconomic factors were one of the primarily explained factors that cause gaps in science achievement with black students. Furthermore, it indicated that the gaps in science achievement gaps begin very early, even as early as kindergarten (Morgan et al., 2016).

Comparable to the aforementioned and reviewed studies, a study by Betancur, Votruba-Drzal, and Schunn (2018) also explored socioeconomic factors such as poverty as a measure for determining science achievement. Similar to the Morgan et al. study (2016), Betancur et. al (2018) used the Early Childhood Longitudinal Study, Kindergarten Class of 1998-1999. The data was deciphered to focus on a subsample of about 9250 children who were clustered in 2700 schools. The study used the correlation design to investigate whether socioeconomic factors were strongly linked to students’ science skills. The results signified that science achievement was directly correlated to household income. Thus, this research added to the case that a students’ socioeconomic factors pose a strong link to their science achievement.

2.5. Barriers of the Home Environment: Impact of Exposure and Access

Historically, Minority groups have been subject to socioeconomic barriers and social inequities in poverty (Alexander, 2001). Low-income households experience difficulty possessing social capital, which are resources and tools necessary for learning (Falk, Storksdieck, & Dierking, 2007). Specifically, influences, such as books, computers, magazines,

educational games, a comer for study, and good nutrition, support student learning, yet these influences are harder to acquire by groups experiencing poverty (Archer et al., 2012; Kao, 2004). With being prone to poverty, Minority groups experience the lack of access impacts their opportunities to engage in learning outside the school environment (Dawson, 2014).

Specifically, in science, learning extends beyond the classroom through a landscape of resources, such as educational television, radio, museums, zoos, aquariums, national parks, community activities such as 4-H and scouting, and many other scientifically enriching enterprises (Archer et al., 2012; Falk & Dierking, 2010). These, outside of school learning experiences, enhances and supports students' mastery of science concepts (Chesnutt et. al, 2018). Students are better able to make connections and retain learning when drawing on their personal experiences from their environment (Clark and Fleming, 2019). Additionally, students are provided with needed foundational tools, such as background knowledge (Cervantes, Hemmer, & Kouzekanani, 2015). Consequently, a lack of exposure or access to outside of school learning experiences limits student achievement (Blair et. al, 1999).

As an example of this impact of outside school exposure, a study conducted by Tsai & Yang (2015) found that students exposed and engaged in learning resources outside of school performed better in science than those who did not. Tsai & Yang (2015) conducted this study "to understand the effect of student- classroom-, and school-level factors on the science performance of 8th-grade Taiwanese students in the Trends in International Mathematics and Science Study (TIMSS) 2011" (Tsai & Yang, 2015). For this investigation, a sample of 5,042 students from 153 classrooms of 150 schools was required to complete questionnaires. After using the 3-level multilevel analysis design, the results illustrated that exposure to educational learning resources outside the school was a strong predictor of science performance.

Similar to the findings of Tsai & Yang (2015), Necochea & Cline (1995) found that lack of exposure to outside school learning experiences was one of the reasonings for literacy gaps in science. Similarly, Juan & Visser (2017) investigated this notion by examining science literacy in the home environment as a determinant of science achievement. The sample in the study represented 11,969 South African Grade 9th Grade students who participated in the 2011 Trends in International Mathematics and Science Study (TIMSS). Juan & Visser employed multiple regression analyses to examine the effects of exposure to selected home and school resources on science achievement. The findings concluded that home environments play important roles in students' science achievement. Additionally, the study listed strong associations to home assets and the language of the test being used at home (Juan & Visser, 2017).

Chesnutt, Jones, Hite, Cayton, Ennes, Corin, & Childers (2018) conducted a study that gave a clear picture on how Minority racial groups lack exposure. The study was administered on a group of eight students at low-performing middle school in the southeastern U.S. with using a quasi-experimental control group design. The purpose of the study was to explain the variation in students' concepts of size and scale. The crosscutting concepts of size, scale, proportion, and quantity were used because they provided "students the opportunity to apply scientific knowledge, develop problem-solving skills, and foster a sense of curiosity at different sizes and scales" (Chesnutt et al., 2018, p.877). Chestnutt et al., found that all groups were to make connections with the crosscutting concepts due to lack of personal experiences. Personal experiences were defined as the "exposure to resources, events, or individuals that could enhance or support learning in science, particularly those experiences that take place when students are not in school" (Chesnutt et al., 2018, p.881). A Scale of Objects Questionnaire (SOQ) was used to evaluate the different variations in students' concept of size and scale. The study used multiple

regression design to see the relationship among variables SOQ, exposure (listed as science capital), and Racial/Ethnic Group. The analysis found that exposure to be statistically significant, as well as the variable Racial/Ethnic Group. The study's findings concluded that Non-White students' low performance was closely tied to students' experiences with size and scale outside of school, further giving evidence of the importance of access to outside school learning experiences. However, inequitable funding also impacts science achievement.

2.6. Barriers in Schools: The Impact of Funding

In national statistics, large numbers of students from racially diverse backgrounds attend high-poverty schools (National Center for Education Statistics, 2018). Despairingly, in the U.S., high-poverty schools receive lower funding than other schools. Funding provides better outcomes as schools wisely spend money on needed educational resources to strengthen student learning (Elliott, 1998). Additionally, funding is a means of providing equal opportunities for students as it diminishes the effect of socioeconomic factors on academic achievement (Savasci & Tomul, 2013). Therefore, the disproportionate aspect of funding inequities has historically weakened the nation's capacity by boosting the inequalities in educational outcomes (Beese & Liang, 2010).

As an example, Hall & Ushomirsky (2010) examined the existence of funding gaps in *Close the Hidden Funding Gaps in Our Schools*. Their report found that poor children were already at a disadvantage and receive less in their homes; yet, they have had parallel experiences with receiving less in school (Hall & Ushomirsky, 2010). To demonstrate the existence of a funding gap, Hall & Ushomirsky (2010) examined data from 600 schools in New York (Title 1 and Non-Title 1 Schools). Schools that were designated as Title 1 schools are those that receive allocated federal funding. Title I funds emanated from the original Elementary and Secondary

Educational Act (ESEA) (1965), the precursor to both NCBL and ESSA. The ESEA was originally designated to address social inequities and help close the achievement gap among African-American, Latino, American Indian, and low-income students; NCLB and ESSA are reauthorizations of the original ESEA. However, Hall & Ushomirsky (2010) argued “the law's provisions for ensuring comparability in the core budgets of high-poverty and low-poverty schools are deeply flawed” (p.4) with ultimately showing results that Non-Title 1 schools received more funds than Title 1 schools in New York City (P.S. 251 and P.S.291). Figure 2.3 provides an example of funding levels that existed among high Title 1 and Non-Title 1 schools.

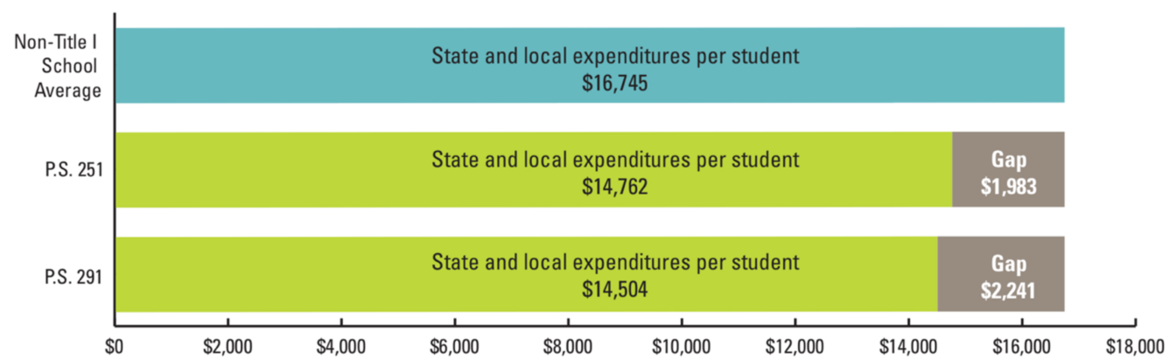

Figure 2.3. Gap in Per-Student State and Local Expenditures Between Non-Title 1 Schools and P.S. 251 and P.S. 291 (Hall & Ushomirsky, 2010).

As funding gaps exist in high poverty schools that are predominately comprised of Children of Color, inequitable funding was a causation for gaps in science achievement among Children of Color. A study by Beese & Liang (2010), supported this notion by investigating school resource indicators and its effect on 2006 PISA results. Providing an international lens, Beese & Liang (2010) compared 2006 PISA data between the U.S. to Canada, and Finland. Both Finland and Canada were included in this study because of their high rankings on the PISA (Beese & Liang, 2010). The study employed a two-level hierarchical linear regression model (HLM) to examine school factors and student factors. The sample included 869 Canadian, 166

US, and 155 Finnish schools as well as included results from 5611 U.S. students, 22,646 Canadian students, and 4714 Finish students. The findings indicated that school funding affected science achievement and international school rankings (Beese & Liang, 2010).

Additionally, Hoisington et al. (2018) conducted a study that exposed funding as an indicator of achievement in science in high poverty schools (mostly comprised of Children of Color). The Hoisington et al. (2018) study was designed "to determine the extent to which instructional expenditure ratios of school districts were related to the academic achievement, as evidenced by Texas Assessment of Knowledge & Skills (TAKS) passing rates for the Reading, Mathematics, Science, Social Studies, and Writing tests" (Hoisington et al., 2018, p. 114). In the study, Texas students were required to take the TAKS, which tested them in all subject areas including science. The data for this study was retrieved from the Texas Education Agency Academic Excellence Indicator System database. A multivariate analysis of variance (MANOVA) statistical procedure was used to determine the effect of instructional expenditure ratio grouping on the TAKS for each subject area. It was tested and significantly proved that, "School districts that had an instructional expenditure of at least 60% had higher TAKS passing rates in all five academic areas for students in poverty than school districts that spent less than 60% on instruction" (p.111). Furthermore, this data concluded that funding was definitely a factor in passing rates in subjects as science. Moreover, in addition to impoverished backgrounds, a lack of exposure to science content outside of schools, and funding opportunities having an impact on science achievement, teacher quality is also a factor that warrants consideration.

2.7. Barriers in the Schools: The Impact of Quality Teachers and Quality Instruction

The NCLB federal legislation of 2001 brought attention to what was considered to be a national concern, recruiting and retaining quality teachers specific for high-poverty schools in urban areas that serve Black students (McKinney et al., 2007). Poor schools in urban areas are not able to compete for or retain adequately trained teachers (Ingersoll, 2004). Simon & Johnson (2015) argued, “teachers systematically favor higher-achieving, non-minority, non-low-income students” (p.117). Therefore, many students in Black communities attend schools with teachers who are less qualified; hence, causing more racial inequality and widening the achievement gap (Mangiante, 2011; Darling-Hammond, 2003). Having less qualified teachers means that Minority students are not subject to receiving high quality instruction (Necochea & Cline, 1995). Effective science instruction includes students being engaged in activities that focus on attaining scientific literacy, such as: describing objects and events, asking questions, constructing explanations, testing those explanations against current scientific knowledge, and communicating their ideas to others (NRC 1996). Instead, Minority students are often exposed to failed instruction deemed as “Pedagogy of poverty”, which focuses on memorization of static facts and theories (Barton, Ermer, Burkett, & Osborne, 2003). Pedagogy of poverty is typically responsible for cross-cultural barriers in learning among disadvantaged groups. Hence, quality instruction by quality teachers has historically impacted student achievement. In sum, urban schools and school systems experience high concentrations of poverty, and often contain significant numbers of numbers of children of Color (Howard & Milner, 2014).

A study by Goldhaber et al. (2015), indicated an uneven playing field among the distribution of quality teachers among advantaged and disadvantaged students (Children of Color, economically disadvantage, etc.). The study, situated in Washington state, investigated

“the inequitable distribution of both input and output measures of teacher quality across various indicators of student disadvantage across all school districts in Washington State”. This study considered every measure of teacher quality, such as experience, licensure exam score, and value-added estimates of effectiveness, to prove that the low rated/low performing teachers are inequitably distributed across every indicator of disadvantaged students (Goldhaber et al., 2015). The study gathered the data for this study by the Washington States Office of Superintendent of Public Instruction. Descriptive analysis was used to provide results that teachers were inequitable distributed across Washington state.

On the local level, the Urban League of Louisiana (2019) released a report that highlighted teacher quality trends in schools in Baton Rouge, LA in 2019. Teacher quality was based on teacher effective ratings of 86 schools. “Of African-American public-school students, 6% attended a school with 80 or more teachers rated Highly Effective; 17% attended a school where fewer than 20% are rated Highly Effective” (Urban League of Louisiana, 2019, p.52). Hence, a large margin of Black and Hispanic students in Baton Rouge were receiving instruction from low-quality teachers. Essentially to be noted, in that same year, “Only one-quarter of African-American students (25 percent) and Hispanic students (24 percent) scored Mastery or above” (Urban League of Louisiana, 2019, p.14) on the state’s standardized assessment. This discrepancy indicated a link between Black students' achievement and their low access to quality teachers.

In research, quality teaching is considered to be a strong indicator for student achievement in science (Darling-Hammond, 2010; Wenglinsky 2002). Quality, well-prepared teachers are the key factor in student achievement (Darling-Hammond, 2010). Johnson (2009) furthered this notion in a study that explored the relationship between effective science

instruction. In the study, two methods were used to see if effective teaching directly relates to student achievement. The first method was conducting a longitudinal study which consisted of observations in randomized science classrooms throughout the span of three years. The study focused on observing the relationship between the science teachers' effectiveness and their students' achievement in science using Local Systemic Change (LSC) Protocol. The study used the Discovery Inquiry Test in Science (DIT), similar to the state assessments, as the instrument to measure the student achievement (Johnson, 2009). Throughout the first method, interviews were conducted with all science instructors for the purpose of being used in the second method, the case study. The case study used three randomly selected science teachers, two effective and one ineffective. "All transcripts from the interviews were coded manually according to the capacity and context belief framework in order to attain their experiences and change in beliefs that led to their level of change in practice" (Johnson, 2009, p.294). The study's findings revealed that quality instruction impacts student achievement in science. The students who had effective teachers significantly outperformed students who had ineffective teachers. Johnson (2009) continued with the argument that "Effective teaching provides a way to narrow the achievement gap in science between White and Non-White students" (p. 301). Therefore, the impact of quality teachers and quality instruction is represented as a barrier to Children of Color.

The following study provided additional evidence of quality instruction being represented as a factor that affects achievement. A study conducted by Qian, Nandakumar, Glutting, Ford, & Fifield (2017) investigated "gender and minority achievement gaps on 8th-grade science items employing a multilevel item response". The study gathered its sample from the TIMSS science assessment in 2007. The subsample included 62.7% White students, 12.9% Black, and 24.4% Hispanic students. The study utilized a multilevel item analysis methodology to estimate item

difficulty, achievement gaps, and items with achievement gaps controlling for student outcomes. Specifically, the results data indicated that Minority students scored significantly lower than White counterparts on the constructed-response item. The constructed response item was deemed easy, which provided a strong indication that students did not receive effective instruction because of students' inability of making real-world science applicable to situations (Qian et al., 2017). Qian et al. (2017) stated, if teachers would "introduce concepts that are easier to understand and closer to life than abstract concepts that are based on prior knowledge and less related to daily life" (p.14), then gaps would be diminished among Minority students. Additionally, in the findings section of this study, minority students did not perform better than counterparts on physics and earth science items. Qian et al. (2017) associates the additional results to failed instruction as students were not introduced to concepts that "require students abstract thinking skills to visualize and develop a logical notion of complex phenomena" (p. 15). While the aforementioned studies point to the disparaging barriers in the home and school environment, additional studies of note have examined the NGSS and its implications for increasing achievement among subgroups of students.

2.8. Implications of the NGSS Closing Gaps in Achievement

After reviewing the causations and factors that result in achievement gaps among Children of Color, it is important to know how the NGSS was designed in its relation to closing the gaps in achievement. The NGSS claimed to be a change agent in the science education field by addressing inequalities that would result in increased science achievement among disadvantaged groups. Therefore, this section of the review is geared towards the NGSS implications of closing the achievement gap. The NGSS used prior research-based strategies or recommendations to assure that its standards would provide a more equitable opportunity and

standards that could be shaped into a curriculum to benefit all students. Hereafter, those strategies are addressed.

Rigorous Standards

The first strategy was providing both learning opportunities and challenges for all students to attain rigorous standards. The NGSS stressed the importance of providing rigorous standards for all because diverse groups have experienced a long history of exclusion from pedagogical practices that promote high achievement. Disadvantaged students, such as Black students, are one of the known subgroups to be excluded from the beneficial educational opportunities. Dating back to 1950, teachers in urban schools, serving Minority and disadvantaged students, often implemented weak instructional practices, often referred to as "pedagogy of poverty", which hinders full student achievement (Haberman, 2010). Waxman, Huang, & Padron, (1995) identified the pedagogy of poverty in inner-city middle-level schools. Their observations were of students typically involved in whole-class instruction and not interacting with either their teacher or other students, students rarely selecting their own instructional activities, teachers typically focused on the content of the task or assignment and spending very little time interacting with students regarding personal issues, encouraging students to succeed, showing personal regard for students, and showing interest in students' work (Waxman, Huang, & Padron, 1995). Therefore, to counteract with exclusion, it was important for the NGSS to incorporate rigorous academic standards that would challenge "pedagogy of poverty".

When academic rigor is defined, it is most commonly used to describe academic quality (Duncan et. al, 2013). However, rigor encompasses curriculum and learning as well. Ainsworth (2011) defined rigor as a "high-quality delivery system for ensuring that all students achieve the

desired end" (p.7). Rigor is also focused on the performance of students. Further, emphasizing rigor in terms of skill development, students should be using critical thinking, problem-solving, collaboration, leadership, agility, adaptability, initiative, entrepreneurialism, effective oral and written communication, accessing and analyzing information, and exercising curiosity and imagination in an educational setting (Wagner, 2008). Consequently, the NGSS standards strategy wrote the standards, in a manner to be deemed as rigorous. Specifically, the NGSS outlined that the standards would require students to participate in activities, such as build models, design investigations, share ideas, develop explanations, and argue using evidence. By incorporating performance expectations as the basis of the NGSS standards, students would learn science content while developing important 21st-century skills such as problem-solving, critical thinking, communication, collaboration, and self-management.

This notion of academic rigor is identified as important in past research. For instance, in a research study crafted by Burris, Wiley, Welner & Murphy (2008), the researchers stressed the importance of academic rigor in relation to closing the achievement gap. The study explored tracking, also known as ability grouping, which often limits student access to high curriculum and quality teaching (Oakes, 2005). "Research demonstrates that tracks stratify students by race and class, with African American, Latino and students from low-socioeconomic households being dramatically over-represented in low-track classes and under-represented in high-track classes" (Burris et. al, 2008, p. 571). Hence, the study examined the effects of detracking students at a diverse suburban high school in New York, whereas all students were given accelerated mathematics. The longitudinal study examined detracking and the effect it had in students earning "two diplomas that represent high standards of achievement—the New York State Regents diploma and the diploma of the International Baccalaureate (IB)" (p. 578). The

study employed a quasi-experimental cohort design to compare pre- and post-reform of detracking on students earning diplomas. Binary logistic regression analysis significantly proved that post-reform increased the probability of students earning diplomas. Therefore, the study supported the idea that introducing students to academic rigor and high expectations is a measure of success.

Significant Literature on Diversity and Equity

The second strategy the NGSS recommended to address educational inequalities was using the best pedagogical practices of key findings in the research literature on student diversity and equity. Therefore, the NGSS included research-based and proven strategies to raise achievement for Minority students in science education. The effective strategies were credited to research by Lee & Buxton (2010). Lee and Buxton, two leading science educators, published a book that provided an analysis of current trends in the research, policy, and practice of science education (Lee & Buxton, 2010). The authors investigated the achievement gap and the reasoning for it continuing to exist in education. In addition, they provided suggestions toward narrowing or eliminating the gaps. Lee and Buxton (2010) examined "instructional practices, science-curriculum materials (including computer technology), assessment, teacher education, school organization, federal and state policies, and home-school connections" (p.ix) through synthesizing bodies of research in the field of science education and its application to practice and policy. Through Lee and Buxton (2010), composers of the NGSS outlined the following as effective strategies for students from major racial and ethnic groups: "(1) culturally relevant pedagogy, (2) community involvement and social activism, (3) multiple representation and multimodal experiences, and (4) school support systems including role models and mentors of

similar racial or ethnic backgrounds" (NGSS Appendix D, 2013, p. 12). These effective strategies were used in the following case studies.

The NGSS Case Studies

The third strategy the NGSS recommended to address educational inequalities was to examine the effective strategies/practices through case studies to assure their success. The case studies were "not intended to prescribe science instruction, but to illustrate an example or prototype for implementation of effective classroom strategies with diverse student groups" (NGSS Appendix D, 2013, para. 2). There were seven case studies performed representing a disadvantaged population. Case two (NGSS Appendix D, 2013) was specifically written to show effective implementation among Minority groups. The effective strategies were based on previously mentioned authors, Lee and Buxton (2010). The case study's setting was a Sequoiah Middle School. At the time, Sequoiah Middle School was an urban school with 65% of the students being non-White (targeted students). The study provided a telling vignette, whereas the teacher, Ms. C., used effective teaching strategies to have her students meet objectives. Through teaching concepts of the NGSS, she connected the students' community and real-world issues with disciplinary core ideas. Her students "had an opportunity to build toward understanding of the disciplinary core ideas and scientific practices to achieve the performance expectations from the middle school grade band in life sciences (LS1: From Molecules to Organisms: Structures and Processes), in physical sciences (PS1: Matter and Its Interactions), and with an introduction to some core ideas in ETS1: Engineering Design" (NGSS Appendix D, 2013, p.3). Students gained a more comprehensive understanding of science with the NGSS through the integration of the disciplinary core ideas with scientific and engineering practices and crosscutting concepts. Ms. C's students felt "a sense of place", as they were allowed to make home-community

connections by applying their funds of knowledge to learning. Her methods were proven to be effective for all students, particularly students from diverse racial and ethnic backgrounds. Ultimately, the case study supported that the NGSS could impact performance among Minority groups. Additionally, the case study suggested project-based learning as the most effective learning model to benefit disadvantaged major ethnic groups. The limitation of the NGSS in case study two is that a factor such as having the necessary school support/funding system could hinder effective implementation.

2.9. Positive Outcomes of the NGSS Closing Gaps in Achievement

In addition to the three previously mentioned strategies, another implication to the NGSS closing the gap was evidence of positive outcomes with the usage of the NGSS as an intervention. There were several studies that strongly suggested the NGSS could affect science scores among Disadvantaged Groups. Marshall & Alston (2014) specifically measured whether professional development aligned to the NGSS, impacted on Minority students. The professional development (PD) project was entitled *Inquiry in Motion*. It was "designed to (a) facilitate teacher transformation toward greater quantity and quality of inquiry-based instruction, (b) improve student achievement in science practices and science concepts, and (c) begin to narrow the achievement gap among various groups" (Marshall & Alston, 2014, p. 807). The study was conducted over the course of 5 years. The sample was inclusive of 11 schools, 74 middle school teachers, and 9,981 students (Marshall & Alston, 2014). The students in this study were from highly diverse schools. The study used a quasi-experimental design to measure subgroup performance on three science tests called Measure of Academic Progress tests. The performance of students whose teachers received the training were compared to the performance of students who did not receive the training. Through using an Analysis of Variance (ANOVA) and

Levene's Test, the study significantly proved that when the NGSS were implemented correctly, all groups (males, females, Whites, African Americans, and Hispanics) saw gains in their performance. More importantly, the achievement gap decreased between the Minority and their counterparts (which was proven through a One Sample T-test). Overall, the study indicated that inquiry-based instruction, a suggested method by the NGSS, positively impacts Children of Color. However, this study indicated that teacher training is needed for effective implementation.

Asowayan, Ashreef, & Omar (2017) conducted a systematic review to explore the effects of the NGSS with consideration of the increased cultural diversity in the U.S. The study focused "on such objectives as science-related values of students, cultural competence of teachers, and the challenges of teaching science disciplines in the conditions of cultural diversity" (Asowayan et. al, 2017, p.65). The sample for this study consisted of 52 academic entries or empirical research and case studies. Keywords were used to gather this data, such as the NGSS, science-related values, cultural diversity. Additionally, the thematical analysis was the method used to analyze the provided data. In the study's findings, it was revealed "that modern students possess such science-related values as social presence, decreased power distance with tutors, simplicity of learning process, multitasking, universal accessibility of learning instruments, readiness to work with big data, readiness to use online software and tools" (Asowayan et. al, 2017, p.63). Further implications of the study argued that the NGSS provided students with a sense of belonging. In addition, its many opportunities provided students with their motivational needs. However, the limitations in this study were specifically for teachers. The challenge revealed through the analysis instances of poor cultural sensitivity among teachers. Identifying a students' cultural background was revealed as impacting the way that students derive and interpret evidence (Asowayan et. al, 2017).

In a study by Williams, Brule, Kelley, & Skinner (2018), a program called Science in the Learning Gardens (SciLG) was used to "address two well documented, inter-related educational problems: under-representation in science to students from racial and ethnic minority groups and inadequacies of curriculum and pedagogy to address their cultural and motivational needs" (p.1). The program, SciLG, was designed for sixth through eighth grade students as it directly aligned to the NGSS (Williams et al., 2018). The study's purpose was to investigate how SciLG would impact predictors of engagement and learning in science, science grades, and science identity. The study's sample was results from 113 students and three science teachers. These participants were from two low-income urban middle schools, with both schools implementing the SciLG program. The study used correlation to measure the science outcomes. The students were surveyed using scales adopted from Skinner et al. (2012) and Saxton et al. (2014) to gather data on learning in science class, engagement in science class, and science identity. Science grades were gathered from the students' fall 2015 and spring 2015 grades. In the study's findings, the SciLG program significantly tested as a positive indicator of science-class engagement, science learning, grades, and science identity. This study provided evidence that pedagogical practices recommended by the NGSS benefit Children of Color by sparking their interests through real world experiences, which undoubtedly raises their achievement.

In addition, Anderson, De Los Santos, Bodby, Covitt, Edwards, Hancock, & Welch (2018) conducted a study which argued that the NGSS is a measure of closing the achievement gap. Their study investigated how a design-based implementation research (DBIR) project could support the three-dimensional learning goals of the NGSS, which are Science and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas. The DBIR examined in this study was a science education program called "Carbon TIME project, which focused on teaching

carbon cycling and energy transformations at multiples scales" (Anderson et al., 2018, p. 1026). The project provided publicly available teaching units, assessments, and teacher professional development, all of which were used in the study. In the study, Anderson et al. (2018) involved "160 participating teachers working in diverse middle and high school classrooms, with each teacher and their students participating for two successive years (about 900 different classrooms total)" (p.1031). The schools selected for the study were urban, suburban, and rural schools with students of diverse ethnic and economic backgrounds. Formative and summative assessment systems were used as instruments to measure students' understanding of the three-dimensional learning goals of the NGSS through the Carbon Time implementation. The study used hierarchical linear models (HLM)-based analyses to prove the results as statistically significant. Moreover, Carbon Time positively impacted students understanding of the three-dimensional learning goals of the NGSS. Additionally, "Carbon TIME reduced the achievement gap between higher pretest and lower pretest students within classrooms" (Anderson et al., 2018, p. 1041). Ultimately, this research proves that measures that support three-dimensional learning as recommended by the NGSS increase achievement among Minority groups.

A common similarity throughout these research studies is that the NGSS positively impacted student achievement by implementing innovative programs for learning. The studies indicated that innovative methods of learning, such as PBL, have the ability to meet the students' engagement and motivational needs. In return, as students' overall science confidence and interest increased in learning content, their achievement in performance in science. Additionally, Kanter & Konstantopoulos (2010), deemed student engagement as being an important factor in academic success. Similarly, Siew & Ambo (2018), argued when students find learning

enjoyable, this in turn promotes their interest in learning science. Therefore, in these studies, the success of the NGSS was attributed to how its implementation.

However, while promising and warranted, the NGSS are not a panacea. Issues also exist with the standards and their implementation.

2.10. Limitations to the NGSS Closing Gaps in Achievement

After reviewing the implications of the NGSS closing gaps in achievement and positive outcomes of the NGSS closing gaps in achievement, it is important to know possible limitations of the NGSS. Therefore, this section of the review is geared towards examining both barriers and challenges to the NGSS closing gaps in achievement. In addition, the section presents identifying studies whereas the NGSS proved to have no significant effect on learning.

Looking Beyond National Standards

The Obama Blueprint document asserted that common standards are important in achieving the equality goal of having all children, regardless of circumstance, achieve at high levels (Mathis, 2010, pg.1). Common standards were accepted to be implemented to vast populations rapidly through the Race to The Top Initiative. However, some authors argued that it does not impact student achievement, especially disadvantaged groups. Lee & Wu (2017) implied the notion in their study which examined "the trends of the U.S. states' reading and math proficiency standards before and after the adoption of the CCSS and explores their impact on school practices and student achievement" (Lee & Wu, 2017, p.1). The study was a comparison of data from NAEP when both NAEP and state assessment data were available: 2003, 2005, 2007, 2009, 2011, 2013, 2015 and 2019. The study used Hierarchical Linear Modeling (HLM) to look at the trajectory of select states' rigor of the standards, CCSS and non-CSSS. Additionally, the study used regression to see the relationship between state-level CCSS policy factors and the

NAEP gains in student achievement (from 2009-2015) (Lee & Wu, 2017). In the study's findings, the CCSS state students had a significant difference in non-CCSS counterparts in achievement.

Among beliefs on common standards was the notion that the success of national common standards is dependent upon school and teachers who have the capacity to support those underachieving students (Cobb & Jackson 2011; Brown & Clift, 2010). Prevalent issues, such as equalized funding and access to the key educational resources needed for learning, have also been alluded to the reasoning for gaps in national common standards (Darling-Hammond, 2004). Lee, Liu, Amo, & Wang (2014) referred to school resources, teacher capacity, and teacher practice as internal factors that affect student achievement. The study measured the internal, in comparison with external factors (common standards) to see how each influenced student performance on national and state assessment datasets in reading and math. The study sampled data from the Early Childhood Longitudinal Study, Kindergarten class of 1998-1999 (ECLS-K). The study used the difference-in-differences method to compare the changes in outcomes between internal and external influence. Findings indicated that the internal factors accounted for more significant gains than external factors. Additionally, the study argued, "Simply raising external state or national standards will not help break the inner cycle, particularly for disadvantaged minority students and their schools that already perform way below those external standards and cannot narrow the gap" (Lee, 2014, p.802). Therefore, to receive effective implementation, the focus should be on access to quality teachers and resources must be available for students. These students require additional resources to "level the playing field" (Johnson, 2005). Yet students, such as Children of Color, live in poverty and are overrepresented in the lowest performing schools (Hursh, 2007; Hylsop, 2011). These non-academic barriers are

represented as prime indications of low achievement among Children of Color in science. The barriers are pre-existing as students are marginalized before there enter school. While the NGSS has presented the idea that students learning should be authentic and from students' own social context, it has remained in question whether it has addressed pre-existing barriers among Minority Students. Therefore, there are limitations on whether the creation of common standards, such as the NGSS, could address educational equity in the U.S.

Looking Beyond a Test Score

Another implication to common standards not being a solution is the suggestive to the issues in standardized testing. Milner IV (2012) argued that an achievement gap based on standardized test results should not be how researchers analyze disparities among disadvantaged students. In the current environment of dissatisfaction with public education, the standardized test score has been the most important indicator of educational achievement and increases in students' test scores (Koca, 2017, pg.114-115). However, the use of standardized tests as the primary method to evaluate schools and teachers has contributed to severe problems in the U.S. (Hani, 2016). Standardized tests are recorded as the recurring instrument that undoubtedly displays the achievement gap between African American and Non-minority children (Wells, Griffith, & Kritsonis, 2007). Therefore, Milner IV (2012) challenged policyholders to shift focus from trying to improve test scores and "expand their analysis to opportunity gaps among groups" (p. 693), such as Children of Color. Milner IV (2012) implications were that standardized testing promotes that student should be on an expected level; however, it is a concern because those groups who are marginalized and from different playing fields. Hence, Milner (2012) argued that addressing the non-academic barriers was important in providing equitable opportunity among all learners. Milner (2012) provided recommendations to teachers, principals, and counselors to

improve their practices, suggesting a framework that provided implications for "naming, capturing, and transforming their explanations of educational practices related to issues of opportunity" (Milner, 2012, p. 698). The five tenants outlined in the framework were: color blindness, cultural conflicts, myth of meritocracy, low expectations and deficit mindsets, and context-neutral mindsets and practices (Milner IV, 2012). The framework provides emphases that explain "deeply inequitable systems, processes, structures, policies, and practices that can prevent some students from reaching their full capacity" (Milner IV, 2012, 693). Furthermore, this research (similar to other research) strengthened the assertion that standards do not have the individual power to affect achievement. Instead, the focus should be addressing non-academic barriers.

2.11. Negative Outcomes to the NGSS Closing Gaps in Achievement

While there are limitations to common standards closing the achievement gap, the following studies revealed findings that illustrated how the NGSS failed to address the non-academic barriers. Chesnutt, Jones, Hite, Cayton, Ennes, Corin, & Childers (2018) challenged the idea of the NGSS being the answer to closing the achievement gap. Chesnutt et al. (2018) used crosscutting themes by the NGSS in their study to see the factors that contribute to students' understandings of size and scale. The study stated how the NGSS argued that "Crosscutting concepts have value because they provide students with connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich their application of practices and their understanding of core ideas" (National Research Council, 2012, p. 233). The crosscutting concepts referenced were size, scale, proportion, and quantity, which provided students with "the opportunity to apply scientific knowledge, develop problem-solving skills, and foster a sense of curiosity at different sizes and scales" (Chesnutt et al., 2018, p.877).

However, the study provided compelling evidence that all groups may not be able to make connections with the crosscutting concepts due to lack of personal experiences. Personal experiences included "exposure to resources, events, or individuals that could enhance or support learning in science, particularly those experiences that take place when students are not in school" (Chesnutt et al., 2018, p.881). The scale of Objects Questionnaire (SOQ) was used to evaluate the different variations in students' concept of size and scale. The study performed multiple regression to see the relationship among variables SOQ, Exposure (listed as science capital), and Racial/Ethnic Groups. Exposure tested significant, as well as Racial/Ethnic Group. Therefore, findings concluded that Non-White students' performance was closely tied to students' experiences with size and scale outside of school. Such an investigation gave evidence of the importance of access to outside school learning experiences. Furthermore, it provided evidence that the measures of the NGSS could not solely close the achievement gap.

McCormick (2019) investigated whether meets the NGSS meets its argument about self-efficacy. By the NGSS, self-efficacy was signified as the reasoning for Students of Color's disinterest in STEM subjects. The study examined Children of Color's self-efficacy and STEM interest between groups of students who received and did not receive instruction with the NGSS. The sample was from 580 students who identify as Black or Latino. The students were administered the Student Attitudes Towards STEM survey to measure their interest. Quantitative data was gathered through correlation, which showed the relationship between self-efficacy and STEM interest (McCormick, 2019). However, an independent samples t-test significantly revealed no difference in self-efficacy between groups of students who received and did not receive instruction with the NGSS. The study implied that focus should be on the implementation of the standards. More importantly, it called for more science programs that

would interest students in science and future careers in science, technology, engineering, and math (STEM).

Ultimately, these studies revealed that some gaps in achievement still exist due to socioeconomic factors. Socioeconomic factors place marginalized groups at a disadvantage in science. Success in science learning is dependent upon outside learning experiences and students' self-efficacy. The theme in studies among the studies with positive and negative outcomes to the NGSS closing gaps was the importance of implementation. Asowayan et al. (2017) argued that poor cultural sensitivity among teachers creates challenges for Children of Color. It is essential for teachers to identify students' cultural background. Therefore, Marshall & Alston (2014) called for more teacher training to effectively implement the NGSS. Similarly, Betancur, Votruba-Drzal, & Schunn (2018) suggested that policies should be aimed at improving how teachers address socioeconomic gaps in children during the early elementary and preschool years.

2.12. Summary

The NGSS emerged with the assurance that the standards would reach all learners, no matter their race or socioeconomic background, and narrow gaps in achievement to underserved learning. This is important and beneficial to Black and Hispanic students, who have historically faced large gaps in learning when compared to White students, especially in the subject, science. Yet, this review of literature provided a concern on whether the NGSS merely meets its argument. The NGSS outlined several strategies supported by research that are suggested to guarantee equitable opportunity in performance for disadvantaged students, such as inquiry-based learning. However, there are non-academic, pre-existing barriers that plague the Minority students before the entrance of grade school. In the presented studies, these barriers were

introduced as a hindrance to achievement among Children of Color. For instance, poverty and lack of access or exposure are barriers that Minority students (especially those who are Black) have a history of being more prone to. Yet, poverty was unveiled as the linkage to the causations of gaps in learning. Additionally, the literature established that poverty-stricken schools, consisting of majority Black students, experienced less funding and resources. This questions how successful implementation can be conducted with an absence of the necessities needed for instructing students. Moreover, variables such as, High-quality pedagogical practices and quality teachers, affect performance among Children of Color. Yet, in Louisiana, economically disadvantaged students and Black students are more likely to attend schools with the least effective teachers, (Urban League of Louisiana, 2019). Therefore, the NGSS would have to address many uncontrollable barriers in science achievement to narrow the achievement gap.

This review of literature provided the rationale that more research should be conducted to contribute topics, such as achievement gap, national standards, and science achievement among Children of Color. Research around this topic provided the notion that there is more needed to contribute to the subject of science as science learning is important, yet problematic for Children of Color in the U.S. This review of literature provided the following unanswered questions:

- Do the NGSS have the power to increase science achievement for Children of Color overtime?
- What constitutes successful and failed implementation of the NGSS?
- What are the main factors that affect student achievement with the NGSS in local state, such as Louisiana?

Therefore, the overarching concern remained the same in this study. Can the NGSS aid in narrowing gaps in the achievement gap in Louisiana?

In this second chapter, a review of literature was conducted from the field of science achievement for Children of Color (subgroups). In Chapter Three, the elements of this research study are presented. These elements included research design, research questions, participants, setting, data sources, analysis, researcher positionality, and terms used in the study.

CHAPTER THREE. METHODS

The purpose of this study was to investigate the NGSS and its implications of being a curricular and pedagogical intervention in terms of narrowing the achievement gap in science education for Children of Color. The research plan, including the methodology, sampling strategies, subject/participant selection, setting, data sources, collection strategy, data analysis, ethical concerns, and my position as a researcher within such a study are the primary components of this section. In addition, the applicability of a theoretical framework for this study will be discussed in depth.

3.1. Definition of Key Terms

The following terms are used as they apply to this study. They are defined hereafter.

Achievement Gap

The achievement gap is a term used in education and, subsequently policy. The disparities in scores from standardized testing are between Black and White, Latina/o and White students (Ladson-Billings, 2006).

African-American

This term applies to individuals who are of African origin but born in the U.S. (Agyemang, Bhopal, & Bruijnzeels, 2005). African-American as a racial and ethnic designation generally denotes descendants of enslaved Africans.

Black

Black is also a racial and ethnic term that is often used interchangeably with African-American (McKinnon, 2001). A note of distinction is that all African-American can be Black,

but someone born in Jamaica or Trinidad and others are technically Black but not African-American.

Children of Color

An all-encompassing term used in education, related fields in education, and research (McAdoo, 2019). The term denotes a diverse group of children who are non-White.

Culturally Responsive Teaching

The belief that culture could influence the way students learn in classroom (Shade, Kelly, & Oberg, 1997). Therefore, the teacher articulates a vision of teaching and learning to a diverse society and designs instruction that builds on their students' knowledge while stretching them beyond the familiar (Gay, 2018).

High Stakes Testing

When testing affects critical decisions for U.S. students, including impacting individual students and special student populations and determines factors such as promotion, retention, curriculum, and other issues of current interest (Heubert, & Hauser, 1999). Being that standardized tests' usage can potentially determine so many factors for students, it is often referred to as "high stakes testing".

Minority

This term describes the groups of people who are fewer in numbers than the major group in the U.S. (Meyers, 1984). A minority person in the U.S. describes an individual who is African American, Hispanic, Native American, Asian Pacific, or Asian Indian.

National Standards

A national system of standards and assessments, often created in result to a public dissatisfaction with education, are designed to raise the achievement levels of all students

(Ravitch, 1995). In the U.S., the current national standards for reading and math are the Common Core Standards, while the national standards for science are the NGSS.

Opportunity Gap

The belief that academic disparities among students could be caused by their social context (Milner IV, 2012). This reflects the barriers against students of low socioeconomic status and other marginalized communities.

These terms are germane to this proposed study. When describing children's ethnic and racial status, some documents and citations used differing terms interchangeably, such as minority or Children of Color, Black and African-American. Statistics reported by state and governmental agencies have sometimes shifted their terminology. Terms that describe humans are important to consider, but they are not the focus of this proposed study. Equality important to defining terminology is the theoretical frame and conceptual framework that undergird the present study.

3.2. Theoretical Framework - Socio-Transformative Constructivism Theory

The purpose of this study was to investigate the NGSS and its implications of being a curricular and pedagogical intervention in terms of narrowing the achievement gap in science education for Children of Color. Through a thorough review of literature, information around this topic was quite equivocal. The NGSS implied that the standards have several recommended strategies to support and target economically disadvantaged students and minority racial and ethnic groups (NGSS Appendix D, 2013, pg. 12). However, the literature presented contradicting results that both confirm the efficacy of the NGSS and disconfirm their implementation. There were several indications in the review of literature that the NGSS supports science achievement. At the same time, in other research, studies provide results of it not affecting student

achievement on disadvantaged groups, such as Children of Color. Additionally, the literature identified an absence of experimental research studies with science achievement among Children of Color in Louisiana specifically. Therefore, the support of a theoretical framework could provide usefulness to grounding this study. A theoretical framework is valuable as it illustrates how research fits into what is already known and how research contributes to the topic to the field (Maxwell, 2005).

A theory was defined by Kerlinger (1986) as “a set of interrelated constructs or concepts, definitions, and propositions that presents a systematic view of phenomena by specifying relations among variables, with the purpose of explaining and predicting the phenomena” (p.9). Socio-transformative constructivism (STC) theory was selected to ground this study in justifying, articulating, and providing rationale behind the relationships between or among variables. The STC is defined as a learning theory that provides a framework that educators often deploy to ensure effectiveness of academic processes in the conditions of cultural diversity (Asowayan, Ashreef, & Omar 2017, pg.65). The STC integrates “cross-cultural education with social constructivism to provide a framework for teaching and learning that is more critical, inclusive, relevant, and connected to students’ everyday lives” (Rodriguez, 2015, p.448). The NGSS implications fall under the same principle as STC. The NGSS ensures better pedagogical practices by providing standards that are accessible to all students, especially those who have traditionally been underserved in science classrooms, hence the title: “All Standards, All Students (Lee, Miller, & Januszyk, 2014). Therefore, STC is most appropriate for framing the NGSS’ “All Standards, All Students” campaign.

The STC is related to theories of multiculturalism and social justice (Rodriguez & Zozakiewicz, 2010). Under STC, knowledge is socially constructed and mediated by cultural,

historical, and institutional contexts (Rodriguez, 1998, 2002). Therefore, it implies that students should be engaged in innovative, socially, culturally, and relevant ways (Rodriguez, 1998). Additionally, STC encompasses several pedagogical practices that are designed to deconstruct existing power structures of which usually are in the classroom. Also, STC is organized into four closely connected elements: a) the dialogic conversation, b) authentic activity, c) metacognition, and d) reflexivity (Rodriguez, 2002). Furthermore, STC argues that a student's success lies in "socially relevant teaching strategies; learning to teach for understanding and involves learning to implement more critically engaging, inquiry-based, and intellectually meaningful strategies" (Rodriguez & Zozakiewicz, 2010, p.24). Much like tenets of STC, the NGSS' dimensions of learning allows students to build models, design investigations, share ideas, develop explanations, and argue using evidence, in which they develop important 21st century skills such as problem solving, critical thinking, communication, collaboration, and self-management (Krajcik, 2015).

The implementation of beliefs and practices as recommended by STC has shown to be valuable in research. In a study by Rodriguez & Zozakiewicz (2005), "research was designed to positively impact the attitudes and participation of culturally diverse girls in science and mathematics" (p.1). In this study, the teachers used pedagogical strategies as recommended by STC orientation, implementing gender-inclusiveness. Results found that "as the girls developed an increased sense of gender identity awareness from grade 4 to grade 5, they also made more meaningful connections between themselves and the science and mathematics curriculum" (Rodriguez & Zozakiewicz, 2005, p.10). Results also indicated "that the number of stereotype indicators dropped in the girls' DAST, as their level of engagement and interest in these courses remained high, and their level of sophistication to explain gender-based behaviors in the science

and mathematics classroom increased" (Rodriguez & Zozakiewicz, 2005, p.10). In Akar & Yildirim (2010), a study was conducted to measure the influence of the social constructivist environment on student achievement in teacher education through pretest and posttest assessments. In the experimental design, the students in experiment group were taught in a social constructivist environment. The control group was subjected to traditional learning. In the study, retention was measured after a three-month summer holiday interval. The results revealed a significant mean difference in favor of the experimental group, ultimately implying that learning in a constructivist environment had more advantages overtime.

In Johnson (2014), an explanation was offered regarding how tutor/tutee interactions affect the dynamics of the teaching/learning experience in a university-based learning assistance center. The peer tutors shared commonalities in using the four elements of the socio-transformative constructivist theory were included in the sessions. The study proved the peer tutoring was a success among students. Additionally in Rodriguez (2015), socio-transformative constructivism was used to manage institutional and sociocultural challenges of a novice teacher. "As a participant of a larger hybrid, intervention project with peers, Gary received multiple hands-on and minds-on experiences for implementing socio-transformative constructivism (STC) during the science methods courses and two summer institutes" (Rodriguez, 2015, p.448). By using socio-transformative constructivism as an orientation to teaching and learning, the novice teacher was able to "gain more access to power to affect change" (Rodriguez, 2015, p.448).

Ultimately, implications of STC are close to the provisions of NGSS. This provided the notion that the NGSS, if implemented appropriately, should affect the achievement gap. More specifically, in this study, the NGSS was investigated in whether it increased the science achievement of Black students in Louisiana. Additionally, attention was focused on whether the

implementation met conditions described in STC. As noted in the literature review, there are barriers that affect successful implementation of NGSS, such as the impact of poverty and socio-economic status, exposure to science-related pedagogical practices, and quality science teaching, access to science-based experiences and teacher trainings.

3.3. Conceptual Framework

In this research, a conceptual framework was included to illustrate the process of acquiring the results of this study. A conceptual framework or conceptual model is a visual diagram or description indicating relationships between or among variables, in which indicates a relationship exists, but lacks the rationale behind the relationship (Kitchel & Ball, 2015). Figure 3.4 displays this potential relationship in this study

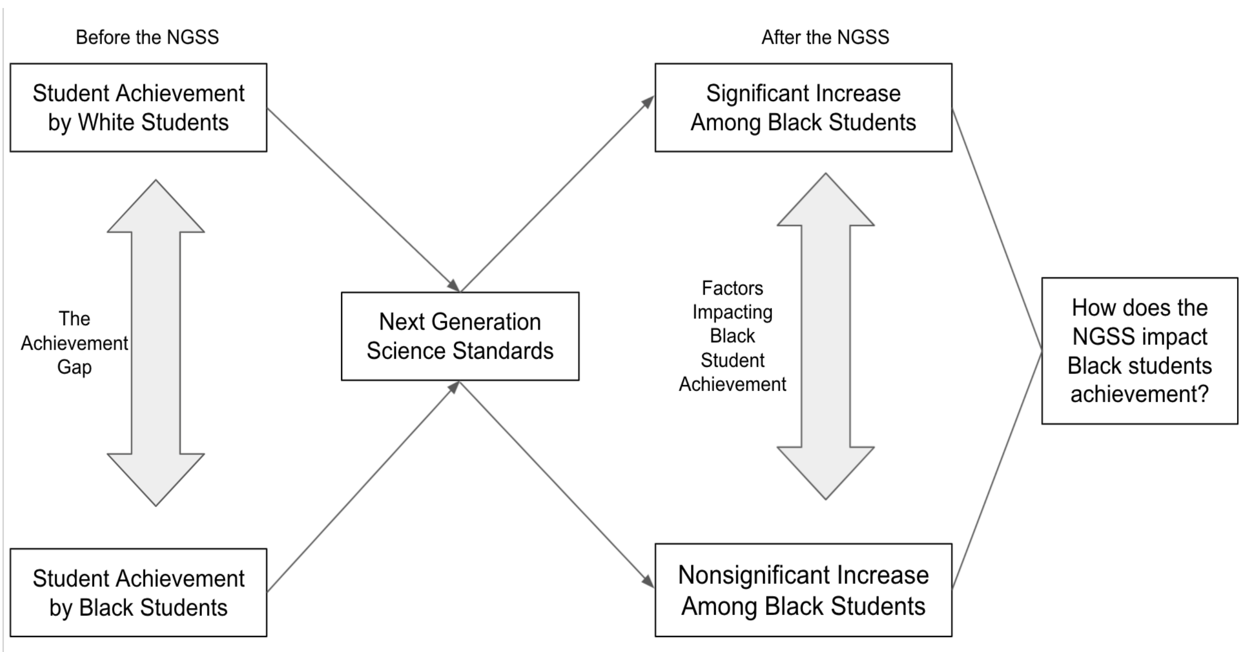

Figure 3.4. Conceptual Framework

The conceptual model of this study was based on the nature of the study and research questions. Before NGSS, a pre-existing gap between White and Black students was evident. If the NGSS significantly increased the achievement of Black students in Louisiana and/or

narrowed the gap among White and Black students, then the implementation of the NGSS was effective. However, if Black student achievement was constant, the implementation of the NGSS was ineffective.

3.4. Methodology

The methodology is "the strategy, plan of action, process or design lying behind the choice and use of particular methods and linking the choice and use of the methods to the desired outcomes" (Crotty, 2003, p.3). This study employed a mixed methods approach in research (Tashakkori & Creswell, 2007) to address the research questions in this study. Mixed methods research is defined as a research design "in which the investigator collects and analyzes data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or a program of inquiry" (Tashakkori & Creswell, 2007, p.4). A mixed methods design was most appropriate for this study as quantitative results were obtained to indicate the impact of the NGSS on the achievement gap, while additionally, qualitative findings were used to acquire the in-debt reasoning for the quantitative results. Therefore, a specific approach in mixed methods that was most fitting for this study is the explanatory mixed methods design (Ivankova, Creswell & Stick, 2006). The explanatory mixed methods design sequentially uses qualitative findings to explain, expand, or validate quantitative statistical results. While RQ1 will require a quantitative approach to acquire significant results about student achievement, RQ2 and RQ3 will use qualitative findings to explain, validate, and/or further expand on the quantitative results.

3.5. Research Design #1

To answer RQ1, as a researcher, I desired to measure if science achievement among Black students in Louisiana was positively increased as a result of the NGSS implementation. In

my study, NGSS was deemed as an intervention to increase performance among Black science achievement. Therefore, the chi-square test of homogeneity was used to measure whether the intervention was successful. This design was appropriate as it used to determine whether frequency counts are identically distributed across different populations" (Bolboacă et. al, 2011, p.531). Hence, the different populations in this study were represented as the independent variable of Black students, consisting of two groups: those who were not taught under the NGSS (2017) and those who were not taught under the NGSS (2019). The dependent variable was represented as the levels of achievement (advanced, mastery, basic, approaching basic, and unsatisfactory) on the Louisiana LEAP test, rather than frequency counts. Through using the Chi-square test of homogeneity, I determined whether the levels of achievement were statistically significantly different in the different populations of 2017 and 2019. Then a post hoc test was used to determine the whereabouts of the differences between the groups. Ultimately, I was able to conclude if the NGSS positively impacted the achievement of Black students.

Sampling, Instrument, Participants

A sample is a subgroup of the target population that the researcher plans to study for generalizing about the target population (Creswell & Guetterman, 2019, p.140). In this design, the non-probability sampling technique was used to secure a sample population. "Non-probability samples are those in which the probability that a subject is selected is unknown and results in selection bias in the study" (Acharya, 2013, p.330). The non-probability technique that was used is purposive sampling technique. The purposive sampling technique, also called judgment sampling, is the deliberate choice of a participant due to the qualities of that participant (Etikan, Musa, & Alkassim, 2016). This research study covers the state of Louisiana, therefore, there was an issue in lack of accessible data and the list of the population being too large.

Therefore, I subjectively selected a unit that represents the population under study with using data from the East Baton Rouge Parish School System, which is the second largest school system in Louisiana and is a decidedly urban district (Lomotey and Milner, 2014).

Setting & Context

East Baton Rouge Parish School System (EBRPSS) consists of several U.S. Blue Ribbon Schools, Magnet Programs, Montessori Programs, and Traditional Education Programs. It is the second largest public school system in the state, with having more than 41,000 students. In addition, it has approximately 5,000 employees with about 3,000 of them being teachers. In 2018, 88% of students were Non-White and 75.9% of students were economically disadvantaged (Urban League of Louisiana, 2019). In 2021, Minority enrollment is 89% of the student body (majority Black), which is more than the Louisiana public school average of 55% (majority Black) (Public School Data, 2020). 78% percent of students are deemed economically disadvantaged (Niche, 2020). These demographics qualify the EBRPSS as an urban emergent school system (Milner, 2012). Urban emergent systems are characterized as containing schools in large cities such as Austin, Texas, Nashville, Tennessee, and Baton Rouge, Louisiana that are clearly not the size of major cities such as Chicago, Illinois or New Your City with populations of less than one million. Schools such as those found in EBRPSS nested in urban emergent environments usually have some characteristics and challenges similar to those of urban intensive schools. These challenges include population density, a significant number of children living in poverty, significant immigrant children, and significant numbers of children classified as minorities (Milner, 2012).

Data Sources

The data came from the instrument of the study, the statewide LEAP test. Participants featured were Black students in Grades 3-8 who were administered the LEAP 2025 assessment in 2017 and 2019. Through implementing this design, I gained Institutional Review Board approval under the terms of "use of student records in research" and using participants from vulnerable populations – children.

Analysis. The IBM SPSS® Statistics Software aided in completing the steps of reporting my findings correlated to my research questions. For the first question, I conducted the Chi-square test of homogeneity to determine if a difference in levels of achievement exists among Black students who were in Grades 3-8 in 2018-2019 (received the implementation of NGSS), and Black students who were in Grades 3-8 in 2016-2017 (did not received the implementation of NGSS) on the Louisiana LEAP test. There were five assumptions required in order for me to move forward to answer my questions. Once I was cleared of the assumptions, I identified my hypothesis. The following hypotheses was stated as:

The null hypothesis is:

H0: the probability distribution in each independent group is identical in the population.

And the alternative hypothesis is:

HA: the probability distribution in each independent group is not identical in the population

Following, I ran the necessary procedures of a Chi-square test of homogeneity. After administering the test, I concluded whether NGSS positively affected LEAP scores.

3.6. Research Design #2

To answer RQ2 and RQ3, employed a case study, designed as described by Yazan (2015), a qualitative research approach that produces descriptive data in the form of written or

oral words from interviews with people and the observed behavior of people; hence, the qualitative interview design. “Interviews provide in-depth information pertaining to participants’ experiences and viewpoints of a particular topic” (Turner, 2010). It was most appropriate for using as a design in this study as it provides more well-rounded discussion and collection of data and information regarding the determinants for student success with the implementation of the NGSS and the factors that negatively impacts successful implementation with Black students. Furthermore, I used the general interview guide approach, often referred to as semi-structured, as it has open-ended questions that allows for a deepen discussion.

Sampling, Instrument, Participants

To get valuable participants for interviews, I employed a purposive sampling approach using criterion sampling as well as convenience sampling as described by Collins, Onwuegbuzie, and Jiao (2007), with the purpose of identifying six individuals who have experience in the field of science with working in the role as teachers or science instructional leaders in EBRPSS. These educators were selected for their experience and knowledge in the science field (criterion). They were recognized and recommended by their administrator as a proficient science teacher (criterion). They were experienced with teaching students in disadvantaged populations (criterion). An included requirement were that educators have experience with teaching science during Louisiana’s Grade level expectation (GLE) era. This allowed me to get perspective from a teacher regarding the shifts in instruction brought by the NGSS. Convenience sampling was also appropriate as target participants are teaching in the parish-wide (county) public school system, EBRPSS, in proximity to the university setting.

Through the nature of this design using human subjects, I gained Institutional Review Board approval. To practice safety measures in regard to COVID-19, the interviews were

conducted via zoom. This also allowed for the interviews to be recorded and transcribed. The semi-structured interviews consisted of open-ended questions which were used flexibly. The participants were provided with an opportunity to share detailed descriptions of their distinctive perspectives on teaching science and student performance with linking to student population and the NGSS. Each interview spanned around twenty to sixty minutes in length. These questions were written to seek the determinants for seeing student success with the implementation of the NGSS from experienced individuals in the field. By the conclusion of the interviews, I had an in-depth understanding about the causations for gaps among students and what would be the necessary steps in closing the gaps.

Analysis. In the analysis phase of the interview design, the researcher must make "sense" out of the responses then grouping the data into aligned sections, also known as themes (Creswell, 2003, 2007). Hence, qualitative measures were applied by identifying patterns of commonalities and differences that exist in research participants' experiences/perceptions about the NGSS and the achievement gap. Pseudonyms were used throughout in place of participants' real names to maintain confidentiality. Hence, determined names were associated with each participant. Following I collected and interpreted data through the interpretive lens with using the socio-transformative constructivism theory, which frames this study. To appropriately answer RQ2 and RQ3, I coded data generated, using an open coding system. Codes were reviewed and examined for duplicity and collapsed until the point of saturation. Codes were grouped into code concepts, then themes were identified. Ultimately, the explanation from themes identified answers to the overarching problem and sub questions in this research study. Figure 3.5 highlights this information.

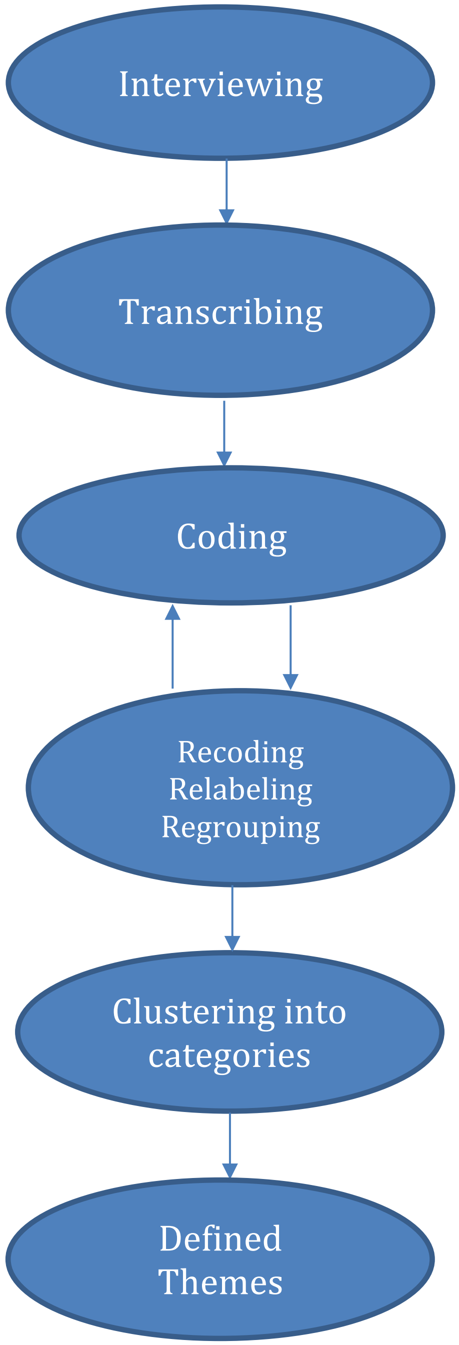

Figure 3.5. Coding Process

3.7. Researcher's Position

For nine years, since 2013, I have had the wonderful experience of serving in the role of an educator. In those years, I have worked with predominately Black students in EBRPSS.

Additionally, I have had the experience of teaching all core subjects: Math, ELA, Science, and Social Studies. In most of my teaching career, my assignments were solely two of the core subjects, Math and Science. Through an instructional lens, I have gained much expertise and knowledge in those fields in education. I was even identified as a teacher leader for both subjects. In addition, I was often selected to make district wide decisions or contribute to implementations in my school district. Eventually, I developed a fond interest in related research regarding the subjects. This exploration of research allowed me to use the best pedagogical practices that would fully benefit my students and my overall professional development. Furthermore, my fondness for the fields of Math and Science grew as I continuously made connections between research and my personal experiences. Following, through much interest and curiosity, I was introduced to the field of testing research. In testing research, an existence of an achievement gap has been proven countless times. Therefore, I was lured into investigating the associating research.

During my time as a teacher, NGSS emerged and adopted in Louisiana with aiming to provide equitable standards to all students regarding their ethnic background. My thoughts were to inquire to whether or not these new academic standards will close the most widely known gap or explore how to effectively use the NGSS to close the gaps in achievement. Hence, I was moved to observe, study, analyze, and eventually conduct research regarding NGSS and achievement among Black students. In this study, I took the role of a researcher with striving to be solely objective throughout my study. I switched job assignments by requesting to teach Social Studies (instead of Science) to prevent any researcher biasness in this study. Conclusively, I was committed to providing a solid study that would contribute to any field that has involvement with my topic.

3.8. Summary

In this chapter, research design, questions, participant/subjects, context, data sources and analysis were discussed for this proposed study. In addition, I attempted to situate myself within the study. In chapter 4, results will be shared. Chapter 5 will address implications and future research ideas around the issues surrounding implementation of the NGSS.

CHAPTER FOUR. RESULTS

In this chapter, I present findings through an extensive means of data collection to investigate the alarming gap in science achievement that plagues Children of Color, specifically Black students. The NGSS was investigated as an intervention in narrowing the gap in science achievement for the Black students in Louisiana. In this section, an in-depth analysis on the effectiveness of the NGSS was created from standardized test results and the insight of educators. Therefore, by thorough examination, findings are presented in this chapter of the study.

4.1 Introduction

The purpose of this study was to investigate the NGSS and its implications of being a curricular and pedagogical intervention in terms of narrowing the achievement gap in science education for Children of Color. Standardized test data and one-on-one interviews were examined to assess the effectiveness and impact of the NGSS' implementation in the state of Louisiana.

Central Research Question: Can the NGSS aid in narrowing gaps in the achievement gap in Louisiana?

The central research question that anchored this study called for an investigation by measuring and evaluating the NGSS and the implications of the NGSS providing a solution to narrowing the gap in science achievement for the Black students in Louisiana. To address the central research question, three sub questions were addressed in this study. These sub questions required quantitative results and qualitative findings. Research question 1 required a quantitative approach, therefore its results will be reported in a quantitative section. Research question 2 and 3 required a qualitative approach, therefore these findings will be reported in qualitative section.

In using both quantitative and qualitative approaches, this study employed the explanatory mixed methods design (Ivankova, Creswell & Stick, 2006) in an effort to examine how the implementation of the NGSS attempted to close the achievement gap in Louisiana. This present study utilized the explanatory mixed methods design in a manner of the qualitative findings expanding on the quantitative results. Hence, data was collected and analyzed from standardized test results. Subsequently, in this research, the perceptions of educators were used to give a deeper understanding of the standardized test results. Using the Chi-square test of homogeneity, the statistical analysis of the standardized test results was completed first in this study to attempt to measure the impact of NGSS on student performance. Thereafter, analysis of interviews was used to provide select educators an opportunity to give insight about student performance. With the use of statistical tests, observations, and interviews, I was able to provide a full, detailed analysis to examine the impact of the NGSS on the achievement gap in science.

4.2 Quantitative Results

In this section, the Chi-square test of homogeneity was used to measure if Black students' in Louisiana science achievement increased because of NGSS implementation. The study used data from the achievement levels of the total population students in EBR Schools (Grade 3 through Grade 8) as measured by the LEAP 2025 science assessment in 2017 and 2019. Data was acquired from available online data on LDOE's website and obtained from the EBR Schools' Accountability Office as per IRB approval.

Sample Demographics

To better understand how the NGSS impacted student performance, I used data from the LEAP 2025 assessment from the 2017 administration and the 2019 administration of the LEAP 2025 assessment. Being that I was interested in using the achievement of Black students in

grades 3 through grade 8; it was appropriate for me to select the Spring 2017 State LEA School LEAP Achievement Level Subgroup report. This report was obtained from the Louisiana State Department of Education's website, www.LouisianaBelieves.com. It included the statewide and district data of subgroups by grade level with further categorizing their percentages in each achievement level according to subject. Therefore, I gathered all the percentages from Black students in grades 3 through 8 in science. Table 4.8 highlights this information.

Table 4.8. The Percentages of Black students by achievement level in EBR Schools (Grades 3 through 8) on LEAP 2025 Science in 2017

Grade Level	Race	Advanced	Mastery	Basic	Approaching Basic	Unsatisfactory
3	Black/AA	4%	14%	40%	26%	16%
4	Black/AA	2%	8%	44%	32%	14%
5	Black/AA	1%	10%	39%	31%	19%
6	Black/AA	2%	11%	44%	27%	16%
7	Black/AA	2%	15%	32%	29%	22%
8	Black/AA	2%	9%	33%	31%	25%
Total	**Black/AA**	**2%**	**11%**	**39%**	**29%**	**19%**

Interested in obtaining the performance results of Black students in grades 3 through grade 8 after the implementation of NGSS, it was appropriate for me to select the Spring 2019 State LEA School LEAP Achievement Level Subgroup report. Hence, I would be able to compare to 2017 data. I repeated same steps that were applied to retrieve 2017 data. The report was obtained from the Louisiana State Department of Education's website, www.LouisianaBelieves.com. It included the statewide and district data of subgroups by grade level with further categorizing their percentages in each achievement level according to subject. Therefore, I gathered all the percentages from Black students grades 3 through 8 in science. Table 3.9 highlights this information.

Table 4.9. The Percentages of Black students by achievement level in EBR Schools (Grades 3 through 8) on LEAP 2025 Science in 2019

Grade Level	Race	Advanced	Mastery	Basic	Approaching Basic	Unsatisfactory
3	Black/AA	3%	14%	31%	36%	16%
4	Black/AA	2%	17%	31%	27%	23%
5	Black/AA	2%	18%	26%	32%	22%
6	Black/AA	1%	13%	33%	28%	25%
7	Black/AA	1%	16%	26%	21%	26%
8	Black/AA	1%	15%	29%	35%	20%
Total	**Black/AA**	**2%**	**16%**	**29%**	**30%**	**22%**

To conduct a statistical analysis, percentages are not efficient. Therefore, the Percentages of Black students in EBR Schools (Grades 3 through 8) who took the LEAP 2025 Science administrations had to be converted to actual numbers. Therefore, the total number of those students were accessed from EBR Schools' Accountability Office as per IRB approval. In 2017, the total population of Black students who tested were approximately 24,170. In 2019, the total population of Black students who tested was approximately 19,570. Next, the percentages of each achievement level were converted to numbers. Table 4.10 highlights this information.

Table 4.10. The Total Population of Black students by achievement level in EBR Schools (Grades 3 through 8) on LEAP 2025 Science in 2017 and 2019

Year	**Achievement Levels**				
	Advanced	Mastery	Basic	Approaching Basic	Unsatisfactory
2017	483	2659	9247	7010	4593
2019	391	3131	5675	5871	4305

Research Question 1: As measured by the LEAP 2025 administration, did the adoption of the Next Generation Science Standards (NGSS) have a positive impact on Black students in Louisiana?

The first research question measured if science achievement in Black students in Louisiana would significantly increase as a result of the NGSS implementation. In the current study, the NGSS is viewed as an intervention to increase performance among Black science

achievement. Therefore, the chi-square test of homogeneity was used to locate if there were significant differences. The different populations in this study represented the independent variable of Black students that consisted of two groups: those who were not taught under the NGSS (2017) and those who were not taught under the NGSS (2019). The dependent variable was the levels of achievement (Advanced, Mastery, Basic, Approaching Basic, and Unsatisfactory) on the Louisiana LEAP test, rather than frequency counts. The levels of achievement of both groups came from the 2017 and 2019 LEAP administration. The IBM SPSS® Statistics Software aided in completing the steps of reporting findings correlated to my research questions.

The Assumptions of Chi-Squared Test of Homogeneity. There were five assumptions that were considered before I moved forward in conducting my analysis. The assumptions are listed as:

(a) one dependent variable that has three or more categories

(b) one independent variable that has two independent groups

(c) independence of observations; and

(d) participants being randomly assigned to groups from a single sample, or prospective or retrospective purposive sampling was used.

(e) all cells of the r x 2 table having an expected count greater than or equal to five.

The fifth assumption related to how data fit in the chi-square test of homogeneity model. Hence, the Crosstabs procedure in SPSS Statistics was used to determine whether the cells of my design have expected counts greater than or equal to five. The Crosstabulation table that is generated by SPSS Statistics was utilized to interpret and determine if this assumption had been met (see Table 3.11). Table 4.11 indicated that 0 cells (0.0%) have expected count less than 5, signifying

that I met the fifth assumption. Therefore, through meeting all five assumptions, I was able to proceed to performing The Chi Squared Test of Homogeneity.

Table 4.11. The Chi Square Test of Assumptions Output

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	527.249[a]	4	.000
Likelihood Ratio	528.886	4	.000
Linear-by-Linear Association	4.747	1	.029
N of Valid Cases	43365		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 390.45.

The Chi Squared Test of Homogeneity. The Chi-square test of homogeneity was used to determine whether the levels of achievement are statistically significantly different in the different groups, 2017 and 2019. Hence, the following hypotheses were stated as:

H0: the probability distribution in each independent group is identical in the population.

And the alternative hypothesis is:

HA: the probability distribution in each independent group is not identical in the population

Table 4.13 indicated that there was a significant difference in the population. The probability was sufficiently small ($p < .05$), therefore, I concluded that it was unlikely that the levels of achievement are all equal in the populations. Hence, I was able to accept the alternative hypothesis and reject the null hypothesis. The results are reported as the following:

The multinomial probability distributions between the two groups were statistically significantly different ($p < .05$).

This finding provided me with significant data that levels of achievement were not statistically significant in the years of 2017 and 2019. Hence, I was able to proceed with post hoc test.

Table 4.12. The Chi Squared Test of Homogeneity Table Output

Level of Achievement * Year of Test Crosstabulation

			Year of Test		
			2017	2019	Total
Level of Achievement	Unsatisfactory	Count	4593	4305	8898
		% within Year of Test	19.1%	22.2%	20.5%
	Approaching Basic	Count	7010	5871	12881
		% within Year of Test	29.2%	30.3%	29.7%
	Basic	Count	9247	5675	14922
		% within Year of Test	38.5%	29.3%	34.4%
	Mastery	Count	2659	3131	5790
		% within Year of Test	11.1%	16.2%	13.4%
	Advanced	Count	483	391	874
		% within Year of Test	2.0%	2.0%	2.0%
Total		Count	23992	19373	43365
		% within Year of Test	100.0%	100.0%	100.0%

Table 4.13. The Chi Squared Test of Homogeneity Significance Output

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	527.249[a]	4	.000
Likelihood Ratio	528.886	4	.000
Linear-by-Linear Association	4.747	1	.029
N of Valid Cases	43365		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 390.45.

Post Hoc. Since I rejected the null, I implemented a post hoc test to see where differences lie. I administered the multiple z-test of two proportions. I used Bonferroni Method to see these

findings (Table 4.14). The different subscripts in Unsatisfactory, Approaching Basic, Basic, and Mastery indicated that proportions significantly differed in the years of test, 2017 and 2019 (See Table 4.14).

Table 4.14. Bonferroni Method Table Output

Level of Achievement * Year of Test Crosstabulation

			Year of Test 2017	Year of Test 2019	Total
Level of Achievement	Unsatisfactory	Count	4593_a	4305_b	8898
		% within Year of Test	19.1%	22.2%	20.5%
	Approaching Basic	Count	7010_a	5871_b	12881
		% within Year of Test	29.2%	30.3%	29.7%
	Basic	Count	9247_a	5675_b	14922
		% within Year of Test	38.5%	29.3%	34.4%
	Mastery	Count	2659_a	3131_b	5790
		% within Year of Test	11.1%	16.2%	13.4%
	Advanced	Count	483_a	391_a	874
		% within Year of Test	2.0%	2.0%	2.0%
Total		Count	23992	19373	43365
		% within Year of Test	100.0%	100.0%	100.0%

Each subscript letter denotes a subset of Year of Test categories whose column proportions do not differ significantly from each other at the .05 level.

Table 4.15. Bonferroni Method Significance Output

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	527.249[a]	4	.000
Likelihood Ratio	528.886	4	.000
Linear-by-Linear Association	4.747	1	.029
N of Valid Cases	43365		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 390.45.

Making multiple comparisons means that there could be an increase the risk of making a Type I error. This can be likened to a “false positive”. As such, I adjusted my analysis to consider these multiple comparisons. Adjustments were made to the level at which I could accept statistical significance for each pairwise comparison; that is, for each z-test of two proportions. First, I calculated the new alpha (α) level. This involved dividing my original alpha level by the number of pairwise comparisons. The following is a guide to my equation:

adjusted alpha level = original alpha level ÷ number of comparisons

I performed five z-tests of two proportions, which is five pairwise comparisons. Therefore, I had to change the alpha level to .01 (i.e., .05 ÷ 5= .01). My results were still significant the results p-value was .000 (Table 4.15). My next steps were to get a clearer picture on how they differed in the two years.

Contingency Table. Next, I generated a contingency table to observe the differences in the expected counts. In Table 4.16, I examined the expected counts of 2019 in relation to the observed counts of 2017 to see key differences. Table 4.16, revealed the following:

- The observed number of students who scored Unsatisfactory in 2019 were larger than the expected results when based on the observation counts of 2017.
- The observed number of students who were Approaching Basic in 2019 were larger than the expected results when based on the observation counts of 2017.
- The observed number of students who were Basic in 2019 were lower than expected the expected results when based on the observation counts of 2017
- The observed number of students who were Mastery in 2019 were larger than expected the expected results when based on the observation counts of 2017

- The observed number of students who were Advanced in 2019 were slightly larger than expected the expected results when based on the observation counts of 2017

Although this provided me with valuable information needed to explain whether the differences in 2019 administration (after the implementation of NGSS) were positive or negative, I desired to investigate the strength of the difference. Therefore, my next steps were to conduct a test to analyze the standardized residuals.

Table 4.16. Contingency Table Output

Level of Achievement * Year of Test * Total Counts (frequencies) Crosstabulation

Total Counts (frequencies)				Year of Test 2017	Year of Test 2019	Total
1	Level of Achievement	Unsatisfactory	Count	4593	4305	8898
			Expected Count	4922.9	3975.1	8898.0
		Approaching Basic	Count	7010	5871	12881
			Expected Count	7126.5	5754.5	12881.0
		Basic	Count	9247	5675	14922
			Expected Count	8255.7	6666.3	14922.0
		Mastery	Count	2659	3131	5790
			Expected Count	3203.4	2586.6	5790.0
		Advanced	Count	483	391	874
			Expected Count	483.5	390.5	874.0
	Total		Count	23992	19373	43365
			Expected Count	23992.0	19373.0	43365.0

Standardized Residuals. Next, the strength of the differences between observed and expected values were measured in each achievement level. This indicated what cells were significant to the chi-square significance value (see Table 4.15). Therefore, in conducting the standardized residuals test, I determined what was contributing the most to the value, and which was contributing the least. To further explain the results, if the residual is less than -2, the cell's

observed frequency is significantly less than the expected frequency. If the residual was greater than 2 and the observed frequency is significantly greater than the expected frequency. Hence, I was provided with results in Table 4.17 as it revealed the following:

- There were more students scoring Unsatisfactory in 2019, which indicated that populations were not the same.
- There were less students scoring Basic in 2019, which indicated that populations were not the same.
- There were more students scoring Mastery in 2019, which indicated that populations were not the same.

Table 4.17. Standardized Residuals Output

Level of Achievement * Year of Test Crosstabulation

			Year of Test 2017	Year of Test 2019	Total
Level of Achievement	Unsatisfactory	Count	4593	4305	8898
		Expected Count	4922.9	3975.1	8898.0
		Standardized Residual	-4.7	5.2	
	Approaching Basic	Count	7010	5871	12881
		Expected Count	7126.5	5754.5	12881.0
		Standardized Residual	-1.4	1.5	
	Basic	Count	9247	5675	14922
		Expected Count	8255.7	6666.3	14922.0
		Standardized Residual	10.9	-12.1	
	Mastery	Count	2659	3131	5790
		Expected Count	3203.4	2586.6	5790.0
		Standardized Residual	-9.6	10.7	
	Advanced	Count	483	391	874
		Expected Count	483.5	390.5	874.0
		Standardized Residual	.0	.0	
Total		Count	23992	19373	43365
		Expected Count	23992.0	19373.0	43365.0

Table 4.18. Standardized Residuals Significance Output

Chi-Square Tests	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	527.249[a]	4	.000
Likelihood Ratio	528.886	4	.000
Linear-by-Linear Association	4.747	1	.029
N of Valid Cases	43365		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 390.45.

Cramer's V. Next it was important that I measure the effect size. To measure the effect size, I used Cramer's V. Cramer's V is defined as an effect size measurement for the chi-square test of independence. Hence, it measures how strongly two categorical fields are associated. In Cramer's V, the following interprets the effect size:

- .25 or higher   Very strong relationship
- .15 to .25   Strong relationship
- .11 to .15   Moderate relationship
- .06 to .10   weak relationship
- .01 to .05   No or negligible relationship

Cramer's V assisted in determining how large the differences were across the populations in this study, which were the performance results of the LEAP 2025 2017 and 2019 administration. Table 4.19 indicated that Cramer's V had an effect size of .110. Therefore, it was indicated that there was a weak association across the two populations. After conducting Cramer's V, it was able to report my overall results in answering the first research question in this study.

Table 4.19. Cramers V's Significance Output

Symmetric Measures

Total Counts (frequencies)			Value	Approximate Significance
1	Nominal by Nominal	Phi	.110	.000
		Cramer's V	.110	.000
		Contingency Coefficient	.110	.000
	N of Valid Cases		43365	
Total	Nominal by Nominal	Phi	.110	.000
		Cramer's V	.110	.000
		Contingency Coefficient	.110	.000
	N of Valid Cases		43365	

Results. The first research question asked did the adoption of the Next Generation Science Standards (NGSS) have a positive impact on Black students in Louisiana. To answer, it required me to analyze all the statistical analysis conducted in this study. The Chi Squared Test of Homogeneity indicated that there were differences in the population of Black students who were taught under the NGSS and those who were not taught under the NGSS. Cramer's V revealed that these differences were not large. Through examining each level of achievement, the Bonferroni Method indicated that all but the advanced group differed significantly among both 2017 and 2019 populations. Hence, the achievement levels of Unsatisfactory, Approaching Basic, Basic, and Mastery had significant differences. In examining the contingency table and standardized residuals, I was provided with the most knowledge in answering research question 1. It was revealed in the standardized residuals results that the number of students scoring Unsatisfactory were larger to after the implementation of the NGSS. While this alluded to a decrease in the higher achievement levels, it was confirmed that there were fewer students who scored Basic in 2019 (after the implementation of the NGSS). However, there was a positive increase in the number of students scoring mastery after the implementation of the NGSS.

Therefore, this indicated that the population of students who were basic could have changed by moving up to a higher (mastery) or lower achievement level (Approaching Basic or Unsatisfactory). Through further analysis, it was found that the population of students scoring Basic was lacking by 991 of expected counts after the implementation of the NGSS. Hence, I had to determine where did those 991 expected counts reside. More specifically, did it increase to Mastery or decrease to Approaching Basic. The population of students who were at Mastery were higher by 563 students of expected counts after the implementation of the NGSS, indicating that 442 students of the 991 expected counts decreased to a lower achievement level. Therefore, more of the population of students who scored Basic in 2017 increased in a level of proficiency after the implementation of the NGSS. Hence, in answering research question 1, as measured by LEAP 2025, the NGSS positively impacted the achievement in science among Black students in Louisiana.

4.3. Qualitative Findings

In the quantitative portion, Chi Squared Test of Homogeneity revealed that the NGSS positively impacted student achievement, as measured by the 2019 LEAP administration. This section consists of the qualitative portion of the explanatory mixed methods design, which explains the results from the quantitative portion of this study. The following Case Study consisted of six one-on-one interviews from select educators to provide insight into Black students' science achievement. This study was not limited to only explaining the factors that positively impacted Black student achievement; it included the factors that negatively impacted Black student achievement. This action was necessary as the number of students scoring Unsatisfactory increased after the implementation of the NGSS. Pseudonyms were used in place of participants' real names to maintain their confidentiality. Data was collected and interpreted

through an interpretive lens using the socio-transformative constructivism theory that framed this study. An open coding system descriptively assigned codes to interview transcripts; then codes were grouped into code concepts. Code concepts were then examined and assigned to overall themes. This process was employed as per Miles, Huberman, and Saldaña (2014). Table 4.20 highlights this information.

Table 4.20. Codes, Codes Instances, Code concepts, and the Resultant Themes

Themes	**Code Concepts**	**Code Instances**
The Home Environment	Generation Cycle	4
	Uninvested Parent	8
	Lack of exposure to learning experiences outside of learning environment	10
The Classroom Environment	Qualified teachers	3
	Low Expectations	4
Resources	Low Funding	5
	No Curriculum	3
	Lack of Materials	4
Student Needs	Parental Involvement	6
	Self-determination	8
	Quality Science Instruction	28
Teacher Needs	Value	2
	Autonomy	3
	Professional Development	7
	Administrative Support	3
Emphasis on Science	Science Weight	8
	Funding	5
	Increased Science Time	6
	Opportunities for Integration	3
	The Investment of Stakeholders	14

Individual Cases

Each participant is individually addressed in this chapter. To provide context to the participants, the following highlights their demographics. Table 4.21 highlights this information about each participant.

Table 4.21. Participant Demographic Data

Participants	Years of Science Teaching Experience	School Level Experience	Description of Participants Most Recent Schools
Mrs. Gomer	**Time Frame** 2003-present **Total Years** 18 years	**Elementary** 5th Grade **Middle** 7th Grade	Test scores are about the same as the state/district average · 99% of students Black · 85% of students Low-income
Mrs. Hollins	**Time Frame** 2009-2021 **Total Years** 11 years	**Middle** 6th Grade 8th Grade	Test scores are far above the state/district average · 44% of students Black · 20% of students Low-Income
Ms. Ashley	**Time Frame** 2015-present **Total Years** 6 years	**Elementary** 4th Grade	Test scores are far above the state/district average · 99% of students Black · 39% of students Low-Income
Ms. Bingham	**Time Frame** 2014-present **Total Years** 7 years	**Elementary** 5th Grade	Test scores fall below the state/district average. · 97% of students Black · 89% of students Low-Income
Ms. Jenkins	**Time Frame** 2016-present **Total Years** 5 years	**Elementary** 3rd Grade	Test scores fall below the state/district average. · 95% of students Black · 82% of students Low-Income
Mrs. Lacey	**Time Frame** 2004-2021 **Total Years** 16 years	**Middle** 7th Grade **Elementary** 3rd Grade 4th Grade 5th Grade	Test scores at are far above the state/district average. · 36% of students Black · 20% of students Low-Income

The participants in this study were six teachers in EBRPSS Schools. These individuals were selected because of their science knowledge, experience and expertise. Pseudonyms were assigned as Mrs. Gomer, Mrs. Hollins, Ms. Ashley, Ms. Bingham, Ms. Jenkins, and Mrs. Lacey and were used to ensure the participants' confidentiality and findings. Participants were selected based on the following criteria: served as a science teacher for grades 3 through 8 in EBRPSS within the last five years (2016-2021), recommended by colleagues as a science leader, and willingness to participate in the research study. The participants' ages ranged from mid-20s to mid-40s, and they taught and/or currently teach in different types of school levels, servicing different types of student populations.

Mrs. Gomer. Mrs. Gomer is a Black female who has taught science and science-related subjects for 18 years in EBRPSS Schools. She has experience in teaching in elementary and middle school, and currently, she teaches in middle school. She has experience teaching during the shifts from GLE's to the NGSS. She has been deemed as a science teacher leader in her schools.

Mrs. Hollins. Mrs. Hollins is Black female who has 11 years of teaching experience. She has a degree in Biological Sciences. She started her career as a science teacher by going through an alternative certification program with LRC. She started teaching physical science in January of 2009. Outside of EBRPSS Schools, she worked at an adjacent, local school district teaching eighth grade Earth Science from 2009 to 2013. In the fall of 2013, she started working in EBRPSS Schools whereas, she taught sixth and eighth grade science and sixth grade math. Most of her science teaching experience was with GLE's. However, she has experience teaching the NGSS. In August of 2021, she was promoted to the dean of students at her school.

Ms. Ashley. Mrs. Ashley is a Black female with six years of teaching experience in EBRPSS Schools on the elementary level. She works in a school where she is departmentalized to only teach science and social studies. She has little experience with teaching under the adoption of the GLEs.

Ms. Bingham. Ms. Bingham is a Black female with seven years of teaching experience in EBRPSS. She works as a departmentalized Math and Science teacher. She is a certified STEM Innovator through Discovery Education. She had the opportunity to be rewarded two grants (Cox Charities & Capital One STEM Teaching Fellows) to fund STEM projects at her school, including starting an Elementary Robotics Club. She has experience with teaching the GLEs and the NGSS

Ms. Jenkins. Ms. Jenkins is a Black female with five years of teaching experience in EBRPSS Schools. She has the least amount of teaching experience, and therefore, she has little experience with teaching the GLEs, however, more experience with teaching the NGSS. She is the lead science teacher at her school.

Mrs. Lacey. Mrs. Lacey is a Black female with 16 years of teaching experience in EBRPSS Schools. She has experience with teaching the GLEs and the NGSS. In teaching both sets of standards, she was recognized as a teacher leader in EBRPSS schools. After the adoption of the NGSS, she was selected by the district to create Teacher Created Materials to help teachers navigate through teaching the NGSS. In August of 2021, she was promoted to the Dean of Students at her school.

In the past five years, Ms. Ashley, Mrs. Bingham, Ms. Jenkins, and Mrs. Lacey taught science on the elementary level. Ms. Ashley and Mrs. Lacey serviced students who performed above average as categorized by their performance on LEAP 2025 test. Mrs. Lacey taught at a

school with a high number of students classified as Black, but a low number of students as Low-Income. Ms. Ashley taught at a school where a low number of students were classified as Black and Low-Income. Mrs. Bingham and Ms. Jenkins serviced students who performed below average as categorized by their performance on LEAP 2025 test. Both teachers had a high number of students who were classified as Black and Low-Income.

In the past five years, Mrs. Gomer and Mrs. Hollins taught science on the middle school level in EBRPSS. Mrs. Gomer serviced students who performed average as categorized by the performance on LEAP 2025 test. She taught at a school where a high number of students identified as Black and were classified as low-income. Mrs. Hollins served students who were above average as categorized by the performance on LEAP 2025 test. Mrs. Bingham taught at a school where a low number of students were both Black and Low-income. In the 2021-2020 school year, Mrs. Hollins and Mrs. Lacey were promoted as the Dean of Academics at their respective schools.

Research Question 2: What are the factors that negatively impact student achievement among Black students in Louisiana?

The second research question highlighted factors that negatively impacted the performance of Black students on the LEAP 2025 Assessments in Louisiana. Interviews were conducted with the forementioned educators in EBR Schools (see Appendix A for interview questions). These educators provided substantial information on the factors that negatively affect Black students in science achievement. Data was transcribed and synthesized; thereafter, the following themes emerged to provide findings and responses to the second research question.

The Home Environment. Within the theme of the home environment were the code concepts of generation cycle (4), uninvested parent (8), and lack of exposure to learning

experiences outside of the school environment (9). The lack of exposure to learning experiences outside of the school environment was key to explaining negative impacts on science achievement among Black students.

In chapter 2, literature was reviewed which addressed that many Black students experience multidimensional poverty in the home environment, and it resultantly affects their achievement in science (DeNavas-Walt & Proctor BD, 2015; Reeves, Rodrigue, & Kneebonee, 2016; Cavanagh, 2007; Morgan 2016; Betancur, Votruba-Drzal, and Schunn, 2018). Consistently, the participants in this study also expressed the home environment as a major factor impacting Black students' science achievement. The code concept of poverty was generated to further explain the factors in the home environment. The four participants who taught at the schools with a high number of Low-Income students believed that the magnitude of poverty negatively impacts the student test performance in science. As Chapter 2 revealed, large numbers of students in EBR Schools are considered low of socio-economic status. Consistently, large numbers of their respective students are considered Low-Income.

Mrs. Gomer stated it is hard for the implementation of the NGSS to close the achievement gap among poor students. This was further explained by Mrs. Hollins, who revealed that the impact of poverty is detrimental to the Black student population because it creates a generational life cycle. Mrs. Hollins stated, "Black America has experienced a long history of being at a disadvantaged in this country. It's very true, that Black people were dealt a bad hand." She stated that the disadvantages led to a generational cycle that caused gaps in education. As described by Beegle (2003), the generational cycle makes it extremely difficult to attain success in education while enduring being poor. Education is signified as an added stressor to poor families; henceforth, it remains in their peripheral view with cycling through generations

(Beegle, 2003). Mrs. Hollins reiterated this notion stating, “When parents do not see the value in education, then their children are sometimes the same exact way.” Ms. Jenkins and Mrs. Bingham added to Beegle’s notion by expressing that their students have a plethora of unexplained absences, ultimately affecting their achievement. This alluded back to parents not seeing value in education.

In addition to being parents seeing the value in education, Mrs. Bingham, Ms. Jenkins, and Mrs. Hollins stated that many parents are not involved in their child’s learning experience. Hence, the code concept of uninvested parents was developed through the synthetization of data. Ms. Bingham shared that her school held an event called the “LEAP Jump Start” for parents of students in Grades 3 through 5. She shared that it was only five parents who attended the event. Bingham stated, “This was an event that would provide parents with the necessary tools and resources to increase their child’s achievement.” However, she was astonished that the attendance numbers were so few.

Ms. Jenkins shared her issues of continuously not being able to direct communication with parents. Ms. Jenkins exclaimed, “I invite parents on class dojo, they do not join. I call parents from the phone number from the J-campus. Either the number is not working, or they just would not answer.” Notedly, Class dojo is a smartphone application that provides communication with parents. J-campus is a database that provides teachers with parental contact information. Ms. Jenkins and other teacher participants indicated that the lack of parental involvement negatively impacts Black student achievement.

In chapter 2, barriers in the home environment impacted achievement because of students’ lack of exposure/access to academic experiences outside of the school environment (Alexander, 2001; Archer et al., 2012; Kao, 2004; Falk, Storksdieck, & Dierking, 2007; Dawson,

2014; Chesnutt, Jones, Hite, Cayton, Ennes, Corin, & Childers, 2018). Similarly, this code concept was developed by participants as they agreed that lack of exposure contributes to their students' gap in achievement. Ms. Ashley, Ms. Bingham, Mrs. Lacey, Mrs. Gomer, and Ms. Jenkins believe that science learning extends beyond the classroom (Falk & Dierking, 2010). Therefore, they shared a list of barriers with their population of students regarding the student's lack of exposure. Mrs. Lacey stated, "Parents who allow their children to visit historical places or places that provide rich learning experiences have a heighten advantage over children who are not exposed to those experiences." Mrs. Lacey confirms that more of her White students have knowledge about historical sites that are beneficial to the academic settings. Interestingly, Ms. Ashley stated that she sometimes is guilty of letting her daughter have experiences at Waterparks and Amusement Parks, rather than museums.

Ms. Jenkins believed those students who are exposed to outside educational experiences could more quickly make connections during a lesson. Ms. Jenkins described this situation as when students have the needed foundational tools, such as background knowledge (Cervantes, Hemmer, & Kouzekanani, 2015). However, her and other participants' populations of students struggle because of their lack of background knowledge. Jenkins further explained by stating, "when students are presented with vocabulary or thought-provoking questions that have to do with things they have never personally seen or experienced, it makes teaching concepts much more difficult for me."

In my observations of Ms. Bingham's class, I watched students struggle with learning about the food chain. The students were developing a food chain diagram. With the students being the consumer, the teacher asked the students to think back to the food served at lunch, which was a ham sandwich. Through further questioning, students were asked about the origins

of the ham. Astonishingly, neither one of the students knew that ham is produced from pigs. Ms. Bingham had to fill in further gaps by explaining that cows produce beef. Ms. Bingham stated that gaps in learning are continuous because of students' little background knowledge. She added that most of her students do not travel outside of their own environment to have many experiences beneficial to an educational setting.

Ms. Bingham expressed that the lack of background knowledge affects students' performance on tests, just as it does during a lesson. Bingham claimed the science practice tests on LDOE's website are not relevant to her population of students. She believed that as a result, they struggle. As an example, she suggested:

> A lot of material on the test expect them to know things they might not be familiar with. For example, that may connect a performance task to destinations such as Yellow Stone Park, Mount Vesuvius, the Grand Canyon, Hoover Dam. Those places are not relevant to my students in Louisiana. Some of them have not traveled outside of Baton Rouge. During our interview, she wondered why the test writers do not connect task to places relevant to students' own environment.

Bingham further explained that they should at least provide them with a writing that gives students background knowledge. In result, they will be able to complete tasks. Moreover, Ms. Bingham and other participants shared feelings that little background knowledge or exposure is detrimental to students. Some participants expressed that those students without learning experience are on a different playing field and must work extremely hard to close their own individual gap.

The Classroom Environment. The theme, the classroom environment, emerged from the code concepts of Unqualified Teachers (3) and Low Expectations from Teacher (4). The code concept of low expectations of teachers explained most of the factors that negatively impacts Black student achievement. The Chapter 2 literature review revealed that many students in Black communities attend schools with teachers who are less qualified; hence, causing more racial

inequality and widening the achievement gap (Mangiante, 2011; Darling-Hammond, 2003). Mrs. Hollins and Mrs. Gomer both exclaimed that EBRPSS Schools have huge issues with having unqualified teachers in science positions; therefore, students suffer academically. In Chapter 2, the Urban League of Louisiana (2019) highlighted teacher quality trends of schools in LA, which confirmed that there was a large quantity of unqualified teachers in EBRPSS Schools. Mrs. Gomer adds to the trends with saying, “Unqualified teachers are prevalent in those schools serving a large population of Black students.” Mrs. Hollins revealed, “Too often, we see unqualified, inconsistent people in science teaching careers, and the students are not getting what they need to be successful in science.” Mrs. Hollins placed some of the blame on administrators for hiring unqualified people in science positions. Being a new administrator, Hollis now understands the reasoning and provided further detail about why administrators settle for less when it comes to science educators. In the interview, she directed me to go to EBR schools’ websites and view the job openings. Following her suggestion, I went to the website and was astonished that science led all other content areas with the most job openings. She confirmed my thinking that administrators are pressured into filling those classrooms with a teacher. Consequently, the administrators hire individuals regardless of their qualifications to solely fill those positions. This discussion supported literature reviewed regarding teacher qualifications (Mangiante, 2011; Darling-Hammond, 2003).

Mrs. Gomer emphatically stated that unqualified teachers in science are problematic for students as it negatively impacts them. She revealed, “Some of the people they put in science classroom, for the sake of filling a position, do not have passion for science. When a teacher does not have a passion for science, then it easily translates over to students.” Therefore, she believed

unqualified teachers contribute to issues surrounding student achievement in science (Darling-Hammond, 2010; Wenglinsky 2002).

Among the code concept of unqualified teachers, Mrs. Hollins believed the shifts of the NGSS might have negatively impacted students' performance in 2019 as teachers struggled to teach the new standards because of their level of expertise. She expressed her beliefs with the following example:

> When we had the GLEs, seventh grade science was life science, sixth grade was physical science, and eight grade science was Earth science. You can get a person that may be good in earth science and put them in eighth grade science and they can do a great job teaching the students. However, when we moved over to the NGSS, all of the sciences were merged together. When I compare the GLEs to the NGSS, I realize that teachers had to be knowledgeable about all sciences. The shifts of the NGSS demanded more from science teachers which hurts students because the teachers were not giving them what they need to be successful.

Hollin's thoughts were that the teachers were not knowledgeable about the concepts demanded by the newly NGSS. Mrs. Bingham confirms this thinking as she stated, "it was extremely difficult for a lot of teachers to go from the GLE's to the NGSS because some of the content was very unfamiliar with the new concepts they had to teach."

Additionally, in The Classroom Environment theme, low expectations by teacher emerged as a code concept. Mrs. Gomer argued that low expectations from teachers has impacted the achievement of many students, especially Children of Color. Gomer shared, "Some teachers have automatically very low expectations for Black students. In a result, they are not successful." Mrs. Gomer further stated, "When you have low expectations for students, you do not give them as many opportunities." Hence in Chapter 2, Ainsworth (2011) argued that low standards have excluded Black student from high-quality instruction. Mrs. Gomer emulated this stance from the literature as she added that low expectations limit students. She continued by saying, "sometimes, teachers are afraid that children might steal or destroy the materials needed

for class. Teachers should not deprive students because of their preconceived notions." Similarly, Mrs. Bingham reflected on her experience in teaching and stated, "When my students come to my class, its feels like they are having science for the first time. They are extremely excited they get to learn by touching things." Ms. Bingham stated she is continuously frustrated by this notion because prior teachers are not providing students with those opportunities. Both Bingham's and Gomer's sentiments are that teachers negatively impact student performance by having low expectations for success.

Resources. Within the theme of the home environment were the code concepts of Funding (3) and Materials (4). Funding seemed to be a significant factor given by participants. In the literature review conducted in Chapter 2, summarization and synthesis revealed that disproportionate aspects of funding inequities have historically weakened the nation's capacity by boosting the inequalities in educational outcomes (Beese & Liang, 2010). In this study, several educators consistently linked the lack of resources that include funding and materials as negatively impacting Black students' achievement in science. Mrs. Gomer explained that funding and resources are necessity among educators effectively teaching students. She stated that in order to address gaps in achievement, funding for resources must be increased to the students of Low-Income populations. Mrs. Gomer stated, "In my years of experience as a teacher, I have noticed that more funding goes to the schools with higher leveled students". She added, "Not a lot of focus is towards low performing schools housing poor students which is unfortunately a large number of our Black students in EBR Schools. You can see this by comparing the school buildings of schools with different populations EBR Schools". Consistently, Ms. Bingham, who teaches in a low-income area, stated her school was infested with rats until they moved into their new building in 2019. While this may be an extreme

example, it is also telling. Ms. Bingham stated that it is important that students need a resourceful environment to teach science. She explained this as the availability of a lab and safe outside environment conducive to student explorations. Ms. Bingham and Mrs. Gomer concluded that inequitable measures have negatively contributed to gaps in achievement among Black students in EBR Schools.

In the code concept of resources, several teachers exclaimed that EBR Schools negatively impacted student achievement by not providing necessary materials. During the first years of adopting the NGSS, Louisiana did not recommend a tier 1 curriculum for science. Therefore, EBR Schools did not adopt a curriculum. Instead, they assembled teachers to create Teacher Created Materials (TCM). The TCMs were units created by teachers in EBR Schools and consisted of lessons that required a surplus of materials. Ms. Gomer, Ms. Bingham, Ms. Jenkins, and Ms. Ashley taught at schools with a high number of Black students. Although the TCMs were solid curricular examples and strong pedagogical strategies, they all expressed that EBR Schools did not provide the materials needed to teach successfully.

Some participants exclaimed that they had to spend their own money to buy their own necessary materials to teach TCMs. Being an instructional lead teacher in science, Ms. Gomer said that she knows teachers who were unwilling to spend their own money on items needed to teach a science lesson. She further explained this situation by sharing:

> Teachers need materials for science. So many concepts require investigations. Therefore, hands-on material is needed. In my past, especially in teaching TCMs, I have spent a great deal of money to make sure my students had resources that would ensure their success in grasping the skills and concepts. However, some of the other teachers did not do the same.

She lamented that this was a direct failure on EBR Schools account. All but Mrs. Lacey expressed the detriments of having a lack of appropriate material. Mrs. Lacey was on the

committee that comprised the TCMs. Possibly, Mrs. Lacey did not see the detriments due to the nature of her population of students, who were not Low-Income. In the study, she expressed that the teachers at her school do not usually buy materials. She added, “If we do not have the materials on campus, in which we usually do, then we request that the students bring the needed materials”. On the other hand, Ms. Jenkins, who teaches Low-Income students, stated that she had made several requests for students to bring inexpensive materials. To her surprise, the students rarely brought the materials. Therefore, in summing up teacher participants’ responses, majority of participants felt the lack of materials negatively impacts student performance.

Additionally, I was provided with more notion to the code concept of materials in a classroom observation. In an observation of Mrs. Gomer’s class, I was able to confirm that lack of materials could negatively impact student performance. The students’ objective was to learn that all living things are made up of cells, which are the smallest living units. Additionally, the lesson’s goal was for students to learn that an organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). However, I noticed that some students did not fully understand the scale of microorganisms. Gomer’s lesson plan indicated that, “Students further connect cells and microorganisms in the Scale Tool as they work to place three new Scale cards into their Scale Card Sorts”. Mrs. Gomer revealed that the district and amplify had a miscommunication. Therefore, the digital scale was not able to be accessed by students, which resulted in the students not fully understanding the scale of microorganisms. I concluded that the lack of students experiencing the digital scale will impact student performance as lessons progress throughout the topic.

Consistently, participants' responses mirrored many of the findings reviewed in literature selected for Chapter 2. While some variations existed, and some felt more passionate than others, it was important to note the reflection of the literature findings in interview data.

Research Question 3: What are factors that determines student success with the implementation of the NGSS?

The third research question highlighted the necessary determinants for students to be successful with the implementation of the NGSS. Interviews were conducted whereas the educators in EBR Schools provided recommendations on narrowing or reducing the achievement gap in science scores for Louisiana students. These educators provided substantial information on the factors that positively affect the Black students in science achievement. Data was transcribed and synthesized; thereafter, the following themes emerged to provide findings to the third research question.

Student Needs. The code concepts of Parental Involvement (5), Self Determination (8) and Quality Science Instruction (28) were merged into the theme of Student Needs. Among these concepts, quality science instruction was clearly indicated as a major factor in students' needs as a determinant for success in science, especially with the NGSS.

In research question 2, educators provided insight into how the lack of parental involvement negatively impacted Black students' achievement in science. Consequently, the participants shared that increased parental involvement positively impacts Black students' science achievement. Several participants addressed the notion that parental involvement could ensure success with students in science, as well as all other academic areas. Mrs. Hollins stated for example that:

> As I think about my own biological children. My husband and I push them in education and help them when they are in need. We are ensuring that they get the resources that

> they need to be successful. The environment that they are in will push them in education. We do not take any excuses, so I think that's one of the things that moves to their success in academics.

Due to being involved and stressing education, Mrs. Hollins revealed that both of her children have experienced being in advanced classes in current and former school locations. When thinking back to her childhood, she stated that she and her husband had an upbringing, whereas education was not a priority. She discussed that by chance, they were successful because of their innate drive. However, she added, “I can see the difference in my children. I feel as if I pushed them in being driven to do well in education. In a result, my son knows more about science than I knew when I was his age.” Such responses were revealing in that they highlighted the significance of family involvement; a finding also revealed in the literature reviewed for this study (Falk & Dierking, 2010).

Consistent with Mrs. Hollin’s beliefs, Mrs. Lacey discussed how parents should seek to expose their children to learning outside of school. She postulated, “This is extremely important in science. The parents who introduce their kids to science at early ages create an opportunity for success.” Consistently, literature reviewed in Chapter 2 mentioned that science learning extends beyond the classroom through a landscape of resources, such as educational television, visits to museums, zoos, aquariums, and national parks, as well as access to community activities such as 4-H and scouting and many other scientifically enriching enterprises and opportunities (Falk & Dierking, 2010). Mrs. Jenkins expressed her belief that if parents have constant communication with teachers, students are more prone to excel in the learning environment. She further explained, “They can hear recommendations per the teacher, that would ensure their child’s success.” Mrs. Lacey and Ms. Ashley, whose school has high performance scores, stated that their school has no issues with parental involvement as parents are extremely involved in their

child's education. They believe this to attribute to their high student achievement at their respective locations. Ms. Ashley shared, "We are blessed to have a lot of parents that push their kids to excel; this helps us out." She described parental involvement as an aid in making sure students performed their best. The majority of participants concluded that parental or familial involvement are necessary tenets for student success.

To add to the theme of the Students Need, Mrs. Gomer, Ms. Ashley, Mrs. Lacey, and Mrs. Hollins revealed that a students' self-determination is key to their success. These teacher participants have all witnessed students with no drive or will to learn. For instance, Mrs. Ashley specified that these students often do not excel in the learning environment. Mrs. Gomer affirmed, "We can build a student's self-determination in order for them to be successful." Mrs. Hollins implied that it should start with making sure students' most basic needs are met as she referenced Maslow's Hierarchy of Needs (1943). She stated, "a student's physiological, safety, belonging and love needs must be met first." Mrs. Hollins assured that she has experienced student success by ensuring that those students' lower levels of needs are met. Specifically, she provided an example by stating,

> I had a sign on my door that said, "welcome scientists". I make the students really believe that they are scientists. Students had to jump on board and become scientists. I created a culture that even if they made a mistake or failed a test, they still were scientist. This pushed them to try hard and be better. I had a lot of students buy into the idea. Therefore, they saw success.

Hollis believed that, in turn, she gave the students a sense of belonging in her classroom environment by motivating them to be successful. Other participants agreed and concluded that the notion of self-determination is a determinant for success in science learning.

Quality Science Instruction (38) represented the highest occurrences of the code concepts in this study. All of the educators who participated in this study continuously provided insight

into what science instruction should look like and assured me that pedagogical practices would create the conditions for student success. First, the educators stated that science instruction should be engaging to students. Mrs. Gomer recalled her High School Biology teacher who made learning engaging. She stated, “My biology teacher in high school was an amazing science teacher. Everything with so hands-on. We did the dissections, and so many more experiments whether simple or complex, such as looking through microscopes to see microorganisms.” She exclaimed that she and her classmates were successful in science because of his pedagogical practices. His actions also attributed to her loving science. Similarly, Ms. Jenkins stated, “In college, I was introduced to hands-on, interactive lessons that engage learning by sparking her personal interest through thought-provoking questions.” This also resulted in her having developed a love for science.

Ms. Ashley concurred as she stated that she ensures that her science lessons are engaging. She added, “Science needs to grab students’ attention. This can be done by hands-on activities.” Mrs. Gomer also agreed as she concluded that her students get excited when they are allowed to cut items, and look through microscopes, and experience hands-on investigations. At Mrs. Lacey’s and Ms. Ashley’s schools, students are enrolled in a science lab class in addition to their science class. Mrs. Lacey commented that this pedagogical practice ensures that students are investigating and experimenting. She added, “The principal at our school realized that students are engaged in science if it hands-on.” In my observations of Mrs. Jenkins class, I noticed that students were excited as they were headed to science lab for the exploration component in the lesson. Lacey and other participants felt strongly that hands-on investigations are determinants for success and necessary for achievement.

Additionally, in the code concept of quality instruction, the educators stated that science should be in taught, whereas students can make connections to real world application. Mrs. Gomer claimed that she loved that the NGSS made it easy to connect science to things relevant to their own environment. This is often referred in the NGSS as students learning through exploring a phenomenon. As mentioned in Chapter 1, by means of equitable opportunity, the NGSS strategically embedded phenomenon in standards so that students could explore methods that would allow them to study the world or phenomena from their own social context, as well as from the perspective of other cultures or groups (Asowayan, Ashreef, & Omar, 2017). Ms. Ashley described the phenomenon as a means to allow teachers flexibility and autonomy to make learning relevant to their students. She expressed, "Teachers can create their own phenomena or use recommended ones." Mrs. Gomer stated she once linked a phenomenon to the coastal erosion, which take place in Louisiana. She stated, "We have an issue regarding coastal erosion, which is an example of a problem, whereas we need to figure out a solution. That is something in students' own environment. They relate to flooding due to high water levels in Baton Rouge" Ms. Jenkins said she also enjoyed the NGSS because of it providing elements that connect to real-world experiences. She further explained, "I like that it starts with a phenomenon, giving the students something to constantly reference back to and make suitable connections." A majority of the participants all expressed the connections allowed by teaching the NGSS increase student achievement among Children of Color.

Ms. Bingham implied that project-based learning, a recommendation by NGSS, also creates the conditions for student success. Chapter 2's literature review mentioned, including project-based expectations were the most effective learning model to benefit disadvantaged major ethnic groups (NGSS Appendix D, 2013). Mrs. Anthony described project-based learning

as teachers allowing students to explore findings instead of teaching them the content. She further explained by stating, “Students are introduced to task rather than memorizing facts.” Mrs. Gomer added a similar sentiment in that, “the NGSS are well written out with opportunities for project-based learning.” Therefore, she added that “project-based learning allows students to gain more comprehension and analytical skills.” Chapter 2 also contained reviews about how the innovative practices such as project-based learning help students develop important 21st-century skills, which includes critical thinking, problem-solving, collaboration, leadership, agility, adaptability, initiative, entrepreneurialism, effective oral and written communication, accessing and analyzing information, and exercising curiosity and imagination in an educational setting (NGSS, 2013).

Similarly, Mrs. Lacey stated that project-based instruction includes student-led and teacher facilitation practices in the learning environment. She argued, “With the teacher taking more of a facilitator role, students can better retain knowledge. This makes learning more relatable and feasible to reach a wide range of students and creates equitable opportunities for students.” Consistently, Mrs. Bingham reported that when she let go of her control in her classroom, her students flourished. She addressed how students enjoyed the student-led/teacher-facilitated instruction. However, she also expressed that the way we assess the NGSS should shift. She stated:

> If the standards are centered around performance-based instruction, the state assessment should be mirrored as such. We cannot assess a student’s ability to conduct an investigation to determine whether the mixing of two or more substances results in a new substance on a paper and pencil multiple choice test. We should focus on the performance-based expectations using hands-on material as provided by the NGSS when assessing our students.

She exclaimed that this benefits Students of Color as they struggle on standardized tests. Moreover, a majority of the participants believed that the implementation of project-based

learning based on student performance provided the opportunity for all students to actively participate in learning. For instance, Ms. Jenkins stated that project-based standards create a "cognitively challenging and hands-on learning experience for students. These science teachers' perceptions imply that students learn by doing; rather than seeing, hearing, or memorizing."

Teacher Needs. Within the concept codes Value (2), Autonomy (3), Professional Development (7), and Administrative Support (3), the theme of Teacher Needs emerged as ingredients for student success for achievement in science. Mrs. Gomer and Mrs. Hollins similarly stated that school districts and other stakeholders need to value science teachers. Mrs. Hollins added:

> In doing so, pay science teachers for what their worth. You'll draw in more science people to become educators in science. It's hard to find science teachers who actually have the content knowledge and have higher degrees, such as a master's in science. Pay them what they deserve.

She exclaimed that the value would ensure more quality teachers in science educator positions. Consistently Mrs. Gomer believed that school districts must take necessary actions to hire and retain good science teachers. Both Hollins and Gomer expressed this would ultimately create the conditions for higher student achievement.

Additionally, in the theme of teacher needs, majority of teachers expressed autonomy as a teacher need that positively impacts student achievement. Ms. Ashley, Ms. Jenkins, and Mrs. Hollins all attributed autonomy to their current and past success of their student achievement. Mrs. Anthony stated:

> In my experiences, the principal sort of allowed me to have autonomy. I did what I needed to do to ensure my students' success. When Louisiana adopted the NGSS. It was just given out of nowhere with no instructions. Therefore, I went through the standards and figured out the best way to teach them.

Similarly, Mrs. Hollins specified that she is grateful that her former principals gave her autonomy. Hollins stated she was able to use her professional judgment and make the best decisions for students. Ms. Jenkins also used autonomy and linked it to student success. She qualified:

> We used a curriculum called Discovery Ed. With this curriculum, I was not policed on how to teach it. I did not have the principal or anyone else interfere telling me what order I should teach content in. I had options to choose from different activities that would best benefit my students. I was free to make my lessons engaging and fun.

A majority of participants also expressed the nature of teacher autonomy as benefiting their student performance in science. Additionally, participants believe autonomy is necessary for teaching the NGSS, as it allows flexibility to fit the needs of their individual classes.

In the theme, Teacher Needs, participants stated that teachers need training, especially with the NGSS. Mrs. Gomer, Ms. Bingham, and Ms. Lacey alluded to the idea that if teachers are effectively trained with the NGSS, students are more prone to be successful. Several teacher participants complained about how the district did not initially offer trainings after the adoption of the NGSS. Ms. Jenkins indicated, “Science is not a priority; therefore, they do not offer professional development for it”. Mrs. Gomer stated some teachers still struggle with teaching the NGSS. Mrs. Bingham felt strongly professional development is necessary for teachers. She shared her own personal experience of the difficulties that she initially had teaching the NGSS. She stated,

> In my journey, I've improved so much in facilitating science education. My first year as a science teacher, before the NGSS standards and the 5 E’s, I did a lot of front loading with a couple of experiments here and there. Those students had a difficult time grasping so many concepts from a textbook. Through attending professional developments, I learned how to make a better impact on my students by changing my teaching practices.

Gomer credited her principal, who ensured that she provided the teachers with ongoing professional development within the school. Mrs. Gomer added that administrators needed to do

a better job of taking science seriously. For elementary teachers who teach Math, ELA, Social Studies, and/or Science, Mrs. Jenkins suggested that principals should observe and evaluate science lessons instead of just focusing on the other subjects. Jenkins asserted, “this would hold some teachers who were not giving their best instruction in science.” Ms. Bingham added that her administrator also provided the science teachers at her school with a science coach. She stated:

> The science coach provides a lot of support to me. She comes to our school and assists me once a month. I can always email or call her when I need help. She makes sure we are able to collaborate with other teachers from other schools. As a result, our teachers are very knowledgeable in science education.

Mrs. Bingham and other teacher participants strongly indicated that educational leaders and school districts should be providing ongoing professional developments in science education. Mrs. Gomer asserted that given the despairing gaps in science education towards disadvantaged groups, leadership should further push for teacher training in science. She maintained, “teachers need to learn more effective teaching methods that take students' diverse ideas and beliefs into account”. She further declared, “it is a matter of national economic interest and also justice”. Each participant expressed sentiments that the major components of professional development and coaching teachers could impact science achievement.

Emphasis on Science. The code concepts of the Science Weight (8), Funding (3), Instructional Minutes (6), and Opportunities for Integration (3), The Investment of Stakeholders (14) emerged into the theme, The Emphasis on Science. Science weight was the largest code concept in emphasis on science. Each participant expressed that there is an insignificant value of science on the school, district, state, or national level. The participants had strong feelings about science. Mrs. Hollins stated:

> Science education is important to our society because everything that we do everything that we part take in has to do with science. From the sun rising in the mornings, to us going to sleep physically in our beds, everything is connected to science and it's so essential that students understand that science is everywhere. Just like we see the numbers with math, everything that we do can be linked back to science.

Consistently, Mrs. Gomer stated, “We live in a society where most things are technology and science-based. You need to have science skills to evaluate, experiment, and find new ways to solve problems.” Educators made connection to science as driving us into the future. As an example, Mrs. Ashley expressed science is key to future technological advancements. Ms. Bingham quoted Richard Riley, “We are currently preparing students for jobs that don’t yet exist, using technologies that haven’t been invented, in order to solve problems that we don’t even know are problems yet.” Overall, participants believed that if science had more value, then students would be more successful in achievement. Ms. Lacey added that science value should undoubtedly be stressed to Black students because fewer numbers of the Black population are represented in STEM related fields.

In Chapter 1 & 2, it was revealed that math and reading take precedent to science. For example, the CCSS was first prioritized for math and reading (Achieve, 2013), even when science has historically faced lower achievement scores (NAEP, 2009). Consequently, the teachers in this study shared that even with the implementation of NGSS, a measure recommended to increase science achievement and science pedagogical practices, there was still a lack of emphasis in science in the state of Louisiana. The state’s assessment index that determines school performance scores. As indicated in Chapter 1, science and social studies are weighted as one point (each), ELA and Math were weighted as two points (each) (Title 28 EDUCATION Part XI, 2020).

For this reason, even with the NGSS, educators feel that it is hard to get the focus on science. Mrs. Gomer maintained, “Districts will not focus on science because they know it would not be of much affect in contributing to school performance scores. As an example, Mrs. Hollins complained about the rollout of new science curriculum, Amplify. She stated that EBR Schools did not provide any training for the curriculum prior to implementation. While the district provided a week of training for Math and Literacy at the beginning of this school year, no training was available for science, even with a new curriculum. She felt strongly that this would affect science achievement.

Mrs. Gomer states, “There is disregard for science, and it trickles down to each individual school.” Similarly, Ms. Bingham claimed that administrators are not apparently concerned whether teachers are even teaching science on the elementary level (most elementary teachers teach multiple subjects with science). She affirmed that some teachers do not even honor the science instructional minutes. She witnessed teachers say, “I take away their science time because they struggle in ELA and Math.” She considered this as problematic as she firmly believes that science concepts can help students in other subjects. Mrs. Jenkins stated, “There is very little time to teach science. I have 75 minutes to teach science and 30 minutes to teach science.” Further contributing to issues in science instructional minutes, Mrs. Jenkins added, “When principals schedule an event, then they typically schedule it during science time”. Consequently, Ms. Ashley and Mrs. Lacey are at one of the few elementary schools in EBR Schools that departmentalized science. They do not have the issue whereas their science time is compromised for other subjects or events. They both taught/teach science during a full instructional day, and they attributed it to their success in science achievement.

Respective to a greater focus on science, Mrs. Gomer declared there are numerous opportunities for the integration of science in other subjects. She stated, “It should be stressed that science should be taught cross curriculums. If you teach science, you're also emphasizing math skills in writing skills and comprehension skills. The measuring in science and math are one in the same.” Similarly, Mrs. Lacey acknowledged, “Science can cause increases in your reading and math scores.” She confirmed that the critical thinking that students use in science is beneficial to other subjects. Four of the participants teach at STEM focused schools; STEM encompass science and math. At these schools, students must engage in a student-centered learning environment in which students investigate and engineer solutions to problems. Overwhelmingly, these participants at STEM schools believed that science integration is apparent to growing students across core subjects and curriculums.

Each participant mentioned that stakeholders should make a better effort to improve science education. Mrs. Gomer stated, “funding is key.” In chapter 2, literature reviewed, pointed to the fact that funding provides better outcomes as schools wisely spend money on needed educational resources to strengthen student learning (Elliott, 1998). Gomer stated schools should be willing to provide funds to have training, materials, and resources for science teachers.

Additionally, participants added that there is a need for community involvement. For instance, Ms. Ashley expressed that she takes advantage of community partners. She stated, “In Louisiana, we actually have so many community partners who enjoy coming out in and assisting in science.” Similarly, Mrs. Bingham, Mrs. Hollins, and Ms. Jenkins also used community partners in their science classrooms. Mrs. Jenkins declared, “Educators can create multiple opportunities to introduce students to people in their communities that work in science/STEM

careers." Mrs. Bingham confirmed her goal is to spark students' interest in STEM related careers. She stated:

> I remember the first time I introduced careers to my students. They were amazed that someone that worked in technology could make six figures. It sparked their interest. They wanted to learn more about it. I included a description of the career, required educational experiences, and the average annual salary. I reach out to allow professionals in some of those same careers to speak with students through video conference or in person. The purpose of U.S. teaching students is to help them become college and career ready. Without exposing them to those careers they will not going to be ready."

Mrs. Hollins stressed that groups such as Black students and students of low socioeconomic status should certainly be introduced to STEM careers. Mrs. Lacey referenced the underrepresentation in STEM careers. She explained by stating:

> Minority students continue to be underrepresented in the STEM fields, which are the highest paying jobs in the U.S. When teachers notice minority students who have the skills and interest in STEM areas, they need to work with them individually to nurture them and launch them onto a successful career pathway.

The participants recognized community support as a large emphasis on science. Majority of participants believe it to be a determinant for student success.

4.4. Summary

In Chapter Four, I reported the findings from the explanatory mixed method design and provided the explanation for student achievement by using educator insight. First, student performance data was assessed by LDOE and EBR Schools to undergo statistical measures. The statistical measures provided the notion that the NGSS positively impacted students achievement indicated in performance results from 2019 LEAP 2025 Administration. Next, IRB approval was obtained, and educators were selected to be interviewed in this study. Hence, one-on-one interviews were conducted with six participants. Then, through rigorous data analysis, six significant themes emerged into the findings for this research. The findings from this study provided important new information on Black student science achievement in Louisiana,

including factors impacted the achievement and the determinants for success with NGSS. Findings from this study also extended to previous studies on science achievement among Children of Color, which are indicated in Chapter 2.

In Chapter Four, I reported the findings from this study. Chapter Five consists of further discussion of findings through an interpretation of the results. Additionally, potential future, extended research is discussed.

CHAPTER FIVE. DISCUSSION AND IMPLICATIONS

The purpose of this study was to investigate the NGSS and its implications of being a curricular and pedagogical intervention in terms of narrowing the achievement gap in science education for Children of Color. Therefore, in using standardized test results and the insight of educators, this study assessed the effectiveness and impact of the NGSS' implementation in Louisiana. This study utilized student performance results from the LEAP 2025 to conduct a statistical analysis that measured the effects of the NGSS as an intervention in narrowing the achievement gap, specifically examining scores from 2017 and 2019. The study also employed one-on-one interviews with six elementary and middle school educators in EBRPSS schools to gain more insight about the necessary conditions for science achievement, as well as the implementation of the NGSS. Thus, the present study adds meaningful discussion about the problematic achievement gap in science education and contributes to the existing literature in providing detailed information regarding the NGSS and its impact on achievement and the factors that work with and against its implementation for Black students.

5.1. Discussion of Findings

The conceptual model of this study, shown in Chapter 3, provided an outline to analyze and better understand findings on whether implementation of the NGSS impacted student achievement in Louisiana. Although the overall results signified that the NGSS positively impacted student achievement among Black students in Louisiana, the study results also indicated significant unfavorable changes in the achievement levels results among both populations of Blacks students included in the study. Moreover, this study informed in-depth results about the differences in the Black student achievement, as measured by the 2017 and 2019 LEAP 2025 Administration.

Key differences emerged as significant results in this study between the population of Black students who were taught and not taught under the NGSS. Simply put, correlation is not causation. Through the use of the Chi Squared Test of Homogeneity, the results of this study exposed the notion that it is not always possible to determine significance in the comparison of groups by looking at mere numbers; population sizes are important. The data in this study revealed that all but the advanced levels of achievement held significant differences when comparing the results of the LEAP 2025 administration in 2017 and 2019, respectively. Through usage of Cramer's V as a measure of association, it was determined that the differences were not large in the population, yielding the results of a weak relationship.

With further analysis, insight was gained by comparing the observed and expected frequencies. An understanding was provided from the contingency table and standardized residuals, as it revealed that changes took place in the levels of achievement the implementation of the NGSS. Those changes revealed that there were significant increases in students scoring in the Unsatisfactory level of achievement after the implementation of the NGSS. This, in turn, provided knowledge that the NGSS as an intervention did not result in a strong impact for some students as more moved to the lowest levels of achievement after the implementation of the NGSS. Of more concern, there were fewer students than expected in the Basic level of achievement after the implementation of the NGSS, which could explain the increases in the Approaching Basic and Unsatisfactory level of achievement. However, this was not the case. While it alluded to the trajectory of overall student performance going downwards, the changes in students scoring in the Mastery level of achievement increased more than the lower achievement levels after the implementation of the NGSS Specifically, the Basic level achievement changes increased more to Mastery than downward to Approaching Basic and

Unsatisfactory, which determined my results of the NGSS positively impacting Black students' achievement in Louisiana. However, the results do not negate the finding that there were increases in the lowest level of achievement, Unsatisfactory, across the different populations.

Moreover, through use of interviews, this study explained the positive and negative factors that accounted for the student performances with including teacher perceptions about science achievement within and beyond the scope of the NGSS, to investigate what contributes to the success and failure in science education, therefore in some form, explaining the quantitative results of this study. Framed within the theoretical context of the Socio-transformative constructivism (STC) theory, this study revealed that there are certain conditions that should be met to ensure equitable achievement for all students in education when educating students in science. The existing achievement gap in Louisiana presents itself to be a challenging issue that plagues Children of Color in science education. Therefore, presenting the need the need for all students to be on an even playing field in education. Hence, the themes of this study, provided by educators, appropriately addressed means of providing equitable opportunity for all students as it answered the positive and negative factors to the achievement of students in Louisiana, specifically, Children of Color. In the following section, participants' perceptions are discussed in terms of implications

With a focus on the purpose of this study, data was gathered from teachers who teach populations of Black students. These teachers were selected for their knowledge and expertise related to teaching science to Children of Color. In looking examining the participant data, I noticed trends that further proves the existing of an achievement gap. Two participants, Mrs. Lacey and Mrs. Hollins, worked at schools with fewer numbers of Black students with scores above the state and district's average. Two participants, Ms. Bingham and Ms. Jenkins, worked

at schools with a large number of Black students who had scores below the state and district average. Interestingly, one other participant, Ms. Ashley, worked at a school with high numbers of Black; however, the school's scores were above the states district average. The demographics difference between Ms. Ashley and the other participants working at schools with a high population of Black students was that her school had a low number of Low-Income students.

By transcribing the participants of this study responses, valuable themes were developed to add to past literature and new findings in the field of science education. Consistent with the literature in Chapter 2, barriers in the home environment, such as poverty and exposure/access (DeNavas-Walt & Proctor BD, 2015; Urban League, 2019; Reeves, Rodrigue, & Kneebone, 2016; Cavanagh, 2007; Morgan, 2016; Betancur, Votruba-Drzal, and Schunn, 2018). Through analyzing the participants' responses, the derived theme of home environment helped explained the negative impacts in Black student achievement. However, new findings emerged that attribute to deeper historical inequitable experiences, such as generational cycles and unvested parents. These concepts are integral to explaining negative impacts in achievement. Hence, it is difficult to attain success in learning when parents do not value and/or promote education.

In Chapter 2, exposure/access to learning experiences, referenced by Alexander, (2001); Archer et al. (2012); Kao (2004); Falk, Storksdieck, & Dierking (2007); Dawson, 2014; Chesnutt, Jones, Hite, Cayton, Ennes, Corin, & Childers (2018) was identified by participants as the most prevalent impact that negatively impacts student achievement. Each participant described that exposure/access to learning experiences is essential to student learning as students need background knowledge to succeed in science.

Additionally, this study provided similar findings to specific barriers in the school environment as discussed in chapter 2 (Beese & Liang, 2010; Hall & Ushomirsky, 2010;

Hoisington et al., 2018; McKinney et al., 2007; Ingersoll, 2004; Simon & Johnson, 2015; Mangiante 2011; Darling-Hammond 2003; Necochea & Cline, 1995; Qian, Nandakumar, Glutting, Ford, & Fifield, 2017). Interestingly, a new finding in the classroom environment emerged as low expectations of students, which described teachers not trusting that the students are capable of receiving high quality teaching, hence excluding them from the actual benefits of high-quality instruction. As a participant revealed, this is a detrimental impact placed on Children of Color and students of low socioeconomic status.

In answering research question 3, the themes that emerged from data analysis provided more rationale to the STC theory, by stressing the importance of all stakeholders in education and taking all necessary actions to create conditions for the success of all students. Precisely, the themes of student needs, teacher needs, and greater emphasis on science education were pinpointed as having the power to impact student achievement on a wide scale and move toward closing gaps in achievement among Children of Color. Among the students' needs, new findings pointed to students' self-determination. Relating to Maslow's Hierarchy of Needs (1943), participants felt students' needs of physiological, safety, belonging, and love must be met in order for them to achieve success.

Furthermore, giving students quality instruction emerged as another substantial determinant in student success, which was consistent with the implications of the NGSS, as discussed in the literature review in Chapter 2 by Ainsworth, (2011); Wagner, (2008); Lee and Buxton (2010), and included as points of discussion in the NGSS Appendix D, (2013). The findings provided a strong indication that science teachers are required to make an engaging learning experience for students. This includes a focus on experiential, hands-on opportunities with the practices of students' conducting investigations and using the engineering design. In

addition, it was revealed that learning should be meaningful and connected to the students' daily lives, again, a finding consistent with the NGSS' recommendations of learning through a systematic view of a phenomenon. In addition, quality instruction of science emerged a critical need to students; participants uniformly recalled how previous science teachers impacted their resultant practice.

In teachers delivering high-quality instruction, project-based learning was signified to increase student achievement. Notably, the NGSS, if implemented faithfully, has the potential to provide the opportunity for project-based learning, as the standard included performance expectations. This innovative learning practice promotes both student-led and teacher-facilitated learning environments among all populations of students. This references back to tenants of the STC theory, as teachers are encouraged to create the conditions for learning in an environment which encourages and promotes cultural diversity (Asowayan, Ashreef, & Omar, 2017).

In this study, the theme of teacher needs was revealed an implication that should be met to ensure quality instruction to students. Findings provided the notion, if teacher needs are met, then student needs are easier to meet. Furthermore, the study revealed the importance of valuing teachers. Teacher value was a concept that highlighted teachers as they influenced student success both short and long term and positively influenced student outcomes. A significant implication of this research is that what teachers prioritize through practice, and what they promote and encourage, needs to be respected and valued for their contributions to educating young minds. Additionally, the study mentioned that teachers should be afforded more autonomy in their practice, being free to use their professional judgement. Teachers need adequate pay, which supports in students receiving more qualified and quality science teachers.

In further addressing research question 3, findings signified that there should be a greater emphasis on science. According to participants, science should never be sacrificed for other subjects. Greater emphasis on science puts our current society on a pathway to success as students receive 21st century skills to succeed in an age of information and increasing demand. Adequate funding promotes positive impacts in achievement, as teachers receive more resources to support student learning.

In efforts of exhibiting greater emphasis on science, community involvement is essential. There are individuals in science related fields, who are successful and living comfortably. That notion needs to be relayed to students. Through community partners, students' attention are captured. Additionally, the importance of science needs to be conveyed on a nation wide-scale in the U.S. Hence, policyholders must actively make the decision that supports science achievement for all students.

The themes in this study provided an additional rationale regarding the NGSS and its implications of addressing gaps in achievement. The NGSS was revealed as having the means of impacting the achievement gap under certain conditions.

5.2. Significance of the Study

This study uniquely investigated the achievement gap in reference to Louisiana students' performance in science that extended beyond and within the scope of the NGSS. While the NGSS were written as a means of addressing diversity and making provisions for minority and economically disadvantaged groups, there was little known data that indicated whether the the implementation of the NGSS addressed the achievement gap in specific states, such as Louisiana. In this present study, it was important to use educator insight with framing the study inside the STC theory. Educator insight has always been underrepresented in the process of

education reform and innovation (Ashraf, 2019). Summaries of significant studies without teacher input and participation, reform has resulted in no positive or long-lasting effects (Brown, 1994). Therefore, in this study, it was valuable to have teacher perceptions and experience considered regarding educational reform. This study signified the implication that changes in science education are apparent. Teachers should be at the forefront of implementing change through decision-making and in implementing best pedagogical practices in the classroom. Additionally, there are outside factors that require attention in order to support the educational attainment of all students.

5.3. Implications for Practice

This current study contributed to the respective fields of student learning, student achievement, science learning, science achievement, and pedagogical practices. The provided findings in the study were that the NGSS implementation had a positive impact on Black student achievement. Additionally, educators provided insight in maintaining achievement and pointing out the factors that negatively impact Black student achievement in Louisiana. This study offered many considerations about science teaching and learning, such as equitable opportunity, accountability, and pedagogical practices, which will improve education.

To ensure success, teachers and policymakers should do whatever it takes to impact the home environment. Specifically, there should be means of controlling the variables of generation cycles, uninvested parents, and students' lack of exposure to learning experiences outside the learning environment. This could be completed by policyholders providing incentives to parents for providing outside science-related experiences to their children. Policyholders should continue to provide support in addressing the socio-economic gap among the Black population.

Policyholders should also take necessary measures to ensure qualified teachers and quality teachers are in the classroom environment, especially among the underserved populations. Efforts could be made in making the teaching profession more marketable. Moreover, greater allocations of funding could be geared towards teachers and materials to ensure that they have the means of impacting student performance. In appropriately using funds, policymakers, administrators, and other district leaders should provide opportunities for supporting teachers in science education through training and coaching. Therefore, in practice, teachers could provide students with the best science pedagogical practices. The end goal should be that students gain 21st century skills that important to our current society, such as problem solving, critical thinking, communication, collaboration, and self-management.

Another implication for practice is establishing an alternate way to assess students in science. Standardized testing is problematic as Children of Color and Low-Income students underperform in achievement. Furthermore, if teachers assess students throughout the year by using hands-on activities to meet the performance expectations of the NGSS, then it should be the same for the summative assessments. Therefore, standardized testing could be omitted for assessing students' knowledge of science content. Moreover, rather than using standardized testing, students could be accessed by their performance with hands-on material to meet the NGSS performance expectations.

With greater emphasis on science, principals should know science. They should be trained in their school's respective science curriculums with the NGSS. In addition, they need to be trained through hands-on investigations with understanding of the benefits of science learning. They should also be able to see how science is assessed on standardized tests. This could limit their often connotations that science teaching is about memorizing terms.

Consequently, on the LEAP 2025 science tests, students are expected to complete tasks reflective of the multiple dimensions of the standards.

In achieving goals in science, science time should be increased and equally distributed across core subjects in education. Science also should be integrated across all disciplines. In all these demands for improving education, policymakers should value the benefits and realize that science education for all students is undoubtedly important as the well-educated students offer a better future by solving current issues, as well as the issues that do not even exist yet.

5.4. Recommendations for Future Research

The findings from this study revealed critical information on the achievement gap and what impacts success and failure in science education. My interest in this topic was deep-rooted in my experiences in science teaching to Children of Color. In the role, I have observed opportunities for research to explore and assess ways to strengthen policies and practices that focus on increased student achievement in science education.

A limitation of this study that I identified was the lack of using educators of other race populations. It would be interesting to examine this present study using different perspectives from other races. In addition, it would have been beneficial to hear perspectives from males of any race population in this study. There is a possibility that their experience, perception, and insight in science education may differ from females.

In future research, this study could include or compare other student populations who often experience disadvantages, such as the EL and Low-Income populations. In addition to this, further discussion about the similarities and differences of experiences between other race populations of students, such as White, Hispanic, and Asian populations, could be studied to provide findings valuable to the field of science education.

With reference to this study, similar studies could be replicated in other regional areas of the U.S., evaluating the effects of the NGSS (e.g., rural, urban schools). As the present study setting was limited to educators in EBR Schools, it would be beneficial to replicate this study and evaluate it across several regions in Louisiana. Additionally, studies in other U.S. geographical regions might provide interesting and useful results.

Further implications of this study might investigate the best pedagogical practices for science teachers. Studies could be conducted to examine the effectiveness of professional development. Additionally, studies might desire to focus on administrators, such as examining their knowledge of science. Being that the home environment detrimentally affects students of Low Income, studies could investigate strategies for impacting the influences of the home environment.

In this study, it was revealed that teachers who taught science in elementary levels were departmentalized to only teaching science. Consequently, those teachers only focused on science, in which they did not have to compromise their science for subjects, such as ELA and Math. Therefore, a study could examine the benefits of departmentalizing science in elementary education. In relation to an administrator's role, this present study could be replicated to show how educational leaders in schools impact their school's science performance.

In this study, project-based learning was introduced as recommended pedagogical practice. Studies could be replicated to determine the effectiveness of project-based learning. This study could also be repeated with a focus on community involvement. In this study, several teachers expressed the benefits of inviting the community in science related fields to inform students on their job duties and responsibilities, as well as their pay. It would be interesting to see how community involvement increases student motivation in science.

In exploring future research, there is a rich area for additional empirical studies that centers on how teachers navigated teaching during the COVID-19 pandemic. COVID-19 constantly changed the educational landscape for learning (Harris & Jones, 2020). Teachers were forced in to a virtual or hybrid model, which limits engagement in hands-on activities. Yet, it could be studied to see if findings support or disregard those models of instruction. Future research should examine other dynamics, such as the effect of natural disasters. In Louisiana, students constantly lose instructional days as a result of impacting hurricanes. Therefore, examining particular strategies and techniques for effective instruction during a crisis could be studied in relation to science education.

Furthermore, studies that examine topics such as the achievement gap, the NGSS, and science education could be created with survey research. In turn, this large-scale data could bridge research and practice by providing quantifiable results from the perspectives of teachers on a wide scale. Employing other forms of research designs in quantitative and qualitative forms could potentially acquire different viewpoints and understandings of the achievement gap in science education.

5.5. Summary

Overarchingly, the purpose of this study was to investigate the NGSS and its implications of being a curricular and pedagogical intervention in terms of narrowing the achievement gap in science education for Children of Color. In this study, the NGSS, when measured as a curricular and pedagogical intervention, positively impacted Children of Color. However, this study suggested that certain conditions must be met to ensure student success in science, including student needs, teacher needs, and the emphasis on science. These conditions are essential to

counteracting factors, such as barriers students may experience in their home environment and school environment.

This research contributed to the fields of science education and the historical achievement gap among Children of Color. By understanding the results and findings of the explanatory mixed methods design of this study, policyholders, educational leaders, educational leadership scholars, school districts, principals, and teachers can learn how to impact our society through science education.

APPENDIX A: ONE ON ONE INTERVIEW PROTOCOL

Study: **AN INVESTIGATION EXAMINING THE CLOSING OF THE ACHIEVEMENT GAP IN LOUISIANA WITH THE NGSS**

Date:

Time:

1. Tell me about your career as it relates to science.
2. Why is science education so important in our present society?
3. Let's talk about the educators in science education. What do you think is the vital role for all science educators?
4. With having your experience, what important factors come into mind when thinking about the success/failure of students in science education?
5. Can you specifically name and elaborate on the reasoning(s) that contributed to the success/failure in science achievement based on the LEAP scores at your school?
6. What do you think schools must do to improve science education? Or how can they address the factors that work against science education?
7. Historical data and research nationally, statewide, and locally show that there are huge gaps in learning among Black students and students of low socioeconomic status. Why do you feel those gaps are present? How do we address those gaps?
8. How do you feel about the Next Generation Science Standards? What are your feelings toward the shifts from the GLE's to the NGSS?
9. How does the NGSS address the gaps in learning among Black students and students of low socioeconomic status?

10. How else can we improve learning to those often-underserved groups, such as Black students and students of low socioeconomic status?

APPENDIX B: IRB APPROVAL

Office of
Research & Economic Development

TO:	Margaret-Mary Sulentic Dowell LSUAM | Col of HSE | Education
FROM:	Alex Cohen Chairman, Institutional Review Board
DATE:	13-Sep-2021
RE:	IRBAM-21-0887
TITLE:	AN INVESTIGATION EXAMINING THE CLOSING OF THE ACHIEVEMENT GAP IN LOUISIANA WITH THE NGSS
SUBMISSION TYPE:	Initial Application
Review Type:	Expedited Review
Risk Factor:	Minimal
Review Date:	13-Sep-2021
Status:	Approved
Approval Date:	13-Sep-2021
Approval Expiration Date:	12-Sep-2022
Expedited Categories:	07
Requesting Waiver of Informed Consent:	Yes
Re-review frequency:	Annually
Number of subjects approved:	6
LSU Proposal Number:	
By:	Alex Cohen, Chairman

Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.

APPENDIX C: IRB APPROVAL continued

5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. **SPECIAL NOTE: When emailing more than one recipient, make sure you use bcc. Approvals will automatically be closed by the IRB on the expiration date unless the PI requests a continuation.**

** All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/research*

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VITA

George Christopher Cage was born and raised in South Mississippi. Cage earned a Bachelor of Science in Healthcare Administration in 2010 and received a Master of Arts in Teaching Elementary Education. Prior to attending Louisiana State University to begin his doctoral journey, he taught Elementary School, predominantly Math and Science.

While in the classroom, Cage focused on integrating arts through instruction and using the best innovative strategies reflective of the 21st century. Outside of the classroom, Cage worked relentlessly to advocate for educational equity through volunteer work, mentoring, and tutoring. In 2016, he was selected to serve on EBRPSS Math Curriculum Team. In 2017, he was selected to be a part of the EBRPSS Science Assessment Writing Committee. In 2018, he was chosen as a Foundation of EBR Schools STEM Fellow, in which he also received a grant to fund a school-wide STEM initiative at his school.

In 2018, Cage received the Association of Classroom Teachers Fellowship Fund 2018 that assisted in funding the duration of his coursework in the Educational Leadership & Research (P-12 Educational Leadership) Program. In 2019, he earned the Educational Specialist Distinction from Louisiana State University while pursuing his doctoral studies. In the same year, he was recognized as an EBRPSS Teacher Leader. Following, in 2020, he was hired as a math curriculum writer for Reconstruction, a company based in Boston, MA.

In his current position as a Math Coach in EBRPSS, Cage continues his commitment to education in the capacity of curriculum, instruction, and discipline in the Baton Rouge area metroplex. Cage's current research agenda encompasses a broad spectrum of critical areas in the field of Science Education and the field of testing, including closing the achievement gap among

Children of Color, and best usage of science pedagogical practices surrounding student retention and success.