

EVALUATING THE EFFECTIVENESS OF MONTESSORI READING AND MATH
INSTRUCTION FOR THIRD GRADE AFRICAN AMERICAN STUDENTS IN
URBAN ELEMENTARY SCHOOLS

by

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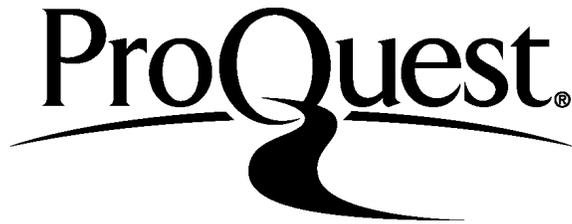
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ABSTRACT

KATHERINE ELIZABETH. BROWN. Evaluating the effectiveness of Montessori reading and math instruction for third grade African American students in urban elementary schools. (Under the direction of DR. CHANCE LEWIS)

Improving academic achievement for students of color has long been the subject of debate among advocates of education reform (Anyon, 2013; Breitborde & Swiniarski, 2006; Payne, 2008). Some scholars have advocated for the Montessori method as an alternative educational approach to address some chronic problems in public education (Lillard, 2005; Murray, 2011, 2015; Torrance, 2012). Montessori programs are expanding in public schools (National Center for Montessori in the Public Sector, 2014c) at a time when the American public school population is more racially diverse than ever before (Maxwell, 2014). A review of the literature reflects a lack of consensus about the efficacy of Montessori elementary instruction for students of color in general, and lack of attention to outcomes for African American students specifically (Dawson, 1987; Dohrmann, Nishisda, Gartner, Lipsky, & Grimm, 2007; Lopata, Wallace, & Finn, 2005; Mallet & Schroeder, 2015). The purpose of this study is to evaluate the effectiveness of reading and math instruction for third grade African American students in public Montessori, traditional, and other school choice settings, using end-of-grade standardized test scores from a large, urban district in North Carolina. Stratified sampling was used to select demographically similar traditional and magnet schools for comparison. Group mean reading and math test scores were compared using factorial MANCOVA and MANOVA procedures. African American students at grade three were found to perform at significantly higher levels in both reading and math in public Montessori schools than

in traditional schools. No statistically significant difference was found in math achievement between African American third grade students in public Montessori and other magnet programs, although the Montessori group did achieve at significantly higher levels in reading. This suggests that the Montessori method can be an effective pedagogy for African American students, particularly in reading. Based on these results, recommendations are provided for policy, practice, and future research.

DEDICATION

To my grandmother and namesake, Catherine Lucas, who always told me I could be a
doctor.

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CHAPTER 1: INTRODUCTION

Since the publication of the *A Nation at Risk* report (National Commission on Excellence in Education [NCEE], 1983) over 30 years ago, educational scholars and practitioners have debated how best to reform American public education. These conversations about education reform have often centered on identifying a viable alternative to traditional instructional approaches (Anyon, 2013; Breitborde & Swiniarski, 2006; Gee, 2013; Payne, 2008). Advocates of the Montessori method of education argue that the approach has the potential to address many of the persistent problems facing American schools (Lillard, 2005; Noguera, n.d.; Zhao, n.d.), including the failure to adequately serve students of color (Hall & Murray, 2011; Rambusch, 2007/1976). The Montessori method is a constructivist approach to education characterized by multiage classrooms, hands-on learning materials, extended periods of independent work time, and minimal use of teacher-centered, whole group instruction (Lillard, 2005, 2013; Mallett & Schroeder, 2015). Originally developed by Maria Montessori in Italy in the early 1900s, the Montessori method gained a foothold in suburban private schools in the United States in the 1950s and 1960s (Whitescarver & Cossentino, 2008). Over the last two decades, Montessori programs have been expanding in American public schools as well (National Center for Montessori in the Public Sector [NCMPS], 2014c).

This expansion comes at a time when the landscape of public education is rapidly evolving. Two historic milestones in American education were recently reached. In the 2014-2015 academic school year, non-White students were the majority in American public schools in grades K-8 (Maxwell, 2014); that is, racial “minorities” are no longer in the minority numerically. Also, as of 2013, the majority of American public school students come from low-income families (Suits, 2015). Using data from the National Center for Education Statistics, Hussar and Bailey (2014) report that the percentage of students of color will continue to grow in coming years. By 2022, Hispanic student enrollment is projected to increase by 33%. African American student enrollment will grow by 2%, while White student enrollment is slated for a 6% decrease. During the same period, the population of multiracial students is expected to grow by 44% (Hussar & Bailey, 2014). These trends suggest that the typical American public elementary school student is no longer White or middle-class, even though schools as institutions are still predicated on that mythical norm (Anyon, 2013; Lorde, 1984).

Montessori has historically been a popular approach in private school settings in the U.S., especially preschools (Whitescarver & Cossentino, 2008), and as such has acquired a stigma as an early childhood educational approach for the elite (Murray, 2012). In reality, Montessori programs have been expanding in public schools since the 1990s (NCMPS, 2014c; Whitescarver & Cossentino, 2008). Currently, there are almost 500 public schools offering Montessori instruction (NCMPS, 2014a). These include early childhood, elementary, and even middle school programs; over 100 public school Montessori programs serve adolescents (NCMPS, 2014a). These public school programs are making Montessori education accessible to students and families who do not have the

resources to attend private schools. A preliminary analysis of public Montessori programs indicates that 55% of these schools are Title I schools serving high-poverty communities (Debs, 2014). Students of color also have a significant presence in public Montessori schools; over a quarter of students in whole-school Montessori programs are African American, and almost one-fifth are Hispanic/Latino (Debs, 2015). This suggests that public school Montessori programs are experiencing the same demographic shifts that currently characterize American public education more generally.

The growth of public Montessori programs has been interpreted by some (Lillard, 2005; Whitescarver & Cossentino, 2008) as a symptom of public dissatisfaction with traditional schooling and desire for change. The contemporary educational reform movement dates back to the 1983 publication of the *A Nation at Risk* report, which critiqued the lack of rigor in American public education (Breitborde & Swiniarski, 2006). As a result, the standards-based reform initiatives of the 1980s and 1990s sought to raise the bar for student achievement and hold schools and districts accountable for student progress (Breitborde & Swiniarski, 2006). Legislation like the 2001 reauthorization of the Elementary and Secondary Education Act, also known as No Child Left Behind, largely failed to achieve its stated goals of closing achievement gaps and reaching 100% student proficiency in reading and math (Breitborde & Swiniarski, 2006; Zinn, Baker, & Betebenner, 2002). Some stakeholders have become disillusioned with high-stakes testing and the accountability movement (Darling-Hammond & Hill, 2015; Erskine, 2014; Stitzlein, 2015). At the same time, the push for 21st century skills like innovation and collaboration has gained momentum (Kivunja, 2015; Trilling & Fidel, 2009). This perceived need for change, along with the freedom and autonomy provided by charter

school laws (Whitescarver & Cossentino, 2008), have created both a desire for alternative pedagogies like Montessori and spaces for them to flourish.

Statement of the Problem

African American students have long been excluded from and marginalized in American public education (Anderson, 1988; Breitborde & Swiniarski, 2006; DuBois, 1967, 1997/1903; Woodson, 1933). Although the era of “separate but equal” was supposed to end with *Brown v. Board of Education* (1954), schools are once again becoming racially segregated (Kozol, 2006). Students of color are increasingly concentrated in urban settings (Wilson, 2012). High-poverty, high-minority urban schools face challenges such as high rates of teacher turnover, low graduation rates, and overrepresentation in special education (Lewis, Chambers, & Butler, 2012). Students of color encounter institutionalized racism (Lewis et al., 2012), while students from low-income families struggle in school systems where middle-class cultural capital is a prerequisite for success (Anyon, 2013). Too many African American students are pushed out of school through inequitable use of exclusionary discipline (Skiba, Michael, Nardo, & Peterson, 2002) and placed at increased risk of incarceration, a phenomenon dubbed the “school-to-prison pipeline” (American Civil Liberties Union, n.d.). African American students in urban districts are likely to have a preponderance of relatively inexperienced, White, female teachers (Hancock, 2011). However well-intentioned they may be, these teachers often lack an understanding of African American culture (Delpit, 1995; Ladson-Billings, 1995) and language (Heath, 1983).

As a result of these problems, the African American students who largely attend urban schools have historically been underserved (Wilson, 2012). One symptom of this

disparity is a corresponding difference in academic achievement (Vanneman, Hamilton, Baldwin Anderson, & Rahman, 2009). Although this phenomenon is often referred to as the *achievement gap*, a more accurate term is *opportunity gap*. This reflects the deficit in opportunities to learn that often characterizes the school experiences of students of color and low-income students, rather than some inherent deficit in the students themselves (Flores, 2007). On the 2013 National Assessment of Educational Progress (NAEP), fourth grade White students scored 26 points above their African American counterparts in reading and math (National Center for Education Statistics [NCES], n.d.). Only 15% of African American students were classified as proficient in reading at grade four. In math, 17% were scored at proficient (NCES, n.d.). No comparison group is needed to conclude that these numbers indicate a failure to adequately provide a basic education to African American students.

The opportunity gap persists and even widens as students age. In 2014, for the first time, the national high school graduation rate reached 80%, a milestone that was cause for great celebration among educators and policymakers (Balfanz et al., 2014). However, only 68% of African American students graduate from high school on time (Balfanz et al., 2014). For these students, the cost of the opportunity gap can be high. This disparity is mirrored in higher education attainment. Although African American students constitute 15% of undergraduates, a rate commensurate with the general population, the four-year graduation rate for African American college students is only 21%, as compared to 39% for the general population (NCES, 2013a). These statistics suggest that both the K-12 public school system and institutions of higher education have

an obligation to better prepare and support students of color with the academic skills they need to succeed in institutes of higher education.

Many K-12 school reform and improvement efforts have focused on improving achievement for these students (Payne, 2008). Darling-Hammond (2010) has argued that given the changing demographics of the United States, the success or failure of American public education will ultimately depend on this improvement. Some scholars and educators have looked to Montessori as a possible model for school reform (Borman, Hewes, Overman, & Brown, 2003; Lillard, 2005; Noguera, n.d.; Torrance, 2012; Zhao, n.d.). However, the question of how well Montessori fosters achievement for African American students in urban areas remains. Thus, the need for research on how effectively public Montessori schools serve these students is pressing.

Purpose of the Study

The purpose of this study is to evaluate the effectiveness of Montessori public school programs in urban settings for African American elementary school students. Specifically, this study will focus on third grade math and reading achievement for African American students in public Montessori programs in a large, urban district in North Carolina. Third grade reading scores have been found to be significant predictors of later academic achievement, especially for students of color (Hernandez, 2011). Acquiring the ability to read proficiently by the end of third grade is key to future academic success; while much instruction in grades K through three focuses on learning to read, from fourth grade on, students must read to learn (Fiester, 2010). Hernandez (2011) found that students who cannot read proficiently at grade three are four times more likely to drop out of high school than proficient readers.

Elementary math achievement is also an important indicator of future student outcomes. Research has confirmed the logical link between elementary mathematical skill and later math achievement (Bailey, Siegler, & Geary, 2014; Ritchie & Bates, 2013). The effects of elementary math learning extend beyond childhood. Ritchie and Bates (2013) found mathematical knowledge at age seven to be a powerful predictor of socioeconomic status at age 42. Examining elementary math learning for students of color is particularly salient, given the underrepresentation of African Americans in STEM (science, technology, engineering, and math) fields (National Science Foundation National Center for Science and Engineering Statistics, 2015). Improving math education for students of color may help to expand the pipeline of African American students entering STEM fields.

Thus, these metrics merit particular attention as both a measure of instructional quality and a predictor of future outcomes, both academic and otherwise. Furthermore, third grade marks the end of the lower elementary three-year cycle of Montessori instruction (American Montessori Society [AMS], 2014), and is therefore an appropriate time for summative assessment. This study will assess the viability of Montessori as an alternative form of instruction for African American students. The results of this study constitute a useful contribution to the ongoing conversation about educational reform and can help inform the implementation of the Montessori model in public school settings.

Research Questions

To this end, four research questions have been developed to guide this study:

- 1) Do African American third grade students in public Montessori programs in urban settings exhibit significantly different levels of achievement in math

compared to African American third grade students in similar school choice programs located within the same district?

- 2) Do African American third grade students in public Montessori programs in urban settings exhibit significantly different levels of achievement in reading compared to African American third grade students in similar school choice programs located within the same district?
- 3) Do African American third grade students in public Montessori programs in urban settings exhibit significantly different levels of achievement in math compared to African American third grade students in similar traditional public schools located within the same district?
- 4) Do African American third grade students in public Montessori programs in urban settings exhibit significantly different levels of achievement in reading compared to African American third grade students in similar traditional public schools located within the same district?

Hypotheses

Previous research on the effectiveness of Montessori in public school settings, particularly for students of color, has yielded mixed findings (Ansari & Winsler, 2014; Dohrmann, Nishida, Gartner, Lipsky, & Grimm, 2007; Lopata, Wallace, & Finn, 2005; Mallet, 2014; Mallet & Schroeder, 2015). Thus, non-directional null hypotheses have been formulated for each of the four research questions.

H_1 : There is no significant difference in levels of achievement in math for African American third grade students in public Montessori programs in urban

settings as compared to African American third grade students in similar school choice programs in the same district.

H₂: There is no significant difference in levels of achievement in reading for African American third grade students in public Montessori programs in urban settings as compared to African American third grade students in similar school choice programs in the same district.

H₃: There is no significant difference in levels of achievement in math for African American third grade students in public Montessori programs in urban settings as compared to African American third grade students in similar traditional public schools in the same district.

H₄: There is no significant difference in levels of achievement in reading for African American third grade students in public Montessori programs in urban settings as compared to African American third grade students in similar traditional public schools in the same district.

Theoretical Frameworks

This study will be conducted from a critical theoretical perspective with an epistemological grounding in positivism. This approach both intersects with and departs from the Montessori philosophy.

Critical Theory

Critical theory provides a perspective focused on social change, with an emphasis on marginalized and oppressed groups (Agger, 1991; Patton, 2002). In the context of American schools, African American students have historically been one such group (Anderson, 1988; Lewis et al., 2012). The purpose of this study is to evaluate the

effectiveness of Montessori as an instructional approach for these students, with the goal of informing policy and practice for school improvement and reform. Since this study is ultimately designed to effect social change to benefit African American students, critical theory is an appropriate theoretical framework for the task. This approach is consistent with the spirit of Montessori education as originally articulated by Maria Montessori. Dr. Montessori¹ developed the Montessori approach initially for students with disabilities, who were generally regarded as unteachable and were not granted access to public schools (Lillard, 2005; Whitescarver & Cossentino, 2008). The first Montessori school served children from a public housing project in a very poor neighborhood in Rome (Lillard, 2005; Whitescarver & Cossentino, 2008). Dr. Montessori viewed education as a tool for effecting social change and, ultimately, world peace (Maria Montessori, 1971). Given this historical context, critical theory fits well with the Montessori philosophy.

Positivism

Positivism is a paradigm frequently utilized in quantitative research (Mackenzie & Knipe, 2006). In the tradition of Auguste Comte, positivism asserts that researchers can apply scientific methods to the study of observable phenomena in order to deduce objective truths about reality (Mackenzie & Knipe, 2006). Though positivism has been extensively critiqued in recent years as being Eurocentric, decontextualized, and reductive, it remains the foundational premise for much research conducted in both the hard and social sciences (Kincheloe & Tobin, 2009). Assessing educational effectiveness through statistical analysis of scores from standardized formal assessments, as this study does, is a positivistic approach.

¹ For clarity, the method is referred to as Montessori, while the person is referred to as Dr. Montessori.

The positivistic elements of this study are somewhat more difficult to reconcile with Montessori philosophy than the critical elements. Formal assessment in and of itself is inconsistent with the Montessori approach; Dr. Montessori argued that teachers should assess student learning and growth holistically through close observation (Maria Montessori, 1967). Many goals of Montessori education, such as fostering peace and promoting a love of learning, are difficult to quantify and assess. Test scores and grades are thought to promote extrinsic motivation rather than the intrinsic love of learning that Montessori educators prioritize (Lillard, 2005). While testing and grades are inevitable in public education, the use of test scores alone to assess student learning presents an ideological conflict. However, as Whitehurst (2014) asserts, “the principal lever for K-12 public education reform for the last 40 years has been test-based accountability” (para. 1). The American Montessori Society specifically acknowledges this pressure to demonstrate student learning through achievement on standardized tests (Murray, 2010b). Because of the importance and influence of standardized test results on educational policy and reform, I have opted to retain this focus in this study. Furthermore, quantitative research, which typically has positivist leanings, still holds the greatest sway over policymakers (Eisenhart, 2001). Thus, a positivist evaluation of some educational outcomes in a Montessori setting is more likely to be influential. For these reasons, the use of the positivist lens is justified, in spite of its conflicts with Montessori philosophy.

Overview of Methods

This study employed a quasi-experimental study with a posttest-only intact group design. Since students are not randomly assigned to schools, especially in the case of special programs like Montessori, this design is more feasible than a true experimental

study. This study compared group mean reading and math test scores for African American third grade students in reading and math in Montessori, traditional, and other school choice settings within the same region of a single urban district in North Carolina. The sample consisted of African American students who have completed third grade at public Montessori schools, traditional schools, and other school choice programs within this district between 2007 and 2014. Because fidelity has been linked to academic outcomes (Lillard, 2012), markers of fidelity associated with the program are reported in chapter three. The Montessori students constituted the treatment group, while the students from the traditional schools and the other choice programs made up the comparison groups. Because children from families who select a choice program, like the Montessori schools included in this study, may be different from children from families who attend their neighborhood schools, comparison groups from both traditional and other choice programs were included. Stratified sampling was used to select traditional and magnet schools that were comparable to the Montessori schools on various demographic measures. Data consisted of scores on end-of-year standardized state reading and math tests from the 2006-2007 school year to the 2013-2014 school year. Factorial multivariate analysis of covariance (MANCOVA) and multivariate analysis of variance (MANOVA) were conducted to check for statistically significant differences among group mean reading and math scores.

Significance of the Study

This study adds to the body of literature surrounding effective practices and instructional approaches for African American students. Improved academic outcomes for these students would not only be a victory for social justice, but would also produce a

host of benefits for society at large. The average high school dropout incurs a cost of over \$37,000 annually to society due to incarceration, crime, health problems, and welfare benefits (Belfield, Levin, & Rosen, 2012). High school and college completion are related to more positive economic outcomes: the employment rate for college graduates in 2012 was 87%, compared to 64% for high school graduates and 48% for high school dropouts (Balfanz et al., 2014). The benefits of improved education are not just economic; Freudenberg and Ruglis (2007) demonstrate that high school completion is also correlated with more positive health outcomes. Thus, identifying effective educational practices to provide a solid early elementary academic foundation to improve these long-term outcomes for some of the most vulnerable and underserved students is a critical undertaking. This field of study will only play a larger part in conversations about improving public education as these populations continue to grow (Hussar & Bailey, 2014).

For school policymakers, this study can help inform decisions about the expansion and use of the Montessori approach in public schools. Between 2000 and 2014, 290 new public Montessori programs were implemented (NCMPS, 2014c). Research into how effectively these programs serve students of color is essential to understanding if these programs are a good investment. For Montessori educators, this study draws attention to and provides information about outcomes for African American students in Montessori programs. Several scholars within the Montessori community have argued that more research is needed in this area (Hall & Murray, 2011; Stansbury, 2012; Yezbick, 2007).

Definition of Terms

Academic achievement. For the purposes of this study, academic achievement refers to performance on formal, summative standardized assessments.

African American. This term refers to students who are classified as African American by their school system. Student ethnicity was determined from school records.

Effectiveness. Program effectiveness was determined by student performance on formal, summative standardized assessments.

Montessori program. Schools employing a Montessori program have multiage classes, Montessori-trained teachers, and a full complement of Montessori materials. For the purposes of this study, only public school Montessori programs were considered.

School choice program. This term refers to public schools that are a part of the local education agency, but require active selection on the part of the parent and/or student in order to attend. For the purposes of this study, this includes whole-school magnet programs, but not charter schools.

Similar. Similarity between treatment and comparison schools was determined based on the percentage of African American students and percentage of students who are eligible to receive free or reduced-price lunch (FRL).

Traditional public school. This term refers to public schools that are neither charter nor magnet schools. The majority of the students in the school come from a geographically delineated attendance zone. Parents and students do not apply to or select the school; attendance is by default.

Organization of the Study

This study is organized into five chapters. This first chapter provides an overview of the topic, research questions, methods, and the study's significance. The second

chapter provides a synthesis of the extant literature about academic outcomes for students in Montessori programs, with a focus on African American students specifically. The third chapter describes the research design and methods for data collection and analysis. In the fourth chapter, the results of the data analysis are provided and the research questions are answered. The fifth chapter discusses conclusions that can be drawn from the results and suggests directions for future research.

CHAPTER 2: REVIEW OF LITERATURE

The purpose of this study is to evaluate the effectiveness of the Montessori method for African American students in third grade reading and math. This review of the literature provides important context about the history and nature of the Montessori method, as well as a synthesis of relevant prior studies of outcomes for students in Montessori programs. The organization of this review of literature is depicted in Figure 1. This chapter opens with an account of the origin of the Montessori method in Italy, as well as a history of Montessori in the United States. A more detailed description of the philosophy and curriculum is also provided. Key issues in the field of public Montessori today are discussed, including the place of Montessori in debates about education reform, student demographics, and concerns about implementation and fidelity. The current state of Montessori literature is addressed. Conceptual and theoretical writings about the Montessori method and academic achievement are subsequently reviewed, with special attention to African American students. Next, empirical studies of academic achievement for Montessori students are synthesized, beginning with preschool studies. Although the age group differs from the population of interest for this study, the bulk of the existing studies on African American Montessori students specifically comes from this body of literature. A synthesis of the literature on African American students and the impact of the Montessori method is provided first, followed by a synthesis of studies with other populations. Studies of both public elementary school Montessori settings, with African

American and other students, are then reviewed. Lastly, this literature is summarized in the context of the current study. This review of the literature indicates that a study highlighting outcomes for African American students specifically at the elementary level is needed.

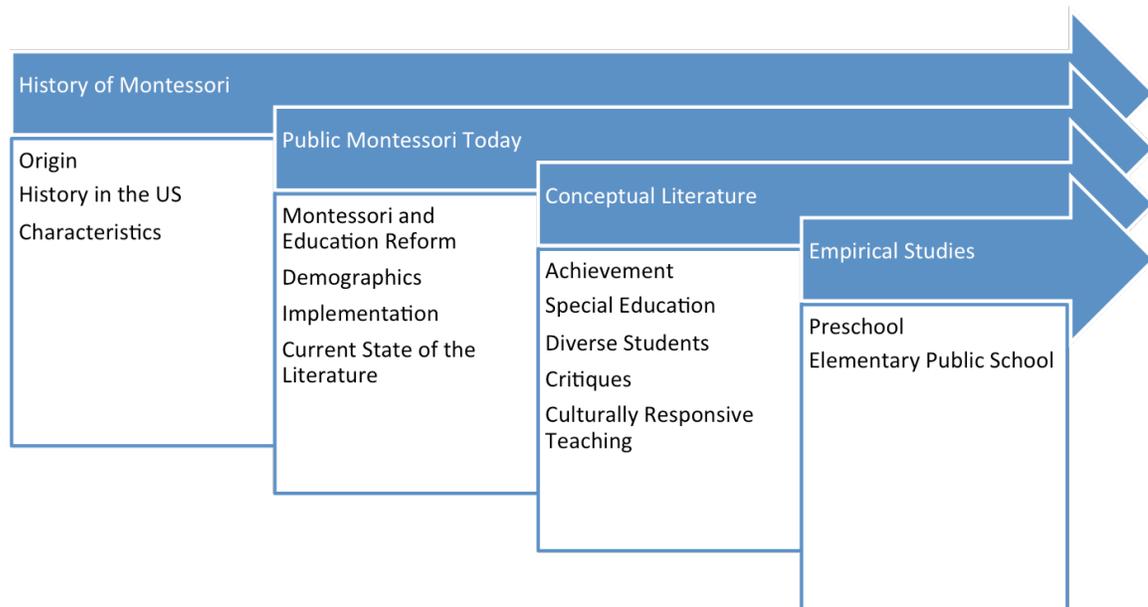


Figure 1: Organization of literature review

History of Montessori

Origin

The origin story of Montessori has been told by numerous scholars and writers (Donabella & Rule, 2008; Lillard, 2005; Whitescarver & Cossentino, 2008); indeed, this story has taken on an almost legendary quality among Montessorians. The method was developed in Italy in the early 1900s by Maria Montessori, who originally trained as a

physician (Donabella & Rule, 2008; Lillard, 2005; Whitescarver & Cossentino, 2008). Influenced by the work of Jean Itard and Edouard Seguin, Dr. Montessori became interested in working with children with disabilities (Lillard, 2005; Whitescarver & Cossentino, 2008). According to Lillard (2005), the public school system deemed these children unteachable; they were essentially discarded from society. Dr. Montessori developed a special set of physical materials to teach these children. Under her supervision, these children were eventually able to achieve on par with their non-disabled peers. Based on this success, she adapted her method and materials for use with non-disabled students. In 1907, Dr. Montessori opened her first school, the *Casa dei Bambini*, or Children's House, in Rome. This school was located in a housing development for impoverished factory workers and their families. She went on to open additional schools and train teachers throughout Europe and beyond (Lillard, 2005; Whitescarver & Cossentino, 2008). Diamond and Lee (2011) assert that Montessori now has the "widest geographical spread of any education program" (p. 962), with schools in over 100 countries on six different continents.

Montessori in the United States

Although the Montessori method originated in Europe, it spread to the United States fairly quickly after its inception, where its popularity has since fluctuated. Whitescarver and Cossentino (2008) provide a helpful history of the Montessori method in the United States, while the National Center for Montessori in the Public Sector (NCMPS) has published a similar history (2014c) with a special emphasis on the evolution of public school Montessori. Whitescarver and Cossentino (2008) identify three phases of Montessori adoption in American schools, while NCMPS (2014c) identifies an

additional distinct period. The first phase, according to both sources, occurred in the 1910s, just a few short years after the first *Casa dei Bambini* debuted in Rome. During this time, according to Whitescarver and Cossentino (2008), Montessori enjoyed a brief burst of popularity in elite New York private schools serving an exclusive, high-socioeconomic status (SES) group. NCMPS (2014c) cites examples of free, public Montessori programs operating in Los Angeles and New York during these years as well. For a few years, Montessori enjoyed widespread acclaim both in popular media and within the education establishment. A prominent and widely read critique by William Heard Kilpatrick of Teachers College, published in 1914, marked the beginning of the end for this phase of Montessori, as the method quickly fell out of favor. Kilpatrick denounced the Montessori method as unscientific and inconsistent with child development. Whitescarver and Cossentino (2008) suggest that Dr. Montessori's status as both a foreigner and a woman worked against her; other American teacher educators were hesitant to come to her defense in the wake of Kilpatrick's attack. By the end of World War I, most of the Montessori schools opened in the U.S. during this initial frenzy had closed (Whitescarver & Cossentino, 2008).

American Montessori enjoyed a resurgence in the 1960s and 1970s (NCMPS, 2014c; Whitescarver & Cossentino, 2008). Whitescarver and Cossentino (2008) highlight the popularity of Montessori private schools serving middle- and upper-class suburban families during this epoch. At the same time, according to NCMPS (2014c), Montessori was adopted as a component of the War on Poverty and employed in compensatory early childhood education programs like Head Start. This second phase also saw the birth of the American Montessori Society (AMS), founded by Nancy McCormick Rambusch in

1958. Rambusch worked to make Montessori more compatible with mainstream American educational institutions; this included establishing Montessori teacher training programs at American universities and incorporating some traditional American classroom equipment into the established set of Montessori materials (Rambusch, 2007/1976; Whitescarver & Cossentino, 2008). NCMPS (2014c) identifies an additional phase of American Montessori during the years of 1975 to 1989, when Montessori magnet programs were employed strategically in urban areas to encourage voluntary desegregation. Khan (1990) also alludes to the role Montessori played in some districts' desegregation efforts.

The last phase, according to both Whitescarver and Cossentino (2008) and NCMPS (2014c), began in the 1990s and continues into the present day. This phase, they suggest, is marked by the growth of Montessori programs in public schools. NCMPS (2014c) notes that this expansion has been linked to the school choice movement and efforts to close the so-called "achievement gap" between White, middle-class students and students of color in low-income communities. Not surprisingly, this growth parallels the birth and expansion of charter schools; most of the whole-school Montessori programs opened since 2000 are charters (NCMPS, 2014c). As of this writing, there are over 500 public schools offering Montessori instruction in the United States (NCMPS, n.d.).

Whitescarver and Cossentino's (2008) narrative highlights the historical roots of American Montessori in private schools. Indeed, the vast majority of Montessori schools in operation today are private schools (Murray, 2015). This history, and the sheer number of private Montessori schools, likely explains why Montessori is widely perceived as an

elite, private school pedagogy (Murray, 2012). NCMPS (2014c), however, offers a counternarrative, demonstrating that Montessori also has a history of being deployed to advance social justice causes.

Characteristics of the Montessori Method

Montessori is not just a curriculum, but rather a comprehensive philosophy of child development that informs a unique pedagogy. Lillard (2005) identifies the following eight key elements of the Montessori philosophy:

1. Movement and learning are closely related.
2. Children learn better when they have a sense of control over their learning.
3. Children learn best when they are interested in what they are learning.
4. Extrinsic rewards ultimately damage motivation to learn.
5. Collaboration fosters learning.
6. Meaningful contexts enhance learning.
7. Optimal adult-child relationships occur when adults adopt an authoritative style.
8. Children learn best in highly ordered, structured environments (p. 29-33).

Lillard (2005) contrasts this approach with the Lockean concept of the child as a blank slate, and the Tayloristic depiction of the school as a factory. These paradigms employ what Freire (1970) terms the “banking” model of education, wherein knowledge is a static thing transferred from teacher to student. Montessorians assert that every child contains unique and limitless potential; the role of the teacher is to guide children and help them develop on their own terms and in their own time (AMS, n.d.b).

In practice, Montessori classrooms are characterized by multiage student groupings, long periods of uninterrupted student work time, and high levels of student

autonomy (Lillard, 2005). One common misconception is that Montessori is a play-based approach; in fact, students and teachers view all of students' classroom activity as serious work (Lillard, 2013). The Montessori motto is "follow the child"; the role of the teacher is to guide and facilitate activities for individual students and small groups rather than lead the class in whole-group, direct instruction. Students are not expected to progress lockstep through the curriculum with their peers, but rather advance at their own pace. Learning is facilitated through the use of specialized, hands-on Montessori materials. Teachers assess student learning through close observation rather than through formal testing. To nurture children's intrinsic love of learning, extrinsic reward mechanisms such as grades, prizes, and competition are avoided (Lillard, 2005).

Public School Montessori Today

Montessori and Education Reform

According to Breitborde and Swiniarski (2006), the modern education reform movement was sparked by the publication of the landmark 1983 report, *A Nation at Risk*. While civil rights and school desegregation had been major foci for educational reformers during the 1960s and 1970s, *A Nation at Risk* changed the national conversation from school integration to educational standards and quality (Breitborde & Swiniarski, 2006). The report decried the state of American public education, pointing to "a rising tide of mediocrity that threatens our very future as a Nation and a people" (NCEE, 1983, p. 5). To address the problem of underachievement among American students, the authors of the report recommended more rigorous high school graduation requirements, higher academic standards, increased learning time, and better teacher preparation (NCEE, 1983). This call to action spawned the standards-based education reform movement of

the 1980s and 1990s, culminating in the passage of the 2001 reauthorization of the Elementary and Secondary Education Act known as No Child Left Behind (NCLB) (Breitborde & Swiniarski, 2006).

The passage of NCLB ushered in an era of increased federal accountability and heavy reliance on standardized test scores (Breitborde & Swiniarski, 2006). Per the law, which remained in effect until 2015, schools were responsible for ensuring that all teachers are “highly qualified” in the subject(s) they teach, which often meant meeting state requirements for licensure in that subject area or areas (Swain, 2013). Schools were also responsible for making adequate yearly progress, or AYP, toward having 100% of their students achieve proficiency on end-of-grade tests in reading and math (Breitborde & Swiniarski, 2006; Zinn et al., 2002). This heavy reliance on end-of-grade standardized tests as measures of efficacy for schools and districts made these assessments very high-stakes, leading to backlash from some parents, educators, and scholars (Darling-Hammond & Hill, 2015; Erskine, 2014). Though NCLB is no longer the law of the land, much of this testing infrastructure remains in place at the school and district level. A small but vocal “opt-out” movement has emerged, consisting largely of parents who have expressed their dissatisfaction with schools’ myopic focus on standardized testing by refusing to allow their children to participate in end-of-year assessments (Stitzlein, 2015). Because standardized assessments are deemphasized or absent in Montessori contexts (Lillard, 2005), some of these discontented parents and educators find Montessori attractive (Noguera, n.d.; Zhao, n.d.).

Another central goal of NCLB was to close the “achievement gap” by holding schools accountable for student growth overall and by subgroup (Breitborde &

Swiniarski, 2006). Student test scores are disaggregated by race, free or reduced-price lunch (FRL) status, disability status, and English language proficiency (Zinn et al., 2002). While NCLB both failed to eliminate the “achievement gap” (Lee & Orfield, 2006) and missed the goal of achieving 100% proficiency in reading and math by 2013-2014, some scholars argue that this piece of legislation at least succeeded in prioritizing academic achievement for students from historically marginalized groups (Hall, 2013; Haycock, 2006). Unfortunately, this increased awareness and attention has, on the whole, not resulted in the closing of the “achievement gap” for students of color (Darling-Hammond, 2015; Hall, 2013; Lee & Orfield, 2006). Thus, the debate about policies and practices to improve education for these students remains ongoing.

While some scholars and policymakers have debated standards-based reform, others (Lillard, 2005; Kivunja, 2015; Trilling & Fidel, 2009) advocate for a more radical rethinking of the structure and nature of public education. The modern public school system is heavily influenced by the industrial model and the accompanying philosophy of scientific management espoused by Frederic Taylor (deMarrais & LeCompte, 1999). In the early decades of the 20th century, schools across the United States were made to resemble factories, with uniform batches of students moving lockstep through the school the same way materials would move down an assembly line (deMarrais & LeCompte, 1999; Lillard, 2005). Lillard (2005) argues that this model was an effective approach to producing workers for a factory-based economy. Given the recent move to a knowledge-based economy (Kivunja, 2015), however, some scholars (Lillard, 2005; Trilling & Fidel, 2009) have argued that this model is no longer appropriate for preparing students to succeed in the 21st century. The set of skills deemed necessary to survive and thrive

within this new paradigm has been articulated as the Framework for 21st Century Learning (Partnership for 21st Century Skills, n.d.). Whereas traditional approaches to education have often been characterized by a behavioristic emphasis on obedience, rote memorization, and uniformity (deMarrais & LeCompte, 1999; Lillard, 2005), the 21st century skills model emphasizes innovation, collaboration, and critical thinking (Partnership for 21st Century Skills, n.d.). Several new models of schooling have been proposed to incubate these alternative skills, such as inquiry-based learning (Kuhlthau & Maniotes, 2010), the flipped classroom (Herreid & Schiller, 2013), and critical media pedagogy (Morrell, Dueñas, Garcia, & Lopez, 2013). Scholars such as Lillard (2005), Zhao (n.d.), and Torrance (2012) argue that Montessori is another such model that can foster these skills.

Whether incited by NCLB and the persistent opportunity gap or the movement toward 21st century skills, conversations in educational reform reflect a desire for change. These conversations have created a space for Montessori to be considered along with other nontraditional educational approaches as a way to meet this perceived need for change.

African American Students in Public Montessori Schools

Recent research (Debs, 2015; Murray & Peyton, 2008; The Riley Institute, 2015b) indicates that public Montessori schools serve a significant number of African American students. A 2005 survey of public Montessori schools indicated that at this time, students of color constituted a majority in one-third of public Montessori schools and on average, made up 34% of the student population in the schools surveyed (Murray & Peyton, 2008). These numbers have increased in the intervening decade; Debs (2015) found that

the student population in whole-school public Montessori programs is 56% non-White and 28% African American (Debs, 2015). In South Carolina, one of the states with the most public Montessori programs (NCMPS, 2014a), 32% of all public Montessori students in 2012-2013 were African American (The Riley Institute, 2015b). Both Debs (2015) and the Riley Institute (2015b) found that public Montessori programs tend to be less racially diverse than the general populations of their surrounding school districts. Still, these findings indicate that African American students make up a substantial part of the public Montessori student population, especially given that African American students make up only 15% of students in grade K through eight in public schools nationwide (Hussar & Bailey, 2014). Yet, research about how effectively Montessori programs serve these students is lacking (Ansari & Winsler, 2014; Hall & Murray, 2011; Stansbury, 2012; Yezbick, 2007). Given the significant presence of students of color in public Montessori schools, research on the efficacy of Montessori for these students is critical.

Issues of Implementation and Fidelity

Authenticity is one contentious issue surrounding the implementation of the Montessori method, particularly in public schools (Murray & Peyton, 2008). Program fidelity is an important consideration for researchers because student outcomes have been shown to be related to program fidelity (Lillard, 2012). Although private Montessori schools also vary in their level of authenticity, issues like testing, teacher training, materials, and school infrastructure are often cited as challenges unique to public school settings (Murray & Peyton, 2008). Both AMS (n.d.a) and NCMPS (2014b) have issued guidelines for authentic Montessori practice in public school settings. According to these

organizations, key components of a high-fidelity public school Montessori program include Montessori-trained teachers, Montessori-supportive administrators, complete sets of Montessori materials, a two- to three-hour daily independent work period, multiage student groupings, and a multidimensional approach to assessment. Financial investment, training, leadership, and buy-in from all educational stakeholders are key to successfully launching a high-quality Montessori program in a public school (Cordoba-Jackson, 2007).

Unfortunately, recent data on how public schools implement Montessori in practice are limited. The most recent national data come from a 2005 survey conducted by Murray and Peyton (2008). These data suggest that implementation does vary. This survey included a geographically representative sample of schools constituting approximately one-third of the public Montessori schools in operation at that time. The majority of these schools reported having teachers who had completed or were enrolled in Montessori teacher training. Approximately three-fourths reported having a full complement of Montessori instructional materials in every room. The average daily independent work period reported was 2.4 hours. The vast majority of schools (85%) employed three-year, multiage groupings (Murray & Peyton, 2008).

The Riley Institute (2014, 2015a) supplied more recent data about Montessori implementation in public schools as part of a larger, ongoing study of public school Montessori in South Carolina. Although these data are limited to a single state, they are significant because South Carolina has the second-largest public Montessori presence in the country, with 40 schools (NCMPS, 2014a). The Riley Institute's (2014) survey of South Carolina public Montessori schools, with a robust 95% response rate from

principals, paints a picture of somewhat questionable fidelity. Montessori teacher training is widespread, with 69% of teachers having obtained Montessori credentials and 28% of teachers in the process of earning them. However, only 70% of principals reported that all of their classrooms are outfitted with a complete set of Montessori materials, and less than two-thirds said their classrooms are multiage. Approximately two-thirds of South Carolina public Montessori schools have a daily independent work cycle of two and a half hours or more (The Riley Institute, 2014). These survey data are supplemented by data from classroom observations conducted by the Riley Institute (2015a) in 54 public Montessori classrooms using a classroom observation protocol informed by AMS (n.d.a) guidelines. Scores from these observations ranged from 73% to 94%, which reinforces findings from the survey (The Riley Institute, 2015a). Overall, these data suggest that Montessori is implemented in public school settings with varying degrees of success. This variation complicates research and evaluation, because fidelity of implementation of the Montessori model has been shown to impact student outcomes (Lillard, 2012). This review of the literature indicates a greater need for studies of student outcomes in high-fidelity public Montessori programs, particularly for African American students, as well as documentation of program practices by researchers.

Current State of the Literature

Scholarly interest in Montessori has increased in recent years. The Montessori method was included as one of 29 comprehensive school reform models considered by Borman, Hewes, Overman, and Brown in a 2003 meta-analysis. Although only two studies of Montessori elementary programs were included in the meta-analysis, these authors concluded that the method yielded “promising evidence of effectiveness” (p. 157)

and called for additional research. The scholarly community responded. Bagby (2007) conducted a review of articles about Montessori published in non-Montessori journals between 1996 and 2006; this search yielded 54 articles. Bagby and Jones (2010) later repeated this process and found that 25 additional articles were published between 2007 and 2009. Most recently, Bagby, Wells, Edmondson, and Thompson (2014) identified 74 more articles about Montessori published between 2010 and 2013. Taken together, these findings suggest a marked increase in scholarly interest in the Montessori method.

However, the literature as a whole reflects a lack of attention to outcomes for African American elementary students. As several scholars (Ansari & Winsler, 2014; Lillard, 2012; Stansbury, 2012; Yezbick, 2007) have pointed out, much of the extant Montessori research has been conducted with racially homogenous student populations. While a number of studies of Montessori preschool for African American children were conducted in the 1960s and 1970s (Bereiter, 1967; Berger, 1970; Karnes, 1969; Karnes, Shwedel, & Williams, 1983; Kohlberg, 1968; Miller & Bizzell, 1983, 1984; Miller, Dyer, Stevenson, & White, 1975), few studies of Montessori elementary school (Mallett, 2014) have explicitly examined outcomes for African American students. While many studies of Montessori public elementary education include racially heterogeneous student populations (Cisneros, 1994; Curtis, 1993; Dohrmann et al., 2007; Lopata et al., 2005; Mallett & Schroeder, 2015), these studies often neglect to disaggregate their findings by race. In the most widely cited study of public Montessori education (Lillard & Else-Quest, 2006), racial information about student participants was not even collected. These studies represent an attempt to examine Montessori in the context of diverse public school populations, but do not provide specific information about how African American

students as a subgroup fare in public Montessori elementary programs. The American Montessori Society acknowledges this gap in the literature, and has called for further inquiry into outcomes for African American Montessori students (Hall & Murray, 2011). This suggests that the current study is both timely and warranted.

AMS has also issued white papers identifying opportunities for research, as well as obstacles researchers may encounter (Murray, 2010a, 2010b). They acknowledge the challenge of identifying appropriate measures for evaluating outcomes, as well as the variations in program fidelity and implementation that occur in the public sector (Murray, 2010a). Nonetheless, AMS also recognizes the need for research on outcomes for Montessori students, including performance on standardized tests (Murray, 2010b). This constitutes an acknowledgement of the importance of standardized test results for public Montessori programs' continued existence and expansion, and suggests that the use of these measures to evaluate some dimensions of public Montessori programs is warranted. This research is needed to guide and inform the growth of public school Montessori programs serving an increasingly diverse student population.

Conceptual Literature

Various scholars have published conceptual or theoretical work examining how the Montessori method does, or does not, support student achievement. Here, conceptual pieces relating Montessori to general student learning, students with disabilities, and racially and culturally diverse student populations are reviewed. Conceptual critiques of the Montessori approach are considered as well. Specific examples of Montessori programs serving racially and culturally diverse students, and African American students specifically, are also discussed.

Characteristics of Montessori Conducive to Academic Achievement

Several authors have written about how the Montessori approach theoretically supports learning for all students, regardless of race. Executive function, which encompasses a set of cognitive and emotional skills around self-control and self-regulation, is related to academic achievement (Monette, Bigras, & Guay, 2011). Some scholars (Diamond & Lee, 2011; Howell, Sulak, Bagby, Diaz, & Thompson, 2013) describe how Montessori education can help students develop executive function. Diamond and Lee (2011) argue that the Montessori term “normalization,” which encompasses the ability to engage in extended concentration and resist distraction (Lillard, 2005), can be thought of as representing aspects of executive function like impulse control and orderliness. Howell et al. (2013) describe in detail how the Montessori method promotes planning, organization, and time management in students—three aspects of executive function.

Murray (2011) and Torrance (2012) apply contemporary frameworks of teaching and learning to the relatively old Montessori paradigm. Murray (2011) addresses the issue of motivation in the Montessori classroom. Fostering intrinsic motivation is one of the primary goals of Montessori educators (Lillard, 2005). Murray identifies key components of contemporary theories of motivation espoused by leading scholars in this area and cross-references these with elements of Montessori practice. She details specific Montessori practices that encourage motivation by promoting student autonomy, interest, relatedness, and competence. A qualitative study of Montessori science instruction by Rinke, Gimbel, and Haskell (2013) suggests that Montessori practice supports inquiry in several key ways, including providing opportunities for communication about science

and fostering genuine curiosity and interest. Torrance (2012) also compares the Montessori method to a more modern school of thought: 21st century skills. Torrance argues that although Montessori is an old pedagogy, it aligns with 21st century skills in many ways, and can even provide a blueprint for rethinking schooling to meet modern needs.

Montessori and Special Education

Several authors (Cossentino, 2010; Lillard, 2005; McKenzie & Zascavage, 2011; McKenzie, Zascavage, & Murray, 2011; Orem, 1969; Pickering, 2003; Richardson, 1997) have also highlighted significant overlap between the Montessori method and best practices for teaching students with special needs. Given the disproportionate numbers of African American students in special education (Lewis et al., 2012; Losen & Orfield, 2002; Skiba et al., 2008), the intersection of Montessori and special education merits consideration. Cossentino (2010) noted the numerous similarities between the Montessori method and programs such as Response to Intervention, Head Start, and enumerated best practices for teaching students with ADHD. Lillard (2005) likewise asserted that “children with attention deficit disorders might benefit particularly from the emphasis on focused concentration and routines” (p. 338). Cossentino (2010) argued that the flexibility and individualization of Montessori practice are a natural fit with the principles of special education. Noting Dr. Montessori’s early work with students with disabilities, Cossentino (2010) suggested that the *Casa dei Bambini* could be thought of as the first inclusion classroom. This point is noteworthy because the inclusion model can help address “the issue of racial isolation resulting from segregation based on disability” (Connor & Ferri, 2007, p. 69). This literature suggests that the Montessori approach can

be beneficial for students with learning disabilities, and in particular, can create a more inclusive, integrated educational environment for African American students who have been identified for special education.

Pickering (2003) cites anecdotal evidence that Montessori schools often serve higher-than-average concentrations of students with learning disabilities, precisely because the Montessori method is conducive to accommodating these students' needs. McKenzie and Zascavage (2012) examined Montessori instructional methods in light of identified characteristics of effective special education. They found that the Montessori method of early childhood education exemplifies these characteristics in the areas of scope and sequence, curriculum, pacing, and types of learning. McKenzie, Zascavage, and Murray (2011) drew similar conclusions about the Montessori math curriculum in particular.

Richardson (1997) made the same argument about early literacy skills. She described how the Montessori preschool curriculum prepares students for reading and writing, particularly students with dyslexia. Lillard (2005) also suggested that the Montessori emphasis on phonics may be beneficial for children with dyslexia. A recent meta-analysis suggests that African American students, with or without learning disabilities, also benefit from this phonics-based approach (Jeynes, 2008). While these pieces are largely theoretical, and mostly geared toward the primary rather than elementary level, these authors provide compelling reasons why the Montessori method may support achievement for students in special education, particularly African American students.

Montessori for Culturally Diverse Students

Although it may not be readily apparent how a curriculum designed in Italy in the early 1900s can serve culturally and linguistically diverse students in the United States today, several authors have attempted to address this topic. Speaking to the American context specifically, Nancy McCormick Rambusch (2007/1976) asserted that Montessori has the potential to improve educational outcomes for urban African American children, who, she asserted, were being shortchanged in traditional public schools. She noted that many of the private Montessori schools opened in the 1960s and 1970s were somewhat homogenous, since they were often started by a group of parents for their own children, and identified specific challenges and adaptations that must be considered in order to move Montessori into large-scale, public school settings. Addressing diversity and equity, she argued, would be paramount in order to make this transition.

While Rambusch argued that there was a place for African American children in Montessori schools, other authors have demonstrated that there is a place for African American culture in the Montessori classroom. Mario Montessori (1976), Dr. Montessori's son and successor, argued that schools should be a "cultural environment," where students could "become familiar with the basic aspects of their own culture...[and] enlarge their cultural horizon" (p. 42). This statement reflects an acknowledgement of the important role of culture and diversity in the Montessori classroom. Renton (1998) addressed the issue of linguistic diversity. She advocated for an asset-based approach to students' home languages, in the same way their home cultures are viewed as an asset to be leveraged in the classroom. This same lens can be applied to African American Vernacular English (Wolfram & Thomas, 2002), the home language of many African American students. These authors articulate the Montessori principle of respect for

students' home cultures, a principle that has the potential to benefit African American students.

Montessori and Culturally Responsive Teaching

Many scholars studying academic achievement for African American children have called for a culturally responsive model of teaching and learning (Gay, 2010; Ladson-Billings, 1995). Ladson-Billings (1995) described culturally responsive teaching (CRT) as “a dynamic or synergistic relationship between home/community culture and school culture” (p. 467); that is, the cultures students experience outside the classroom are used to inform the way learning is facilitated inside of it. This section includes a synthesis of articles that describe how Montessori can be deployed in a culturally responsive way, as well as an account of specific examples of Montessori education in communities serving African American and other non-White or international populations.

Rationale for Montessori as CRT. The literature in this area indicates that while the Montessori method itself may not be inherently culturally responsive, it can be administered in a culturally responsive way. As in any other educational setting, CRT in Montessori is ultimately dependent on the presence of educators who are prepared and willing to teach in this way, but the curriculum itself does not create a barrier to doing so. In her qualitative study of Montessori teachers in a racially diverse suburban public school, Yezbick (2007) found that while participants were quick to discuss their students' cultures, they were hesitant to acknowledge their own, and distanced themselves from issues of race. Yezbick concluded that Montessori schools face many of the same challenges as traditional schools in implementing CRT. Stansbury (2012) reached a similar conclusion in her qualitative study of administrator, parent, and teacher

perceptions of race in a public Montessori program serving 25% African American students. She concluded that teacher diversity, “colorblind” rhetoric, and racially disparate discipline are issues in Montessori schools as well as traditional schools, though the Montessori social studies curriculum is less biased than that often found in traditional schools. These studies suggest that CRT is not necessarily embedded in Montessori practice.

Hall and Murray (2011), however, identified intersections between Montessori methods and culturally responsive teaching techniques for African American students. They position Montessori as an alternative to the behaviorist approach to teaching and learning so often found in high-poverty urban schools serving large populations of students of color. They point out that the individualization, flexibility, autonomy, and strong relationships fostered by the Montessori approach are consistent with best practice for teaching African American children. Specifically, Hall and Murray argue that Montessori’s emphasis on cooperative learning and multimodal learning promotes engagement and learning for African American students.

Others (Rule & Kyle, 2009) suggest that the Montessori philosophy is useful to promote interracial understanding and integration. Rule and Kyle (2009) described their experience with the simultaneous initiation of a Montessori program and racial integration at their school. They asserted that “the Montessori ideals of peace and conflict resolution” (p. 293) helped the staff and students navigate the transition from a predominantly African American neighborhood school to an integrated magnet school. Brown and Steele (2015) found that racial discipline disproportionality for African American students was less pronounced in public Montessori schools than in comparable

non-Montessori schools. These authors (Brown & Steele, 2015; Hall & Murray, 2011; Rule & Kyle, 2009) suggest that the Montessori method can be applied in a culturally responsive way with African American students, although Montessori teachers, like any teachers, need the appropriate training and dispositions.

Examples of Montessori in culturally diverse settings. Accounts of Montessori being employed in a wide variety of culturally diverse settings can be found in literature ranging from scholarly qualitative studies to anecdotal accounts in the popular press. While these accounts do not focus on African American students exclusively, they do demonstrate that contrary to popular opinion (Murray, 2012), the Montessori method can be used and is being used with populations beyond White, middle-class children in suburban America.

During the 1960s and 1970s, the Montessori method enjoyed popularity as a method of compensatory education in service of the War on Poverty (NCMPS, 2014c). Numerous programs to serve low-SES African American children emerged during this period. Some, like the Ancona Montessori School (Kholberg, 1968; Stodolsky & Karlson, 1972) and the Sands School Project (Banta, 1968) are discussed in the context of empirical studies later in this chapter. Another such program was a Montessori school founded by Malcolm X's cousin to serve African American children in Compton (Jones, 1968). In a newspaper interview, Hakim Jamal, the school's founder, describes how the school was inspired by and infused with African American identity and empowerment (Jones, 1968). This school is a noteworthy example of how the Montessori method can be used by and for African American communities.

Accounts of Montessori with other non-White populations provide additional evidence that the method is not limited to White, middle-class communities. Robinson (2006) described a public Montessori program successfully serving a diverse community in Fort Wayne, Indiana. Lopez (1992) discussed a Montessori program in California serving children of migrant families and English language learners. According to Lopez, the Montessori approach was selected because of its cultural adaptability and because the Montessori values of independence, interdependence, care for others, and care for the environment align with the culture of the population served by the program. Several scholars (Campbell, 1998; Hixon, 2002; Schonleber, 2011) have documented the use of Montessori education with Native American tribes and indigenous cultures. These authors conclude that the Montessori method was compatible with schools' existing language and culture immersion programs. After conducting extensive interviews and observations, Schonleber (2011) concluded that the Montessori approach actually facilitates the implementation of the native Hawaiian language and culture immersion program at the school she studied. This study provides a detailed look at how Montessori can be used in a culturally responsive way. Hixon (2002) and Campbell (1998) both note the compatibility between the Montessori philosophy and Native American approaches to learning.

In her qualitative study, Schnepf (2010) examined Montessori programs in Tanzania and Russia to determine how diverse cultural contexts impact the implementation of the Montessori model. She found that while educators in both places implement Montessori in a culturally contextualized way, the primary barrier to high-quality implementation is lack of funding rather than cultural differences. These studies

are a testament to the potential compatibility of Montessori and CRT when the two initiatives are implemented with intention. Hoke (2014) asserts that Montessori programs continue to grow in Tanzania. This growth speaks to Montessori's popularity in a broad and diverse global community.

The literature also contains accounts of Montessori in Asia. Kai (2009) describes the adoption of Montessori in Japan, with adaptations to suit the needs of Japanese culture and society. At a Montessori preschool in Bangalore, India, three local cultural practices are integrated into the classrooms: meditation, rangoli art, and eating on the floor (Adair & Bhaskaran, 2010). These practices help make Montessori authentic and culturally relevant in this setting. Lau and Yau (2015) describe how they navigate the cultural context of Hong Kong make the Montessori philosophy accessible to parents at their Montessori school.

These accounts from all over the globe show that Montessori is being implemented in culturally responsive ways with a wide variety of cultures. Although the curriculum originated in Europe, this literature suggests that it does not have to be Eurocentric. If the Montessori method is sufficiently flexible to fit with the languages and cultures of Native American tribes, urban centers in India, and remote parts of Tanzania, then there is reason to believe that it can be adapted for African American students as well.

Critiques

Not all of the conceptual literature surrounding the Montessori method is complimentary. Some scholars (Barron, 2002; Brunold-Conesa, 2008; Debs, 2015; Grillo, 1998; Jacobson, 2007; Pitcher, 1966) have critiqued the method for its perceived

shortcomings and/or incompatibility with the realities of American public education. Pitcher (1966) decried the orthodoxy of the Montessori community, describing it in cult-like terms. Other critiques are more even-handed; Jacobson (2007) highlighted the incompatibility of the Montessori philosophy and the standardized testing that is currently so pervasive in American schools, leading to questions about the future of public school Montessori. Debs (2015) noted that public Montessori schools are often less racially and socioeconomically diverse than the communities they serve, and offers recommendations for improved recruiting and marketing practices to promote equal access. Grillo (1998) considered various models of multicultural education and concluded that better integration of true multicultural education in Montessori is needed. In her postmodern evaluation of the Montessori method, Barron (2002) found that Montessori schools could do a better job of dealing with teacher bias in observation and assessment, recognizing and appreciating diverse parents' perspectives, and fostering divergent thinking. Brunold-Conesa (2008), though generally endorsing Montessori, pointed out that the child-centered nature of Montessori teaching may clash with the teacher-centered philosophies that prevail in some cultures. These critiques demonstrate that the scholarly debate about the value of the Montessori approach is ongoing.

Empirical Studies of Academic Achievement for Montessori Students

Preschool Studies

Because of the popularity of Montessori as an early childhood educational approach, a substantial portion of the studies of outcomes for Montessori students are conducted at the preschool level. Although this study pertains to third grade students, the efficacy of Montessori in earlier grades may be a relevant predictor of its efficacy at this

level. While the curriculum and Montessori materials necessarily change as students advance in level, the fundamental classroom characteristics—the independent work time, the teacher-as-guide, the individual pacing—remain the same. Thus, making inferences about Montessori elementary based on studies of Montessori preschool is not wholly inappropriate. Further, the majority of studies yielding results for African American students specifically were conducted at the preschool level; many elementary school studies have been conducted with diverse student populations, but few disaggregate results by race. For these reasons, preschool studies are included in this review of literature. Likewise, although studies conducted with African American students are of the greatest relevance to this study, findings from studies with other populations are also reviewed to shed light on the scholarly evidence for the efficacy of the Montessori method.

Preschool studies with African American students. During the 1960s and 1970s, there was a great deal of interest in Montessori as an early childhood educational approach to ameliorate the effects of poverty (NCMPS, 2014c). Many of the studies initiated during this era reflect this focus; SES is the focal variable in these studies rather than race, although the studies cited here all include African American students. As such, with few exceptions (Ansari & Winsler, 2014; Karnes, 1969), results from these studies are not fully disaggregated by race, which limits the interpretation of these studies. These studies also frequently conflate race and SES. Literature from this period (Bereiter, 1967; Karnes, 1969; Kohlberg, 1968; Mieзитis, 1971; Mills & McDaniels, 1966; Orem, 1967) also reflects a deficit orientation toward low-income children and children of color that was pervasive during this era (and persists to this day in some circles). Mieзитis (1971)

makes reference to the “educational liabilities” of low-SES children (p. 50), while the title of Kohlberg’s (1968) text is “Montessori with the Culturally Disadvantaged”.

The authenticity of the Montessori programs involved in some of these studies is dubious (Karnes, 1969; Karnes et al., 1983; Miller & Bizzell, 1983, 1984; Miller, Dyer, Stevenson, & White, 1975). In others, exposure is limited to a single year (Ansari & Winsler, 2014; Karnes, 1969; Karnes et al., 1983; Berger, 1970; Miller & Bizzell, 1983, 1984; Miller et al., 1975). These studies, such as they are, suggest no immediate advantages of Montessori preschool over other curricula for African American students, while longitudinal studies (Karnes et al., 1983; Miller & Bizzell, 1983, 1984; Takacs & Clifford, 1988) suggest that long-term benefits may emerge over time.

Cross-sectional studies of Montessori preschool for African American students (Ansari & Winsler, 2014; Berger, 1970; DiLorenzo, 1969; Karnes, 1969; Kohlberg, 1968; Stodolsky & Karlson, 1972; Wexley, Guidubaldi, & Kehle, 1974) generally fail to provide compelling evidence of the efficacy of Montessori instruction. Karnes (1969), Berger (1970), and Ansari and Winsler (2014) find no cognitive benefits of Montessori preschool for African American students over traditional preK. All three studies included samples consisting of between one-half and two-thirds African American students in Montessori and traditional preK. Both Berger (1970) and Karnes (1969) employed random assignment and standardized assessments, including the Stanford-Binet. Program fidelity in these studies ranged from high (Berger, 1970) to low (Karnes, 1969); students in the Karnes study only received two hours of instruction per day, with only a 30 minute independent work cycle. Despite this variation, all three studies yielded similar findings: no advantage of Montessori preschool over other program types in school readiness for

African American students. Using the Learning Accomplishment Profile—Diagnostic, Ansari and Winsler (2014) stipulate that while African American children exhibited growth in both programs, they fared slightly better in traditional classrooms than in Montessori. The students in these studies were evaluated after only one year of Montessori instruction; it is possible that a full three-year cycle of Montessori education may have been needed to see meaningful differences. Nonetheless, these studies suggest no clear advantages of Montessori for African American preschoolers.

Two other cross-sectional studies (DiLorenzo, 1969; Wexley et al., 1974) employing a battery of standardized assessments affirm the value of preschool in general for African American students, but do not provide evidence that Montessori is superior to other preschool programs. The Montessori groups in both studies were predominantly African American, but neither study included detailed information about program fidelity. Wexley et al. (1974) compared disadvantaged students in Montessori and day care to middle-class students with and without preschool and found no significant differences in intelligence or achievement between Montessori preschool students and daycare students. DiLorenzo (1969) employed a much larger sample, but reported similar findings. In this study, over 1,800 preschool-aged children were randomly assigned to treatment and control groups in eight urban school districts in New York. The treatment groups each attended a different type of preschool, while the control groups received no preschool instruction. In one of these eight districts, the preschool employed the Montessori curriculum. Although the total sample was only half African American children, these students made up 78% of the Montessori group. Students who were assigned to the Montessori preschool group fared much better on the Metropolitan

Achievement Test than the control group, who received no preschool. The difference between the preschool group and the non-preschool group was also greatest in the district implementing Montessori, but specific comparisons are not drawn between African American students in Montessori and African American students in other preschool programs. Thus, while these studies demonstrate that preschool is beneficial for African American children, they do not provide much evidence in favor of Montessori preschool specifically.

Studies of Ancona Montessori School in Chicago conducted by Kohlberg (1968) and Stodolsky and Karlson (1972) are generally consistent with these cross-sectional studies. Ancona Montessori School was a racially integrated private preschool that enrolled a set number of low-SES African American students each year through a research partnership with the Office of Economic Opportunity. While the low-SES children are described as African American, the racial composition of the middle-class comparison group is not given, although the tuition-paying families in the school are described as “racially balanced” (Stodolsky & Karlson, 1972, p. 420). Kohlberg found that low-income children in the racially integrated Montessori classroom exhibited greater initial growth in IQ on the Stanford-Binet than middle-class children in a non-integrated, non-Montessori classroom. The low-SES children also demonstrated increased attention and decreased distractibility. Kohlberg cautions the reader, however, that the benefits accrued to the low-SES children may be due to the Montessori curriculum, the integrated classroom, or a combination of the two.

Using a larger sample of 29 low-income, African American children and 29 middle-class children from Ancona matched on age, gender, and previous school

experience, Stodolsky and Karlson (1972) found that both lower-class and middle-class students made significant gains in IQ during the first year, but not during the second or third year of the program. This suggests that the initial growth captured by Kohlberg (1968) may drop off as students continue in Montessori preschool. In his discussion of this study, Chattin-McNichols (1992) hypothesized that the Stanford-Binet may not be sensitive enough to capture the incremental growth that may be occurring in these years. The low-income, African American, second- and third-year students did make significant gains on the arithmetic scale of the Weschler Preschool and Primary Scale of Intelligence. Results from Ancona Montessori School, then, suggest some benefits of Montessori preschool for low-income African American students in math, but these are not necessarily greater than those that would occur in other school settings.

Conversely, longitudinal studies (DiLorenzo, 1969; Karnes, Shwedel, & Williams, 1983; Miller & Bizzell, 1983, 1984; Miller et al., 1975; Takacs & Clifford, 1988) of Montessori preschool suggest that some benefits of Montessori early childhood education may manifest later in African American students' academic careers. With majority-African American student samples, Karnes et al. (1983), DiLorenzo (1969), Miller et al., (1975), and Takacs and Clifford (1988) all found evidence of some academic advantage on various standardized assessments for students with Montessori preschool in the early elementary years. DiLorenzo (1969) and Karnes et al. (1983) found that this advantage disappeared by second and third grade, respectively. Conversely, Takacs and Clifford (1988) found that African American Montessori preschool graduates consistently averaged above school and grade level norms on the reading and math subtests of the California Achievement Test through sixth grade. Miller and Bizzell

(1983, 1984) demonstrated that male Montessori preschool graduates significantly outperformed their peers on standardized assessments of reading and math in grades seven through ten. These longitudinal studies seem to suggest the benefits of Montessori preschool for African American students may emerge and persist long after they leave preschool.

Karnes, Shwedel, and Williams (1983) revisited the group of children studied by Karnes (1969) 15 years after their participation in Montessori and other preschool programs to evaluate long-term outcomes in grade school, high school, and beyond. Post-high school, the Montessori group had the highest concentration of high school graduates, lowest concentration of dropouts, and the highest mean score on a school success composite variable comprised of elements such as successful high school graduation, academic achievement, behavioral record, and need for special services. Although high school results were not disaggregated by race, the authors assert that race was not a significant predictor of the school success composite variable, and that the differences in school success by program type were the same for both African American and White participants. The authors note that these results suggest a “sleeper” effect of Montessori, wherein beneficial outcomes emerge years after treatment. This interpretation is consistent with results from other longitudinal studies (DiLorenzo, 1969; Miller & Bizzell, 1983, 1984; Miller et al., 1975; Takacs & Clifford, 1988). Karnes et al. (1983) posit that the Montessori emphasis on persistence and independence may contribute to students’ success later in life. As a caveat, the samples employed in these studies were not exclusively African American, the studies suffered from attrition over time, and program fidelity varied. Nonetheless, these longitudinal studies provide some support for

the notion that Montessori preschool instruction supports long-term academic achievement for African American students.

Summary. These studies concerned the efficacy of Montessori preschool for African American students. In several of these studies (Karnes, 1969; Karnes et al., 1983; Miller & Bizzell, 1983, 1984; Miller et al., 1975), the authenticity of the Montessori program involved is questionable. In the study facilitated by Karnes (1969; Karnes et al., 1983), for example, students only received two hours of Montessori instruction per day, including an independent work cycle of only 30 minutes. In Miller's studies (Miller & Bizzell, 1983, 1984; Miller et al., 1975), teachers received only eight weeks of training prior to initiating the Montessori program. Many of these studies also examined the effects of a single year of preK, typically at age four (Ansari & Winsler, 2014; Karnes, 1969; Karnes et al., 1983; Berger, 1970; Miller & Bizzell, 1983, 1984; Miller et al., 1975). This is problematic because the Montessori curriculum is designed in three-year cycles; a single year, particularly the second year in a cycle without the first, may not constitute sufficient or appropriate exposure to the treatment. These studies also reflect a lack of multiage-appropriate groupings in the Montessori programs examined (Karnes, 1969; Karnes et al., 1983; Berger, 1970; Miller & Bizzell, 1983, 1984; Miller et al., 1975). These issues indicate that these studies may not reflect the effects of fully implemented Montessori instruction. It is worth noting that these studies frequently conflate race and SES; none of these studies pertain to African American students who are not also low-income.

These problems notwithstanding, the cross-sectional studies involving low-income African American students suggest that while Montessori preschool is superior to

no preschool, it does not immediately produce clearly better or worse outcomes than other early childhood approaches. The preschool studies with the largest sample sizes (Ansari & Winsler, 2014; DiLorenzo, 1969) support this conclusion, as does a synthesis of early studies by Mieztis (1971). However, longitudinal studies (Karnes, 1969; Karnes et al., 1983; Miller & Bizzell, 1983, 1984; Miller et al., 1983) suggest that Montessori preschool may produce long-term benefits for low-income African American students that are not apparent until years after treatment. Since many of these studies indicate benefits from only a single year of Montessori, it is not unreasonable to hypothesize that African American students in the current study may exhibit academic advantages from a full three-year cycle of Montessori lower elementary. However, studies focusing explicitly on African American students at the elementary level are needed to proceed with this hypothesis.

Preschool studies with other populations. Fidelity of implementation is an issue in some of these studies as well (Chisnall & Maher, 2007; Fleege, Black, & Rackauskas 1967; Peng & Md-Yunus, 2014). The racial composition of samples in some studies (Bereiter, 1967; Fleege et al., 1967; Pendergast, 1969) is not explicitly reported; these studies are classified as “other populations” because they cannot definitively be categorized as studies with African American students. Although some scholars found no advantages of Montessori instruction for non-African American students (Bereiter, 1967; Pendergast, 1969), others (Chisnall & Maher, 2007; Fleege et al., 1967; Lillard, 2012; Peng & Md-Yunus, 2014) provide persuasive evidence that the Montessori method may be beneficial for these students, particularly in reading.

Both Bereiter (1967) and Pendergast (1969) failed to demonstrate advantages of Montessori preschool for school readiness in middle-class children. Although the race of the participants is not explicitly stated, Bereiter (1967) frames his study as one of “the early education of the normal child,” as opposed to one of “lower-class Negro children” (p. 17-18). This another example of the deficit mentality toward students of color and low-income students identified previously, and suggests that by “normal,” the author means “White.” Bereiter (1967) compared 17 upper-middle-class students from a Montessori preschool with a group of similar students exposed to a program of direct verbal instruction termed Academic Preschool. The comparison group was culled largely from the waiting list for the Montessori school. The direct instruction group outperformed the Montessori group on all post-tests. Similarly, Pendergast (1969) reported no significant differences in pre-reading skills developed by a group of 120 upper-middle-class children in Montessori preschool, traditional preschool, and no preschool. The program in Pendergast’s study is described as a “bona fide” Montessori school affiliated with a local Montessori association, suggesting some level of program fidelity, although specifics are not provided. This author speculated that in his study, the effect of class might have trumped the effect of educational setting. These findings stand in contrast to those conducted with low-income African American children, where exposure to any type of preschool resulted in benefits.

Other studies, however, have demonstrated advantages of Montessori preschool instruction for White, middle-class, and/or international students. Two such domestic studies were conducted by Fleege et al. (1967) and Lillard (2012). Fleege et al. (1967) compared the performance of 21 Montessori preschool students in a middle-class

Chicago community with 21 students in traditional preschool matched on age, gender, IQ, SES, and parent education level. The authors provide no information about Montessori program implementation or fidelity. Montessori students gained significantly more in verbal ability than students in the control group at the end of preschool. Montessori students also scored significantly higher on measures of maturity and school readiness, including a specific measure of reading readiness. The purpose of Lillard's (2012) study of high-fidelity Montessori, low-fidelity Montessori, and traditional preschool classrooms was to establish the relationship between student outcomes and Montessori program fidelity. The sample consisted of a total of 72 children, mostly White and middle-class, in "classic" (high-fidelity) Montessori classrooms, "supplemented" (low-fidelity) Montessori classrooms, and conventional preschool classrooms. Children in the classic Montessori classroom exhibited significantly greater gains in executive function and letter-word identification than students in both supplemented Montessori and traditional preschool. The effect size for executive function was particularly large. While these studies suggest no advantage of Montessori in math, they do provide evidence that Montessori is more effective in fostering early literacy skills and executive function than traditional preschool.

Two other studies on Montessori preschool come from international contexts (Chisnall & Maher, 2007; Peng & Mid-Yunus, 2014). In a study conducted in New Zealand, Chisnall and Maher (2007) examine the math skills of 34 low-SES Montessori preschoolers and 28 more affluent, non-Montessori preschoolers. While there were no significant differences in strategy, forward number word sequence, number identification, or basic facts tasks, Montessori students scored significantly higher on backward number

word sequence and place value tasks. These findings are particularly noteworthy in light of the discrepancy in socioeconomic status between the two groups. The racial demographics of the sample are not disclosed, and the generalizability of the study to students in the United States is questionable. Nonetheless, this finding reflects positively on the capacity for Montessori preschool to foster numeracy. Peng and Md-Yunus (2014) examine reading and math achievement for first-, second-, and third-grade students in private schools in Taiwan who had attended either Montessori preschool or another form of preschool, while controlling for parent education level. Montessori students scored significantly higher in language arts in all three grades. In math, Montessori students scored significantly higher at first grade, but there were no differences in second or third grade. Peng and Md-Yunus found no effect for accumulated number of years in Montessori. These findings demonstrate clear benefits in language arts, but not in math. Again, these findings cannot be generalized to American populations with confidence, but are important to consider in the current study.

Summary. As with the preschool studies involving the population of interest, fidelity of implementation is a concern in some of these studies. Bereiter (1967), Pendergast (1969), and Lillard (2012) provide the reader with some evidence that the schools involved in their respective studies have some sort of Montessori credentials. No information about program fidelity is provided by Fleege et al. (1967), Chisnall and Maher (2007), or Peng and Md-Yunus (2014). Five studies (Bereiter, 1967; Chisnall & Mayer, 2007; Fleege et al., 1967; Lillard, 2012) examined outcomes for students at the preschool level; of these, three (Chisnall & Maher, 2007; Fleege et al., 1967; Lillard, 2012) found some significant advantages for Montessori students, while two (Bereiter,

1967; Pendergast, 1969) did not. Lillard's (2012) findings are most persuasive, due to the methodological rigor of her study; Pendergast's (1969) hypothesis that class trumps educational approach may explain his and Bereiter's (1967) non-significant findings. Peng and Md-Yunus (2014) examined elementary outcomes for students who had been Montessori students in preschool, with positive effects in language arts in grade one, two, and three. In aggregate, these studies generally suggest that Montessori preschool offers some benefits for White, middle-class, and international students, particularly in reading. Unlike the preschool studies conducted with low-income African American students, none of these studies extend beyond grade three, so long-term effects cannot be properly assessed. Overall, studies of Montessori preschool conducted with African American students and other populations provide some evidence of the method's effectiveness in supporting academic achievement in reading and math, although this is not consistent across the literature.

Elementary Public School Studies

Elementary public school studies with African American students. Several studies (Banta, 1968; Cisneros, 1994; Curtis, 1993; Dawson, 1987; Dohrmann et al., 2007; Duax, 1989; Ervin, Wash, & Mecca, 2010; Gross, Green, & Clapp, 1973; Lopata et al., 2005; Moore, 1991; Mallet, 2014; Mallet & Schroeder, 2015; Stodolosky, 1970) from the last five decades have considered the effects of Montessori education for African American students at the elementary level. As with the preschool studies, the programs involved in these studies vary in their level of fidelity, and although all the studies reviewed in this section include at least some African American students in their samples, results are often not disaggregated by race. Mostly, studies in high-fidelity settings find academic benefits

of Montessori for students of color (Dawson, 1987; Dohrmann et al., 2007; Duax, 1989; Mallet & Schroeder, 2015; Sciarra & Dorsey, 1976), although some (Cisneros, 1994; Lopata et al., 2005; Moore, 1991) do not. Conversely, studies that provide little evidence of program fidelity (Curtis, 1993; Stodolsky, 1970) report no advantage of Montessori instruction for these students. There is some evidence of the efficacy of Montessori instruction for African American students at the lower elementary level (Dawson, 1987; Ervin et al., 2010; Sciarra & Dorsey, 1976), although Stodolsky (1970) found no such evidence. Duax (1989) and Mallett and Schroeder (2015) also find benefits at the upper elementary level, although others (Cisneros, 1994; Curtis, 1993; Lopata et al., 2005) do not. Longitudinal studies (Dohrmann et al., 2007; Mallett, 2014; Moore, 1991) are similarly mixed. Overall, these studies do not provide clear or consistent support for the efficacy of Montessori instruction for African American elementary school students.

Some of these studies (Banta, 1968; Gross et al., 1973; Sciarra & Dorsey, 1976; Stodolosky, 1970) are continuations of or follow-ups to preschool studies begun earlier. One such study was conducted at Sands Elementary School (Banta, 1968). A sample of 72 African American, low-income students from Montessori and Head Start preschool was followed as they advanced to either Montessori kindergarten or multiage, non-Montessori kindergarten. A control group of students with no preschool experience was also included. At kindergarten, the only significant difference on task-based assessments of cognition was between students with preschool experience and those without. Gross et al. (1973) followed up with these students for two years after Banta (1968). Quantitative data from the Cincinnati Autonomy Test Battery on cognitive and behavioral measures again showed no statistically significant differences except between students with and

without preschool, although the Montessori group scored highest on 10 of 13 measures. Sciarra and Dorsey (1976) followed this same group of students through sixth grade. At third grade, the students with four years of Montessori education (one year of preschool plus a complete three-year lower elementary cycle) scored highest on the Metropolitan Achievement Test in math and verbal ability. The Montessori program at Sands Elementary at this time stopped at third grade, so after that, students went into traditional classrooms. By sixth grade, statistically significant differences had disappeared, although the group with four years of prior Montessori experience had the highest scores on three of four subtests of the Metropolitan Achievement Test. Although this study suffers from significant attrition from the original sample, the third grade results are nonetheless important in light of the objective of the current study. Results from these three related studies seem to suggest that Montessori elementary enhances the benefits of Montessori preschool for African American students, but that these advantages fade when students move back into traditional classrooms.

Conversely, another study (Stodolsky, 1970) examining the effects of Montessori elementary for African American students with Montessori preschool yields a different conclusion. Stodolosky (1970) followed 29 low-income, African American students with varying amounts of Montessori preschool who either went on to traditional public schools or stayed in Montessori for lower elementary school. At third grade, both groups of students were found to perform below grade level on the Metropolitan Achievement Test. This study stands in contrast to Banta (1968), Gross et al. (1973), and Sciarra and Dorsey (1976), and does not support the theory that Montessori elementary is superior to traditional elementary for African American children.

Studies from several elementary programs (Dawson, 1987; Duax, 1989; Ervin, Wash, & Mecca, 2010; Mallett & Schroeder, 2015; Moody & Riga, 2011) suggest some benefits of Montessori instruction for African American students. Dawson (1987) evaluated the efficacy of a Montessori magnet program in grades one through five for African American, White, and Hispanic/Latino students. Dawson noted that these classrooms are multiage, though further details on program fidelity are not provided. The African American students in the Montessori program scored significantly higher than test norms and district averages on the Metropolitan Achievement Test and the Iowa Test of Basic Skills (ITBS) in grades one through three. A study conducted by Ervin, Wash, and Mecca (2010) in South Carolina involved comparisons of academic achievement at kindergarten, first, and second grade between Montessori and non-Montessori students within the same schools. Although the sample is described as racially diverse, specific demographic characteristics are not given. MAP (Measures of Academic Progress) test data for the students were collected over a three-year period. The authors reported that a higher percentage of Montessori students scored in the upper range of MAP reading and math tests as compared to the non-Montessori students. The means of the two groups are close, however, and tests for statistically significant differences between the two groups were not reported. Parental choice is also a possible confounding factor, as enrollment in Montessori is voluntary. Also in South Carolina, Moody and Riga (2011) report that a comparison of diverse students in Montessori and non-Montessori elementary schools on state end-of-grade assessments favors Montessori; however, statistical tests for significance were not conducted, and results are not disaggregated by race. Nonetheless,

these studies provide some support for the idea that Montessori promotes academic achievement for African American students at the lower elementary level.

Other scholars (Duax, 1989; Mallet & Schroeder, 2015) demonstrate that this academic advantage is detectable at the upper elementary level. Duax (1989) used the ITBS to evaluate the performance of students in a high-fidelity public Montessori school in Milwaukee. A sample of 84 students took the ITBS at the end of sixth grade, the last year of the Montessori elementary program. Students of color constituted half of the sample, although they are simply described as “minority.” No comparison group is used, but 84% of the Montessori students scored above the 50th percentile on the ITBS. Mallet and Schroeder (2015) conducted a cross-sectional comparison of reading and math achievement of over 1,000 students in grades one through five in high-fidelity public Montessori and non-Montessori schools in Texas. The sample is described as 28% African American, and majority-Hispanic/Latino. No statistically significant differences in reading or math achievement were found in grades one through three, but Montessori students in grades four and five performed significantly better in both subjects than their peers in traditional schools. Neither study employed random assignment, or disaggregated results by race, but both suggest some benefit of Montessori elementary instruction for non-White students.

Conversely, other studies (Cisneros, 1994; Curtis, 1993; Lopata et al., 2005; Mallett & Schroeder, 2015; Moore, 1991) have failed to demonstrate an academic advantage for African American students in public Montessori elementary programs. In a study markedly similar to the current one, Lopata et al. (2005) compare academic achievement on state reading and math assessments for fourth and eighth grade public

Montessori and non-Montessori students in an urban district in western New York. The sample is described as 53% minority; the generic label “minority” is used without providing specific racial demographics. Montessori students were compared to students at a structured magnet school, and open magnet school, and a traditional school, with schools matched for gender, ethnic composition, and SES level. Authenticity of the Montessori program is not discussed in detail, although multiage classes and Montessori materials are mentioned. At grade four, no significant differences were found in language arts; Montessori students did slightly better in math than the open magnet students, but worse than in traditional. In eighth grade, there were no significant differences in math, but Montessori students did worse in language arts than their peers. These findings stand in contrast to those of Duax (1989) and Mallet and Schroeder (2015) in that they demonstrate no academic advantage for Montessori in upper elementary.

In a rather problematic study, Curtis (1993) made the unusual choice to compare students in an urban public Montessori school with students in a gifted and talented program called SIGHTS. The sample, which was equal parts White, African American, and Hispanic/Latino, consisted of 84 fourth grade students at two Montessori and four SIGHTS schools, matched for gender and ethnicity, but not SES. The assumption of equal SES between these two programs is problematic, given the gifted and talented focus of the SIGHTS program, and the underrepresentation of low-income students in gifted and talented programs (Peters & Gentry, 2012). Using the Metropolitan Achievement Test as a measure, the author finds only one significant difference by program: Montessori students scored higher than SIGHTS students in writing. In a sense, these non-significant findings could be interpreted as testament to the efficacy of

Montessori; after all, the Montessori students are being compared to students who have been identified as gifted and talented, and found to be competitive. On the other hand, no academic advantage was actually found in favor of the Montessori students, except in writing. A similar study was conducted by Cisneros (1994), who, more appropriately, compared public Montessori students and traditional school students in third grade. The public Montessori program studied was 40% African American. Students were compared on academic achievement, self-concept, attendance, promotion, and parental involvement. Cisneros found no significant differences between the two groups in any of these areas. As with many of the elementary school studies discussed here, random assignment is not employed. These studies suggest no differential effects of elementary Montessori education for African American students.

Another subset of studies (Dohrmann et al., 2007; Mallett, 2014; Moore, 1991) examined longitudinal outcomes for students exposed to Montessori in elementary school, with some evidence of effectiveness for students of color. Using a sample of roughly equal parts White students, African American students, and Hispanic/Latino students in grades one through eleven, Mallett (2014) demonstrated that accrued years in Montessori do not have a significant effect on academic achievement, as measured by the ITBS and the Texas Assessment of Knowledge and Skills. While her data also reflect a discrepancy in achievement between White students and students of color, she noted that the rate of change for academic achievement remained constant for both White students and students of color. Typically, racial achievement discrepancies widen with age, but this effect was not present in her sample. This affirms the presence of a racial achievement gap in public Montessori schools, but also suggests that Montessori may

help contain the growth of that gap. Thus, this study does provide some support for the hypothesis that Montessori may be beneficial for African American students, although this particular benefit may not be detectable as early as grade three.

Dohrmann et al. (2007) also find some positive long-term effects for African American Montessori elementary students. This study is noteworthy in that it features African American students who are *not* also low-income: the sample was 53% African American students, but only 5% FRL. These students had attended public Montessori from kindergarten through fifth grade and were in high school at the time of the study. A comparison group of students from the same high schools matched for gender, race, and SES was created. The Montessori students exhibited no differences in GPA or language arts and social studies state standardized test scores, but performed significantly better on math and science tests. The Montessori advantage in math and science was substantial: the Montessori group performed one-third of a standard deviation higher than the comparison group on this factor. This finding seems to suggest benefits of Montessori for African American students in some subjects, but not others. An important consideration when interpreting this study is that the high schools attended by the Montessori alumni tended to be highly selective special programs. The authors suggest that this may have led to the creation of an artificially high-achieving comparison group.

Unlike Dohrmann (et al.) and Mallett (2014), Moore (1991) found that academic achievement for African American students in lower elementary Montessori declined over time. This study focuses on Montessori magnet schools serving 61% students of color, comparing these Montessori students to students in traditional schools within the same district, using previous test scores as a covariate. Unfortunately, the sample is only

described in terms of White and “minority” children, so the exact percentage of African American students involved in the study is unknown. However, Moore (1991) mentions that the district is under a desegregation order, which suggests that the “minority” group is likely to be largely African American. Moore pays exceptional attention to documenting the high level of fidelity of these Montessori programs. As a whole, the Montessori students scored above district averages and national norms in kindergarten through second grade in reading, math, and language. Students of color in Montessori scored at or above national norms on reading, math, and language on the ITBS in kindergarten, but exhibit a general downward trend in percentile rank scores during grades one, two, and three. By third grade, students of color in the magnet program are below the 50th percentile in all three areas. This study seems to suggest that Montessori elementary instruction may offer diminishing returns over time.

A consistent thread throughout these studies is the presence of a disparity in achievement between White and non-White students, a phenomenon discussed in Chapter One as the opportunity gap. In spite of the positive results Dawson (1987) found for African American students, she notes that racial disparities in test scores between White students and students of color persisted in the Montessori magnet program. Moore (1991) found that percentile ranks for students of color were persistently lower than those for White students. Dohrmann et al. (2007) also found that African American Montessori students had less positive outcomes than their White peers. Mallett (2014) identified a similar disparity, although she asserts that this gap did not widen as typically expected. Overall, this suggests that Montessori public elementary school programs have not been

effective in eliminating the opportunity gap, although Mallett's intriguing findings merit further investigation in this regard.

Summary. The extant literature on Montessori elementary programs for African American students contains some evidence that Montessori supports reading and math achievement for these students (Dawson, 1987; Dohrmann et al., 2007; Duax, 1989; Mallett, 2014; Mallett & Schroeder, 2015; Moody & Riga, 2011). Other studies find no advantage of Montessori for these students (Banta, 1968; Cisneros, 1994; Curtis, 1993; Gross et al., 1973; Lopata et al., 2005; Moore, 1991; Stodolsky, 1970). Because of this inconsistency, the literature does not support a directional hypothesis in the current study. Based on the studies reviewed here, there appears to be some relationship between level of program fidelity and program efficacy, but this relationship is not consistent. The widespread use of the "minority" student classification is troubling; this term obfuscates the interpretation of outcomes for African American students specifically. In light of the lack of consensus and specificity in the literature, more high-quality studies of academic achievement for African American students in high-fidelity Montessori schools are needed to better illuminate this issue. Given the documented relationship between third grade reading and numeracy and later academic outcomes (Bailey et al., 2014; Fiester, 2010; Hernandez, 2011; Ritchie & Bates, 2013), further study of academic achievement at this level is especially warranted.

Other populations. A number of other studies (Claxton, 1982; Donnabella & Rule, 2008; Fero, 1997; Lillard & Else-Quest, 2006; Manner, 2007) have concentrated on evaluating Montessori elementary for other populations besides African American students. Unlike many other studies reviewed here, these studies generally provide

detailed information about markers of program fidelity; Lillard and Else-Quest (2006), Manner (2007) and Fero (1997) all note that the teachers in their studies are Montessori-trained. Claxton (1982) goes to great lengths to document the fidelity of the program in her study. An exception is the study by Donnabella and Rule (2008), which was not conducted within a Montessori setting, but rather, featured a limited use of Montessori materials as an educational intervention. Some of these studies (Donnabella & Rule, 2008; Manner, 2007) provide some evidence that Montessori may be more effective than other curricula for these other populations, particularly in reading, but others (Claxton, 1982; Fero, 1997; Lillard & Else-Quest, 2006) find little difference between Montessori and non-Montessori students at the elementary level.

Manner (2007) and Donnabella and Rule (2008) find some evidence that Montessori supports achievement in reading and math, respectively. Manner (2007) hypothesized that standardized test preparation may have been a confounding variable in previous comparative studies of Montessori education because Montessori educators generally eschew tests (Lillard, 2005). In public schools where end-of-grade standardized testing is usually mandated, teachers have no choice but to participate; however, Manner theorized that Montessori students may not receive the rigorous and repetitive test preparatory curriculum that many students in traditional public schools receive. Thus, her sample included Montessori and traditional fourth and fifth grade students, matched on third grade test scores, who had received the same type and amount of test preparation. Oddly, race, gender, and SES were not used as matching variables, and the demographics of the sample are not reported. Manner reports that the Montessori teachers had all completed or were completing Montessori training, indicating some attention to program

authenticity. Montessori students in both grades scored significantly higher in reading; no significant differences were found in math scores. These findings suggest that the “test prep advantage” of traditional school students may be a factor in studies reporting no significant differences between Montessori and traditional school students, at least in language arts. The lack of attention to other confounding variables, like SES, makes this study somewhat problematic, but this finding is thought-provoking.

A multiple case study conducted by Donabella and Rule (2008) focused explicitly on the Montessori approach to math. Unlike other studies described here, the participants in this multiple case study did not attend a public Montessori school. Rather, they were four White, seventh grade students in a traditional public school with demonstrated low achievement in math. The authors of this study administered a math assessment before and after the students received eight weeks of supplementary math instruction using Montessori multiplication manipulatives. All four students improved significantly on the post-test, scoring between 95% and 100%. All participants also reported increased enjoyment of multiplication, while three of the four reported increased confidence in math. Certainly, this is an extremely small sample, and this study examines only one mathematical concept. However, given the fact that multiplication is often learned in third grade (Common Core State Standards Initiative, n.d.), this study has implications for the research at hand. This study provides some evidence of effectiveness of Montessori math instruction in multiplication, although this has not consistently manifested in statistically significant differences in comparative studies

Other scholars (Claxton, 1982; Fero, 1997; Lillard & Else-Quest, 2006) who have studied Montessori elementary with students not identified as African American have

failed to demonstrate an academic advantage of Montessori education. Fero (1997) compared public Montessori students to a traditional school control group matched for grade, gender, SES, special education status, and aptitude, as measured by the Test of Cognitive Skills. The district in this study was 95% White and 17% FRL, indicating a relatively privileged population. All Montessori teachers were trained by AMS. Students who had entered the lottery for the public Montessori program exhibited significantly higher aptitude scores than other students, which is why the author included aptitude as a matching variable. This finding is interesting; if Montessori attracts high-aptitude students generally, then one would expect to see Montessori students outperforming traditional school students in studies that do not control for this variable, yet this is not the case across the board. No significant differences were found between Montessori and traditional school students in grades three and four. In second grade, however, traditional school students scored significantly higher in math, while fifth grade Montessori students scored significantly higher in language expression. This finding arguably offers some support for the idea of a Montessori sleeper effect in language, but does not suggest that any appreciable differences are apparent at grade three.

Claxton (1982) also found no difference in academic achievement between Montessori and traditional school students. She administered a battery of tests to Montessori and traditional school students with the aim of measuring academic achievement, among other constructs. Her sample consisted of 182 students in kindergarten through third grade; subjects were matched by sex, grade, and race, but demographic characteristics of the sample are not disclosed. This study is noteworthy for the author's rigorous investigation of the fidelity of the Montessori program involved; the

author conducted rather extensive interviews and classroom observations to confirm the program's authenticity. Claxton found no significant differences in reading and math achievement in kindergarten, second grade, or third grade. In first grade, traditional students were found to achieve significantly higher than Montessori students. This study suggests no differential effects of Montessori education at this level.

One of the most widely cited studies of Montessori education (Lillard & Else-Quest, 2006) also provides little support for Montessori instruction at the elementary level. This study is noteworthy for its unique design. The high-fidelity public Montessori program in the study conducted an annual lottery to assign slots in the program; the experimental group consisted of students who "won" the lottery and entered the Montessori program, while the control group consisted of students who "lost" and went to other schools. The authors note that the lottery basically mimics random assignment, which is often unfeasible in studies like this. Both the control and experimental groups reported incomes that ranged from low-income to middle class; racial characteristics of these groups are not reported. Five-year-old and twelve-year-old children were assessed on a variety of measures, including executive function, cognition, and behavior. Five-year-olds in Montessori performed significantly better on measures of early reading skills and math skills with medium effect sizes, but no significant differences were found for twelve-year-olds on measures of reading and math. This study is widely cited as evidence that Montessori works, and indeed, the findings for the five-year-old group are striking. Results from the twelve-year-old group, however, provide no such evidence with regard to math and reading. In fact, this study affirms the value of Montessori as an early

childhood approach, but renders Montessori elementary no better or worse than traditional in terms of academic gains in these domains.

Summary. This group of studies (Claxton, 1982; Fero, 1997; Lillard & Else-Quest, 2006; Manner, 2007) is noteworthy due to the attention to program fidelity exhibited by the authors. However, this generally consistent level of program fidelity is not accompanied by consistent findings. While elementary students in Manner's (2007) study outperformed their traditional school peers in reading and math at some levels, similar participants in the studies conducted by Claxton (1982), Fero (1997), and Else-Quest (2006) performed no better, or worse, than traditional school students. Donnabella and Rule (2008) found that using Montessori materials as an academic intervention increased students' confidence in math, but this study was extremely limited in participants and scope. More research is needed to reconcile these contradictory findings.

Summary

The Montessori method was originally developed by Maria Montessori in Italy at the turn of the 20th century (Lillard, 2005; Whitescarver & Cossentino, 2008). Although Montessori private schools became popular in suburban communities in the 1960s, the charter school movement facilitated the spread of Montessori programs in public school settings between the mid-1990s and the present day (NCMPS, 2014c). Currently, over 500 public schools offer Montessori instruction (NCMPS, n.d.). Although private Montessori schools have historically served a relatively homogenous population (Whitescarver & Cossentino, 2008), contemporary public school Montessori programs serve a substantial proportion of African American students (Debs, 2015).

The Montessori method is a constructivist approach to education and child development wherein students learn and grow through interactions with the prepared environment and their peers, under the guidance of their teacher (Lillard, 2005). Other key characteristics of the Montessori method include multiage groupings, hands-on materials, extended periods of independent work, individualized instruction, and assessment through teacher observation (Lillard, 2005). The Montessori curriculum is highly prescriptive, even rigid (Breitborde & Swiniarski, 2006); some Montessorians question if the method is, or can be, implemented with fidelity in public school settings (Murray & Peyton, 2008). Extant studies (Murray & Peyton, 2008; The Riley Institute, 2014, 2015) on the implementation of the Montessori model in public schools suggest that significant variation exists in levels of fidelity. Because fidelity has been shown to impact student outcomes (Lillard, 2012), the issue of authenticity merits attention.

Scholarly interest in Montessori education has increased in recent years (Bagby, 2007; Bagby & Jones, 2010; Bagby et al., 2014). Several scholars have identified aspects of Montessori education that, theoretically, are conducive to academic achievement, including executive function (Diamond & Lee, 2011; Howell et al., 2013; Lillard, 2005), 21st century skills (Murray, 2011; Torrance, 2012), and inquiry (Rinke et al., 2013). Others have argued that the Montessori approach fits well with principles and practices from special education (Cossentino, 2010; McKenzie & Zascavage, 2012; McKenzie et al., 2011; Pickering, 2003; Richardson, 1997). However, few studies (Dawson, 1987; Manner, 2014) have explicitly examined outcomes for African American students at the elementary level. In the context of diversity and equity in American schools, several authors have suggested how Montessori might benefit African American students (Hall &

Murray, 2011; Rambusch, 2007/1976; Rule & Kyle, 2009). Some scholars have also addressed the issue of culturally responsive teaching in the context of Montessori schools. Hall and Murray (2011) and Rule and Kyle (2009) identify aspects of Montessori philosophy that are compatible with the idea of cultural responsiveness for African American students, but others (Stansbury, 2012; Yezbick, 2007) suggest that this does not always translate into culturally responsive practice. Nonetheless, the literature contains ample documentation of how the Montessori method can be implemented with African Americans and other non-White populations (Adair & Bhaskaran, 2010; Campbell, 1998; Hixon, 2002; Jones, 1968; Kai, 2009; Lopez, 1992; Robinson, 2006; Schnepf, 2010; Schonleber, 2011). Critiques of Montessori schools have emerged as well, particularly in regard to testing (Jacobson, 2007), diversity (Debs, 2015), and cultural congruence (Barron, 2002; Brunold-Conesa, 2008). As a whole, this conceptual literature provides some foundation for the hypothesis that the Montessori method can promote academic achievement for African American students.

The empirical studies of academic achievement for Montessori students in general, and African American students specifically, do not provide consistent support for this hypothesis. Some studies are plagued by methodological issues and concerns about treatment fidelity (Ansari & Winsler, 2014; Curtis, 1993; Karnes, 1969; Karnes, et al., 1983; Miller & Bizzell, 1983, 1984; Miller et al., 1975; Stodolsky, 1970). These concerns notwithstanding, empirical studies of Montessori preschool suggest that the method may be beneficial in promoting literacy skills (Fleege et al., 1967; Lillard, 2012); this effect is more pronounced for African American students, who seem to reap long-term benefits from Montessori preschool that may not be immediately apparent (Ansari &

Winsler, 2014; Karnes, 1969; Karnes et al., 1983; Berger, 1970; Miller & Bizzell, 1983, 1984; Miller et al., 1975). At the elementary school level, there is some evidence that Montessori supports reading and math achievement for African American students (Dawson, 1987; Dohrmann et al., 2007; Duax, 1989; Mallett, 2014; Mallett & Schroeder, 2015; Moody & Riga, 2011). Some studies, however, have found no benefits for African American students (Banta, 1968; Cisneros, 1994; Curtis, 1993; Gross et al., 1973; Lopata et al., 2005; Moore, 1991; Stodolsky, 1970). Findings for White students and international students are more varied (Claxton, 1982; Donnabella & Rule, 2008; Fero, 1997; Lillard & Else-Quest, 2006), but some research indicates benefits of Montessori instruction, particularly in reading (Manner, 2007).

Based on the literature review, there is some evidence that Montessori elementary instruction supports achievement for African American students, particularly in reading, and to a lesser extent in math. This evidence is inconsistent, and therefore does not provide justification for the use of a directional hypothesis. However, this inconsistency also demonstrates this study has the potential to contribute to this body of literature.

This synthesis of extant studies of Montessori elementary education for African American students has informed the design of the current study in three ways. First, many existing studies of Montessori elementary describe participants only as either “minority” or “White,” which masks important differences among non-White racial and ethnic groups. Other studies describe the racial composition of the sample, but neglect to disaggregate results by race. This study focuses exclusively on African American students so as to bring their experiences to the forefront. Second, many of the studies conducted with African American students included only low-income African American

students, providing little insight into outcomes for African American students of varying socioeconomic levels. This study is not restricted to low-income African American students. In the schools selected for this study, the percentage of students who qualified for FRL in 2012-2013 ranged from 14% to 44%, indicating a more socioeconomically diverse population. This study provides a broader picture of the achievement of African American students across socioeconomic levels. Third, this study was conducted with three Montessori programs exhibiting high levels of programmatic fidelity. These indicators of programmatic fidelity are documented in chapter three to provide additional insight into the relationship between program fidelity and student achievement.

Conclusion

This study aims to illuminate how effectively public school Montessori supports academic achievement in reading and math for African American students in third grade in urban settings. This review of literature indicates that this remains an open question. Given the significant presence of these students in public Montessori programs (Debs, 2015) and the projected increase in this student population throughout the United States in the coming years (Hussar & Bailey, 2014), this research is needed to inform the continued expansion of Montessori programs in public schools and the effort to close the opportunity gap.

CHAPTER 3: METHODOLOGY

The purpose of this study is to evaluate the effectiveness of Montessori reading and math instruction for third grade African American students in urban public schools. As established in the previous chapter, many prior Montessori studies featured diverse student samples, but few examined achievement for African American elementary students specifically. More precisely, there is a need for studies of third grade reading and math achievement for African American students due to the demonstrated importance of reading and math skills at this level (Bailey et al., 2014; Fiester, 2010; Hernandez, 2011; Ritchie & Bates, 2013). This study was designed to fill this gap in the literature. Third grade reading and math end-of-grade state standardized assessment scores were used to evaluate program effectiveness. The treatment group consisted of African American students who had completed third grade in three public Montessori schools in a large, urban district in North Carolina. Comparison groups of third grade African American students were drawn from similar traditional and magnet schools located within the same attendance zones of the same district. School similarity was determined using percentage of African American students and percentage of students qualifying for FRL. Group mean math and reading scores were compared using a factorial MANCOVA and MANOVA. The specific research questions this study addresses are:

- 1) Do African American third grade students in public Montessori programs in urban settings exhibit significantly different levels of achievement in math

compared to African American third grade students in similar school choice programs located within the same district?

- 2) Do African American third grade students in public Montessori programs in urban settings exhibit significantly different levels of achievement in reading compared to African American third grade students in similar school choice programs located within the same district?
- 3) Do African American third grade students in public Montessori programs in urban settings exhibit significantly different levels of achievement in math compared to African American third grade students in similar traditional public schools located within the same district?
- 4) Do African American third grade students in public Montessori programs in urban settings exhibit significantly different levels of achievement in reading compared to African American third grade students in similar traditional public schools located within the same district?

As established in the previous chapter, the existing literature about the effectiveness of Montessori elementary for African American students does not provide clear support for directional hypotheses. Therefore, this study tested the following non-directional null hypotheses:

H_1 : There is no significant difference in levels of achievement in math for African American third grade students in public Montessori programs in urban settings as compared to African American third grade students in similar school choice programs in the same district.

H₂: There is no significant difference in levels of achievement in reading for African American third grade students in public Montessori programs in urban settings as compared to African American third grade students in similar school choice programs in the same district.

H₃: There is no significant difference in levels of achievement in math for African American third grade students in public Montessori programs in urban settings as compared to African American third grade students in similar traditional public schools in the same district.

H₄: There is no significant difference in levels of achievement in reading for African American third grade students in public Montessori programs in urban settings as compared to African American third grade students in similar traditional public schools in the same district.

Research Design

This study utilized a quasi-experimental design to determine if the primary independent variable (school setting) is significantly related to the dependent variables (reading and math test scores). According to Gay, Mills, and Airasian (2012), research can be considered *experimental* if at least one independent variable is manipulated by the researcher. In a “true” experiment, subjects are randomly assigned to treatment and control groups (Gay et al., 2012; Shadish, Cook, & Campbell, 2002). When random assignment is not possible, as is often the case in educational research (Coladarci, Cobb, Minium, & Clarke, 2011), a quasi-experimental design may be used (Gay et al., 2012; Shadish et al., 2002). As randomly assigning students to Montessori or non-Montessori classrooms was beyond the control of the researcher, this study adopted a quasi-

experimental approach. More specifically, a posttest-only intact group design was used to compare mean math and reading scores of Montessori and non-Montessori African American students. This design is diagrammed in Figure 2 (Shadish et al., 2002).

$$\begin{array}{ccc} NR & X & O_1 \\ \hline NR & & O_2 \end{array}$$

Figure 2: Diagram of post-test only design with non-randomly assigned groups (Shadish et al., 2002, p. 116)

This study constitutes *ex post facto* research in that participants were studied only after the treatment was administered (Gay et al., 2012). This posttest-only design was chosen because of the lack of consistent assessment across school settings and school years prior to grade three. Students in these Montessori schools typically begin receiving Montessori instruction in preK or kindergarten, so a pretest administered at the beginning of grade three, or even the beginning of the lower elementary cycle, would risk contamination from prior exposure to the treatment (Montessori).

Population

In quantitative research, *population* can be defined as “the complete set of observations or measurements about which conclusions are to be drawn” (Coladarci et al., 2011, p. 192). The target population of this study, then, is all African American third-grade students in Montessori and non-Montessori public school programs in the United States. In this study, the target population is theoretical (Coladarci et al., 2011) or abstract (Huck, 2011) because it is not possible to take measurements from every member of the

population. Not only is the number of current third-grade African American students very large, but this theoretical population also includes *future* third-graders, who cannot be measured right now. For this reason, it is necessary to define the accessible population and draw a sample from the accessible population; from the statistics of the sample, population parameters can be inferred (Coladarci et al., 2011). The accessible population (Gay et al., 2012) includes African American students who have completed third grade and taken end-of-grade assessments in Montessori and non-Montessori public school programs in the United States. The sampling frame (Huck, 2011) is restricted to African American students who have completed third grade and taken end-of-grade assessments in Montessori and non-Montessori public school programs within the North Carolina school district selected for this study. Furthermore, this large, urban district is divided into regions; sampling will be restricted to the regions where the three Montessori schools are located.

Setting

The stated goal of this study is to evaluate the effectiveness of Montessori instruction for African American elementary school students *in an urban setting*. While the term *urban* in common parlance denotes an association with cities (Merriam-Webster, n.d.), Milner (2012) identifies three different types of urban environments: *urban intensive* consists of cities with populations of one million or more; *urban emergent* refers to large cities with less than one million people; and *urban characteristic*, which refers to areas that are not large cities, but exhibit some of the same characteristics as urban environments, including substantial levels of racial, socioeconomic, and linguistic diversity (Milner, 2012). The United States Census Bureau (2010) defines an urban area

as “densely developed territory that contains 50,000 or more people” (para. 3). In *The Nation’s Report Card*, the National Center for Education Statistics (2013b) describes an urban school district as a district in a city of 250,000 or more. For the purposes of this study, school districts located in metropolitan areas of 250,000 or more serving at least 25% non-White students are considered urban districts. The district selected for this study meets these criteria. It is located in a city of over 700,000. The population served by the district is approximately 40% African American, 22% Hispanic/Latino, and 29% White, with the remainder of students identifying with other ethnicities.

The district selected has three public, established whole-school Montessori lower elementary (grades one through three) programs. All three schools are located in the same region of the school district. One program began in 1992, another in 1996, and the newest in 2005. Fidelity of implementation of the Montessori model has been shown to impact academic outcomes (Lillard, 2012); studies on alternative math curricula have yielded similar findings, reflecting the importance of fidelity in interpreting outcomes (Tarr et al., 2008). Thus, it was important that the Montessori programs selected for this study be relatively high-fidelity, and that evidence of fidelity be reported here. Although classroom observations were not possible given the retrospective design of this study, the programmatic and structural elements of these public Montessori programs are consistent with the recommendations of the American Montessori Society (2014) and are reported here.

All three Montessori programs employ teachers who have completed or are currently enrolled in a Montessori teacher training program affiliated with AMS. All three programs also utilized multiage classes as deemed appropriate by AMS (2014)

during the years examined in this study. For lower elementary, a multiage class consists of grades one through three in the same room. All Montessori classrooms are equipped with standard lower elementary Montessori materials per AMS guidelines (AMS, n.d.c). All three programs report that they regularly provide the two-and-a-half- to three-hour daily work cycle recommended by AMS (n.d.c). Classrooms are staffed with one Montessori-trained teacher and one paraprofessional (AMS, n.d.c). Administrators at these three schools are also provided with Montessori administrator training. These qualifications were verified through correspondence with school- and district-level personnel, and were reported to have been in place during all the years examined in this study. Taken together, these indicators suggest that the three research sites have the proper structures in place to support an authentic public Montessori program. While more detailed observation protocols for high-fidelity Montessori programs exist (AMS, n.d.a; National Center for Montessori in the Public Sector [NCMPS], 2014b), in-depth classroom observations were deemed inappropriate, given the retrospective design of this study.

Sample

The treatment group for this study consisted of African American third grade students enrolled in three public Montessori programs. Because this treatment was implemented at the school level, each Montessori school (Montessori 1, Montessori 2, and Montessori 3) was matched with one magnet school (Magnet 1, Magnet 2, and Magnet 3) and one traditional school (Traditional 1, Traditional 2, and Traditional 3) within the same attendance zone of the same school district. The two comparison groups consisted of African American third grade students drawn from the matched traditional

public and magnet schools. Because the treatment group was sampled at the school level, propensity score matching was deemed inappropriate for creating the comparison groups. To expand sample size, students from multiple years were included; this study included data from the 2006-2007 academic year through the 2013-2014 academic year. All three Montessori programs enroll students in prekindergarten and kindergarten by lottery. These programs are highly sought after with long waiting lists and experience little student turnover between kindergarten and grade three, indicating that the vast majority of students present at grade three have been exposed to a full three-year cycle of lower elementary Montessori instruction. This suggests that the effects observed here at grade three generally represent outcomes from the full three-year cycle of Montessori lower elementary education.

The percentage of African American students and percentage of students qualifying for FRL by school are given in Table 1. Chi-square tests were conducted ($\alpha=.05$) to ensure that treatment and comparison schools were similar in terms of percentage of African American students and percentage of students eligible for FRL. This information is summarized in Table 2.

Table 1: Percentage of African American students and percentage of FRL students by school

School	% African American	% FRL
Montessori 1	26.40	26.80
Montessori 2	68.10	43.97
Montessori 3	21.97	14.44
Magnet 1	57.04	33.52
Magnet 2	65.48	55.59
Magnet 3	31.20	24.52
Traditional 1	19.42	20.38
Traditional 2	56.93	89.83
Traditional 3	12.92	16.55

Table 2: Chi-square tests of independence, treatment and comparison schools

Schools Compared		% African American		% FRL	
		$\chi^2(1)$	<i>p</i>	$\chi^2(1)$	<i>p</i>
Montessori 1	Traditional 1	1.41	.236	1.36	.243
Montessori 1	Magnet 1	19.79*	<.001	1.16	.282
Montessori 2	Traditional 2	2.07	.150	47.85*	<.001
Montessori 2	Magnet 2	.20	.653	2.89	.09
Montessori 3	Traditional 3	2.81	.094	.34	.558
Montessori 3	Magnet 3	2.08	.149	3.85	.050

Note. *Significant at the .001 level

FRL rates at the three Montessori schools ranged from 14% to 44%. Montessori 1 was not significantly different from Traditional 1 in terms of percentage of African American students ($\chi^2(1)=1.41, p=.236$) or percentage of students eligible for FRL ($\chi^2(1)=1.36, p=.243$). Montessori 1 did differ significantly from Magnet 1 with regard to percentage of African American students ($\chi^2(1)=19.79, p<.001$), but not with regard to percentage of students eligible for FRL ($\chi^2(1)=1.16, p=.282$). The difference in proportion of African American students notwithstanding, Magnet 1 was the magnet school most similar to Montessori 1 within this same attendance zone. Similarly, Montessori 2 was not significantly different from Traditional 2 on percentage of African American students ($\chi^2(1)=2.07, p=.150$), but did have a significantly different percentage of students receiving FRL ($\chi^2(1)=47.85, p<.001$). Again, although Traditional 2 was significantly different from Montessori 2 in this regard, it was the best match available within this attendance zone. Montessori 2 and Magnet 2 were not significantly different on either measure; for percentage of African American students, $\chi^2(1)=.20, p=.653$, while for FRL percentage, $\chi^2(1)=2.89, p=.090$. Montessori 3 and Traditional 3 were also not

significantly different in terms of African American student population, $\chi^2(1)=2.81$, $p=.094$, or FRL percentage, $\chi^2(1)=.34$, $p=.558$. Montessori 3 and Magnet 3 were also not significantly different in regard to percentage of African American students ($\chi^2(1)=2.08$, $p=.149$) or FRL percentage ($\chi^2(1)=3.85$, $p=.050$).

Magnet 1 utilizes an educational approach that it labels “Traditional,” featuring a high degree of structure, an emphasis on manners and etiquette, and character education. This school serves approximately 500 students in grades K through five. Magnet 3 employs the Traditional program as well, serving approximately 700 students from preK through sixth grade. Magnet 2, a K-8 school, features a schoolwide focus on STEM (science, technology, engineering, and math). This school serves approximately 1,000 students. Traditional 1, 2, and 3 are neighborhood schools without a special magnet theme. Traditional 1 is a preK-5 elementary school serving approximately 400 students, the majority of whom are White. Traditional 2 is also preK-5 and about the same size, but serves a predominately African American population. Traditional 3 serves a predominately White population of approximately 700 students in grade K through five. The researcher found no evidence that these magnet and traditional schools employ multiage classes or two-to-three-hour independent work periods, suggesting that the instructional methods between Montessori and comparison schools did not significantly overlap. Additional descriptive statistics about the Montessori, magnet, and traditional schools in this study from the 2013-2014 academic year are given in Table 3.

Table 3: Student and teacher characteristics for treatment and comparison schools, 2013-2014

School	Percent Limited English Proficient Students	Percent Students with Disabilities	One-Year Teacher Turnover Rate	Percent Teachers with Advanced Degrees	Percent Teachers in Years 0-3
Montessori 1	0	6	5	53	32
Montessori 2	0	5	25	44	16
Montessori 3	1	5	4	43	14
Magnet 1	1	5	16	14	7
Magnet 2	2	3	26	27	48
Magnet 3	1	7	18	40	20
Traditional 1	2	5	15	28	17
Traditional 2	16	9	15	51	19
Traditional 3	3	7	13	38	29

Instrumentation

This study utilizes scores from the state-mandated End-of-Grade tests (EOGs), standardized reading and math assessments that all North Carolina students must take beginning in grade three (North Carolina Department of Public Instruction [NCDPI] Division of Accountability Services, 2014). Although these standardized assessments are counter to Montessori philosophy, these tests are the most consistently used measures of learning across school settings and school years in this school district. Since the North Carolina testing program began in 1996 (Sanford, 1996), the tests have undergone three revisions. Reliability and validity information for the three editions of the grade three tests used for this study is given below.

EOG Edition Two

The second edition of the EOG reading assessment was administered from 2004 to 2007. The second edition of the EOG math assessment was no longer in use by 2006-

2007, the first year of this study; rather, the third edition was already in use at this point. For the reading test, criterion validity was assessed by correlating EOG achievement with teachers' judgments and expectations; these correlations were found to be moderate to strong (Bazemore & Van Dyk, 2004). Bazemore and Van Dyk (2004) provide a breakdown of reading test items by construct measured as evidence of content validity (Table 4). As evidence of reliability, a Cronbach's alpha of .92 is given (Bazemore & Van Dyk, 2004).

Table 4: Grade three end-of-grade reading assessment edition two content validity results

Construct	Average Number of Items per Form	Average Percentage of Items per Form
Cognition	18.7	37.3
Interpretation	18.3	36.7
Critical Stance	9.7	19.3
Connections	3.3	6.7

EOG Edition Three

For the third edition, as with previous editions, the item development process included teacher review to ensure content validity for both the reading and math assessments (NCDPI, 2009; Bazemore, Kramer, Gallagher, Englehart, & Brown, 2008). A teacher survey similar to the one administered for the second edition was also completed; respondents generally indicated high levels of agreement that the tests align with curricula. For the math test, an external reviewer was brought in to evaluate the alignment between the North Carolina Standard Course of Study in math and the math EOG; this reviewer found strong alignment for the grade three assessment (Bazemore et al., 2008). To assess criterion validity, teacher expectations and judgments of student

achievement were correlated with EOG scores; these correlation coefficients were found to be moderate to strong for both reading (.66 to .69) and math (.60 to .78) (NCDPI, 2009; Bazemore et al., 2008). The mean Cronbach's alpha across forms is .93 for the reading assessment (NCDPI, 2009) and .91 for the math assessment (Bazemore et al., 2008). The third edition of the reading assessment was administered from 2007-2008 to 2011-2012. The third edition of the math assessment also remained in use through the 2011-2012 school year.

EOG Edition Four

The North Carolina EOG is currently in its fourth edition, which was first administered in 2013 (NCDPI, 2014). This edition of the test is aligned with the Common Core State Standards, which North Carolina adopted in 2010 and implemented in the 2012-2013 academic year (NCDPI, n.d.). The Cronbach's alpha for the fourth edition of the reading and math EOGs ranges from .91 to .92 (NCDPI, 2014a), which is considered high reliability (Gay et al., 2012). As with previous editions, the fourth edition of the math and language arts EOGs was developed with teacher input and review to ensure content validity (NCPDI, 2014a). As evidence of construct validity, the percentage of test items associated with each content domain is provided (NCDPI, 2014b). This information is provided in Table 5.

Table 5: Grade three end-of-grade reading and math assessment edition four construct validity results

Construct	Percentage of Test Items
Reading	
Reading for literature	32-37
Reading for information	41-45
Language	20-24
Math	
Operations and algebraic thinking	30-35
Number and operations in base 10	5-10
Number and operations—fractions	20-25
Measurement and data	22-27
Geometry	10-15

Research Procedures

An application for approval of the study was submitted to the University of North Carolina at Charlotte Institutional Review Board (see Appendix). Traditional and magnet schools were identified and selected for the comparison groups. A request for the necessary student achievement and demographic data was made to a local data aggregation institution. Once the data were obtained, the researcher imported the data into IBM SPSS and cleaned the data to prepare for analysis.

Data Analysis

Raw test scores were converted to z-scores for analysis. Z-scores were calculated separately for each edition of the EOG, using the mean and standard deviation established during the creation of each new edition. This conversion makes it possible to compare scores across different years and different editions of the assessments. A factorial multivariate analysis of covariance (MANCOVA) was conducted to check for statistically significant differences among group mean reading and math scores by program type. MANCOVA can be used to analyze differences in multiple dependent

variables based on one or more independent variables, while controlling for the effects of one or more covariates (Tabachnick & Fidell, 2013). A multivariate analysis of variance (MANOVA) was also conducted to include cases in which data for the covariates were missing. In both analyses, program type was the focal independent variable, with three levels: Montessori, magnet, and traditional. Other independent variables used in the analysis included student gender, special education status, and gifted status. Absences and number of days suspended out-of-school were included as covariates. Dependent variables were mean EOG reading and math z-scores. Any analysis of variance is an omnibus test, revealing only the presence of statistically significant differences without identifying specifically where those differences lie (Huck, 2011). For this reason, planned comparisons were conducted to compare reading and math achievement of students in the treatment group (Montessori) to that of students in each of the comparison groups (magnet and traditional).

Assumptions

Several assumptions are inherent in the design of this study. The measures of program fidelity reported are assumed to be meaningful. Tabachnick and Fidell (2013) identify four assumptions that must also be met in order to proceed with the MANCOVA: independence of observations, multivariate normality of the dependent variables, homogeneity of covariance matrices, and reliability of covariates. These assumptions were checked as part of the data analysis. Mahalanobis distances were calculated to check for multivariate normality. Box's Test of Equality of Covariance Matrices was conducted to test the assumption of homogeneity of covariance matrices. The assumption of independence of observations is met because outcomes in any one group do not affect

outcomes in either of the other two groups. The histograms of each dependent variable by group show this to be true. The correlations between the covariates and dependent variables were also tested.

Delimitations

This study is cross-sectional versus longitudinal; growth over time is not addressed due to the lack of universally administered assessments prior to third grade. Measures of academic achievement in reading and math are limited to standardized test scores; this study does not employ more nuanced assessments of learning. This study also does not address learning in science, social studies, or any other content area outside of reading and math. School choice programs are limited to magnet schools; charter school settings are not included. Historically marginalized groups in this study are limited to African American students. Other groups, such as other students of color, students with learning disabilities, and students with limited English proficiency, are not considered. Variations in teacher quality are also not accounted for. This study is strictly confined to Montessori programs in the public sector, and may not generalize to private school settings.

Limitations

Several factors limit the utility of this study. This study represents an evaluation of only part of the Montessori model; the use of standardized reading and math tests scores limits the ability to draw conclusions about other aspects of Montessori education. This study does not directly evaluate social-emotional development, executive function, or achievement in other subject areas. The lack of random assignment of students to Montessori and non-Montessori environments makes causal inference tenuous. While the

use of school matching does control for a host of variables, it is possible that parents who choose Montessori for their children are qualitatively different from other parents in a way that is not captured by the data available for this study. Similarly, though poverty was controlled for at the school level, student-level poverty data were not available. At best, this study represents causal description rather than causal explanation; if students fare better or worse in Montessori environments than others, this study does not explain why. Similarly, this study gets at molar description rather than molecular (Shadish et al., 2002); if Montessori environments are more or less conducive to reading and math achievement, this study does not identify what specific elements of the Montessori approach do or do not support this achievement. While structural elements of fidelity were documented, described, and found to be high, classroom observations from the years for which data were collected were not possible; this limits conclusions that can be drawn about fidelity at the classroom level. The minimal use of testing in Montessori environments as compared to other schools may also be a confounding factor.

Summary

This study was designed to compare reading and math achievement for third grade African American students in public Montessori, traditional, and other school choice programs. In this quasi-experimental design, the treatment group consisted of African American students who had completed third grade in a public Montessori program in a large, urban district between 2007 and 2014. Comparison groups consisted of African American students who had completed third grade in similar traditional and other school choice programs during the same years. Group mean scores on the North Carolina end-of-grade reading and math tests for grade three were compared using

factorial MANCOVA and MANOVA procedures. Results of this analysis are discussed in the next chapter.

CHAPTER 4: RESULTS

This quasi-experimental, quantitative study is designed to evaluate the effectiveness of Montessori reading and math instruction for African American students in grade three. To this end, a comparative analysis of reading and math achievement was conducted for African American students in grade three in Montessori, traditional, and magnet public schools in a large urban district in the Southeast. The measures used for this study were z-scores from end-of-grade, standardized North Carolina grade three math and reading tests from the 2006-2007 academic year through the 2013-2014 academic year. Factorial multivariate analysis of covariance (MANCOVA) and multivariate analysis of variance (MANOVA) were conducted, with school setting as the focal independent variable and standard math and reading test scores as the dependent variables, to answer the following research questions:

- 1) Do African American third grade students in public Montessori programs in urban settings exhibit significantly different levels of achievement in math compared to African American third grade students in similar school choice programs located within the same district?
- 2) Do African American third grade students in public Montessori programs in urban settings exhibit significantly different levels of achievement in reading compared to African American third grade students in similar school choice programs located within the same district?

- 3) Do African American third grade students in public Montessori programs in urban settings exhibit significantly different levels of achievement in math compared to African American third grade students in similar traditional public schools located within the same district?
- 4) Do African American third grade students in public Montessori programs in urban settings exhibit significantly different levels of achievement in reading compared to African American third grade students in similar traditional public schools located within the same district?

For each research question, the null hypothesis was tested. This chapter presents the results of this analysis and the answers to these research questions. Figure 4 provides an overview of the organization of this chapter.

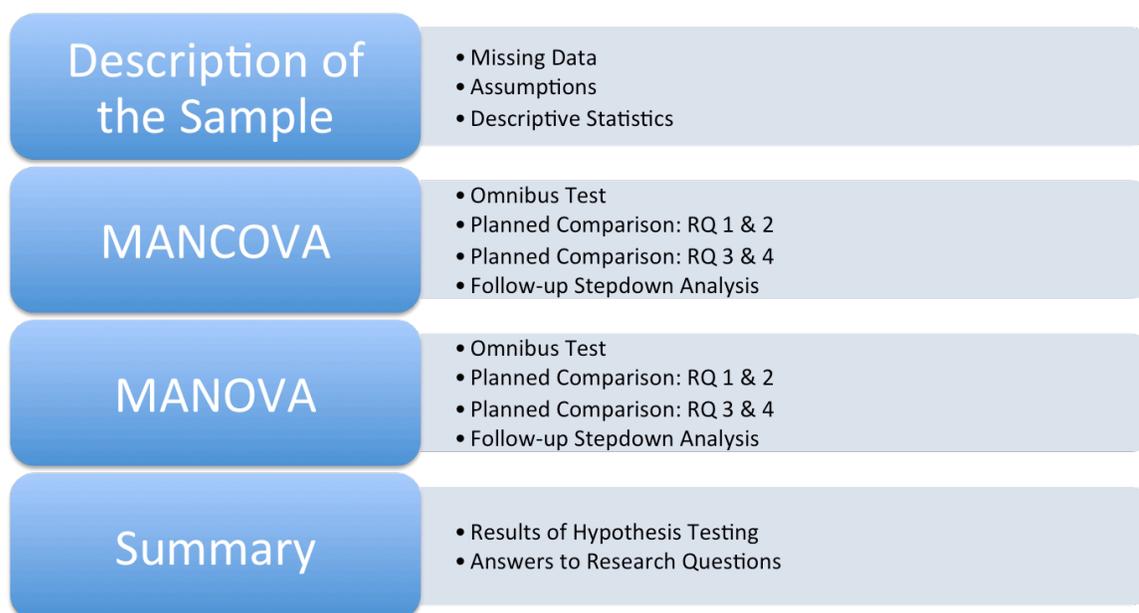


Figure 3: Organization of Chapter Four

First, a description of the sample is given. This includes how missing data were handled, tests of assumptions for MANCOVA and MANOVA, and descriptive statistics for the sample. This is followed by the results of the MANCOVA and MANOVA procedures. MANCOVA and MANOVA are both omnibus tests that encompass all four research questions. For each procedure, planned comparisons were conducted as follow-up tests to answer each research question individually and to explore significant interactions identified among independent variables. Within each analysis, results of the omnibus test are given first, followed by results from the planned comparisons organized by research question. For research question 1, no significant difference was found, but for research questions 2, 3, and 4, significant differences favoring Montessori were identified. Roy-Bargmann stepdown analyses were conducted as follow-up tests to both the MANCOVA and MANOVA procedures to account for the relationship between the two dependent variables; these results follow the planned comparisons. The chapter concludes with a summary of results and answers to the four research questions.

Description of the Sample

Achievement and demographic data were collected for the 2,608 African American students who were enrolled at grade three in the selected Montessori, magnet, and traditional schools in a large, urban district in the North Carolina between 2006-2007 and 2013-2014. Because the data included test scores from multiple editions of the end-of-grade tests, all test scores were converted to z-scores. For students with data from more than one year, only data from the first year, reflecting that student's first attempt at grade three, were used. This was done to ensure that the sample was not biased by the inclusion of students who had two years' worth of exposure to third-grade content and

instruction. Due to the very small number of students in individual ELL and special education categories, these variables were collapsed into dichotomous variables for analysis. Students with an ELL status of monitored, consultative, and served were reclassified as students receiving ELL services, while students classified as exited, not served, or waived were reclassified as students not receiving ELL services. Similarly, students whose special education status was gifted were reclassified as gifted, while students whose status indicated a disability of some kind were reclassified as special education. The number of students who were classified as homeless was too small to include homelessness as an independent variable; this factor is nonetheless included in the descriptive statistics. Number of absences and days suspended out-of-school (OSS) were included as covariates.

Missing Data

Both reading and math test scores were missing for 217 students, or approximately 8% of the total. Because these scores could not be reliably imputed, these students were removed from the sample. Of the 2,391 students remaining, four were missing math test scores and 15 were missing reading test scores. Little's Missing Completely At Random Test was significant, $\chi^2(2, N = 2391) = 33.381, p < .001$, so listwise deletion was not appropriate (Tabachnick & Fidell, 2013). Instead, regression was used to impute the 19 missing values. Because this is such a small number of cases, and such a small percent of the total cases (<.01%), this procedure did not compromise the results of the analysis. Absence and OSS data were missing for an additional 122 students. Because these cases could not be included in the MANCOVA, a MANOVA was also run in order to include these cases. Both procedures are reported here.

A standard multiple regression was conducted to predict math score from absences, group, gender, reading score, disability status, giftedness status, and ELL status. The unstandardized regression coefficients are reported in Table 6. The variance accounted for was equal to 52% (adjusted $R^2=.52$), which was significantly different from zero ($F=274.423, p<.001$). These unstandardized regression coefficients were used to impute values for the four missing math scores.

Table 6: Regression analysis summary for predicting math score

Variable	B	SEB	β	t	p
Intercept	.419	.023		18.209	<.001
Absences	-.008	.002	-.060	-3.971	<.001
OSS	-.038	.012	-.050	-3.282	.001
Gender	.145	.023	.093	6.277	<.001
Reading score	.594	.016	.616	37.450	<.001
Gifted status	.462	.050	.140	9.212	<.001
Special education status	-.204	.043	-.073	-4.797	<.001
Montessori	-.144	.033	-.066	-4.349	<.001
Traditional	-.192	.027	-.108	-7.031	<.001
ELL status	.185	.092	.030	2.019	.044

Note. (a) adjusted $R^2 = .52$ ($n = 2387$)

The same procedure was employed to impute missing reading scores. A standard multiple regression was conducted to predict reading score from absences, OSS, group, gender, math score, disability status, giftedness status, and ELL status. The unstandardized regression coefficients are reported in Table 7. The variance accounted for was equal to 52% (adjusted $R^2=.52$), which was significantly different from zero ($F=266.221, p<.001$). Values for 13 of the 15 missing reading scores were calculated using these unstandardized regression coefficients.

Table 7: Regression analysis summary for predicting reading score with OSS and absences

Variable	B	SEB	β	<i>t</i>	<i>p</i>
Intercept	-.110	.026		-4.291	<.001
Absences	-.001	.002	-.010	-.650	.516
OSS Days	-.016	.012	-.021	-1.345	.179
Gender	-.180	.024	-.112	-7.503	<.001
Math score	.648	.017	.626	37.450	<.001
Gifted status	.199	.053	.058	3.736	<.001
Special education status	-.334	.044	-.116	-7.575	<.001
Montessori	.189	.034	.083	5.489	<.001
Traditional	.009	.029	.005	.303	.762
ELL status	-.472	.095	-.074	-4.959	.000

Note. (a) adjusted $R^2 = .52$ ($n = 2376$)

The remaining two cases were missing data for absences and OSS; for these two cases, a separate regression was run to predict reading scores from group, gender, math score, disability status, giftedness status, and ELL status without absences and OSS. These unstandardized regression coefficients are found in Table 8. The variance accounted for was equal to 52% (adjusted $R^2=.52$), which was significantly different from zero ($F=362.789, p<.001$).

Table 8: Regression analysis summary for predicting reading score without OSS and absences

Variable	B	SEB	β	<i>t</i>	<i>p</i>
Intercept	-.131	.021		-6.258	<.001
Gender	-.178	.023	-.111	-7.710	<.001
Math score	.660	.017	.637	39.787	<.001
Gifted status	.188	.051	.056	3.667	<.001
Special education status	-.326	.043	-.113	-7.581	<.001
Montessori	.205	.033	.091	6.203	<.001
Traditional	.023	.028	.012	.818	.414
ELL status	-.397	.090	-.064	-4.427	<.001

Note. (a) adjusted $R^2 = .52$ ($n = 2376$)

Assumptions

Before conducting the MANCOVA and MANOVA, the researcher screened the data to ensure the assumptions underlying the procedures were met. First, the data were screened for outliers. Some univariate outliers were detected, but these values were found to be within the normal and expected range for their respective variables, and were not found to be overly influential in the analysis. Thus, these data were retained. Mahalanobis distances were calculated to check for multivariate outliers. A total of 125 multivariate outliers were detected; these outliers were found to influence the results, so these cases were excluded from the analysis. No ELL students remained after removing the outliers, so ELL status was not used as an independent variable. Histograms revealed both dependent variables by school setting to be fairly normally distributed; results of the tests of normality are given in Table 9.

Table 9: Tests of normality for reading and math scores by school setting

School Setting	Shapiro-Wilk	df	p
Math			
Montessori	.996	348	.450
Magnet	.997	1361	.024
Traditional	.038	557	.130
Reading			
Montessori	.996	348	.497
Magnet	.993	1361	<.001
Traditional	.994	557	.017

Box's M (92.863) was significant ($p < .001$), indicating that the assumption of homogeneity of covariance matrices was violated. Because this assumption was not met, the Pillai's trace statistic was used in the MANCOVA and MANOVA (Tabachnick &

Fidell, 2013). Furthermore, if variances differ substantially across levels of the independent variable, the chances of a Type I error are inflated (Tabachnick & Fidell, 2013). Tabachnick and Fidell (2013) argue that for robustness, the ratio of largest to smallest variance should be less than 10:1 for all dependent variables. In this case, the largest ratio is 1.24:1, indicating that the risk of a Type I error is not substantially inflated. Lastly, the inclusion of covariates is predicated on the assumption that these covariates are related to the dependent variables. Correlations between covariates and dependent variables are given in Table 10.

Table 10: Correlations among covariates and dependent variables

Measure	Correlations		
	1	2	3
1. Absences			
2. OSS	.135*		
3. Math score	-.162*	-.117*	
4. Reading score	-.127*	-.140*	.691*

Note. * $p < .01$

The correlations between the covariates (OSS and absences) and the dependent variables (math score and reading score) are weak (Huck, 2011) but statistically significant. This indicates that including OSS and absences as covariates in this analysis will help to reduce the amount of unexplained variance in student math and reading test scores. Thus, the inclusion of these variables as covariates is justified.

Descriptive Statistics

Table 11 contains descriptive statistics for categorical, demographic variables included in this study both for the sample as a whole and by school setting. This all-

African American sample was split approximately equally between males and females. The majority of students were classified as general education; only 13.5% of students were classified as special education, and these students were distributed approximately evenly across the three school settings. A small proportion (5%) of the sample was classified as gifted; these students were also distributed approximately equally across the three school settings. A very small proportion (1.8%) of students were classified as homeless. None of the students were designated as English language learners.

Table 11: Participant characteristics as percentages of the treatment and comparison groups

Characteristic	Percent			
	Montessori (N=348)	Magnet (n=1361)	Traditional (n=557)	Total Sample (n=2266)
Gender				
Male	46.6	48.6	53.0	47.9
Female	53.4	51.4	47.0	52.1
Special education status				
Not special education	91.7	92.4	89.3	91.5
Speech/language impaired	1.7	2.1	2.7	2.2
Other health impaired	1.4	1.0	1.3	1.1
Specific learning disabled	4.9	3.7	5.9	4.5
Mild intellectual disability	0	0	.2	<.1
Hearing impaired	0	.5	.2	.4
Educable mentally disabled	0	.1	0	<.1
Serious emotional disability	0	.1	.4	.1
Autistic	.3	.1	0	.1
Gifted status				
Not gifted	96.3	93.6	97.6	95.0
Gifted	3.7	6.4	2.5	5.0
Homelessness status				
Not homeless	99.1	99.0	95.9	98.2
Homeless	.9	1.0	4.1	1.8

Attendance data were also collected; Table 12 provides descriptive statistics for mean number of days absent and mean number of days suspended out-of-school (OSS) by school setting. Students in Montessori schools had the lowest mean number of absences (4.71) and days suspended out-of-school (.03). Students in magnet schools were absent, on average 5.34 days and suspended out-of-school, on average, .11 days. Students in traditional schools had the highest mean days absent (6.41) and days suspended out-of-school (.15).

Table 12: Descriptive statistics for absences and days suspended out-of-school (OSS) by school setting

School Setting	Absences			OSS		
	M	SD	N	M	SD	N
Montessori	4.71	.22	321	.03	.01	321
Magnet	5.34	.13	1296	.11	.01	1296
Traditional	6.41	.24	527	.15	.02	527

Table 13 contains descriptive statistics for the dependent variables, reading and math z-scores, by school setting. Because these scores are reported as z-scores, the mean score for each group reflects that group's performance in relation to the overall, statewide mean established for these assessments. In math, the magnet group had the highest mean at .52, over half a standard deviation above average. The math mean for the Montessori group was only slightly lower (.49). For the students in traditional schools, the mean math score was .14. The Montessori group had the highest mean reading score at .30, or almost one-third of a standard deviation above the mean. Students in the traditional group had the lowest mean reading score at -.14, indicating that this group scored below the statewide average. The magnet group fell in the middle, with a mean reading score of .12.

Table 13: Descriptive statistics for math and reading z-scores by school setting

School Setting	Math			Reading		
	M	SD	N	M	SD	N
Montessori	.49	.04	348	.30	.04	348
Magnet	.52	.02	1361	.12	.02	1361
Traditional	.14	.03	557	-.14	.03	557

MANCOVA Results

After subtracting the 122 cases that were missing data for the covariates, a total of 2,144 cases were included in the MANCOVA. A between-subjects MANCOVA was performed using SPSS on reading and math scores, with school setting, gender, special education status, and gifted status as independent variables. School setting had three levels (Montessori, magnet, and traditional) while gender, special education status, and gifted status were coded as dichotomous variables. Absences and days suspended out-of-school were included as covariates. Table 14 contains mean scores by school setting after adjusting for the covariates. These means were used as dependent variables in the MANCOVA.

Table 14: Adjusted math and reading means by school setting

Group	Math		Reading	
	Mean	Standard Error	Mean	Standard Error
Montessori	.57	.08	.32	.09
Magnet	.57	.04	.13	.04
Traditional	.17	.06	-.19	.06

Note. Covariates=absences and OSS. Scores are reported as z-scores.

Results from the multivariate analysis of the focal independent variable and interactions with the other independent variables are reported in Table 15. Pillai's criterion indicated that school setting significantly affected the combined dependent variables, $F(4, 4250)=3.446$, $p=.008$; however, the effect size was very small, partial $\eta^2=.003$ (Cohen, 1988).

Table 15: Summary of multivariate effects for MANCOVA

Variable	Pillai's Trace	<i>F</i>	df	Error df	<i>p</i>
School setting	.006	3.446*	4	4250	.008
School setting*gender	.002	1.135	4	4250	.338
School setting*gifted status	.000	.053	4	4250	.995
School setting*special ed status	.002	1.267	4	4250	.281
Group*gender*gifted status	.000	.071	2	2124	.931
Group*gender*special ed status	.006	3.064*	4	4250	.016

Note. *Significant at the .05 level

A significant interaction was also detected among school setting, gender, and special education status using Pillai's trace, $F(4, 4250)=3.064$, $p=.016$. This effect was also very small, partial $\eta^2=.003$ (Cohen, 1988). A simple effect test was conducted to explore this interaction (Tabachnick & Fidell, 2013); the MANCOVA was re-run for males and females separately. This simple effect test revealed that the interaction of school setting and special education status was only significant for female students, Pillai's trace, $F(4, 2220)=2.509$, $p=.040$. No other significant interactions occurred between group and the other independent variables.

The results of this omnibus test indicate that a statistically significant difference was present in adjusted mean reading and math scores by school setting, as well as a

significant interaction between school setting, gender, and special education status. However, this finding alone is insufficient to answer the research questions, since the omnibus test does not reveal between which groups these differences lie, or on what measures (Tabachnick & Fidell, 2013). For this reason, planned comparisons were conducted to identify which between-group differences were statistically significant and answer the research questions (RQs) established for this study.

RQ 1 and RQ 2: Montessori vs. Magnet

Planned comparisons were conducted to identify significant differences in adjusted math and reading mean scores between the treatment group (Montessori) and the first comparison group (magnet) to answer RQ 1 and RQ 2, respectively. Results of these planned comparisons are given in Table 16. No significant difference was found for math scores ($p=.086$); this indicates that for RQ 1, the null hypothesis must be retained. Reading scores were found to be significantly different between Montessori and magnet school settings ($p=.038$), with Montessori students scoring higher. Thus, for RQ 2, the null hypothesis is rejected.

Table 16: Results of planned comparisons from MANCOVA: Montessori vs. magnet

Dependent Variable	Contrast Estimate	Hypothesized Value	Difference	Standard Error	p
Math	.010	0	.010	.086	.906
Reading	-.187	0	-.187*	.090	.038

Note. *Significant at the .05 level

Planned comparisons were also conducted to determine how school setting impacted mean reading and math scores for female special education students. This was

done to explore the significant interaction of school setting and special education status for female students identified in the MANCOVA and subsequent simple effect test.

Results of these planned comparisons are given in Table 17.

Table 17: Results of planned comparisons from MANCOVA for female special education students: Montessori vs. magnet

Dependent Variable	Contrast Estimate	Hypothesized Value	Difference	Standard Error	<i>p</i>
Math	-.117	0	-.117	.108	.279
Reading	-.366	0	-.366*	.113	.001

Note. *Significant at the .05 level

Reading scores for these students were found to be significantly different between Montessori and magnet school settings ($p=.001$), with Montessori students scoring higher. No significant differences in math scores were detected for female students with learning disabilities in Montessori and magnet school settings ($p=.279$). While the research questions did not specifically address this subgroup, these results are consistent with those found for the sample overall: a significant difference in reading, favoring Montessori students over magnet students, with no significant difference in math.

RQ 3 and RQ 4: Montessori vs. Traditional

A planned comparison was also conducted to compare math and reading outcomes between Montessori and traditional school settings to answer RQ 3 and RQ 4, respectively. These results are given in Table 18. Significant differences were found in both reading ($p<.001$) and math ($p=.023$), with Montessori students scoring higher in both subjects. This suggests that the null hypothesis can be rejected for both RQ 3 and RQ 4.

Table 18: Results of planned comparisons from MANCOVA: Montessori vs. traditional

Dependent Variable	Contrast Estimate	Hypothesized Value	Difference	Standard Error	<i>p</i>
Math	-.219	0	-.219*	.097	.023
Reading	-.369	0	-.369*	.101	<.001

Note. *Significant at the .05 level

Planned comparisons were also conducted to check for differences in mean reading and math scores for female special education students in traditional and Montessori schools, given the significant interaction of school setting and special education status for female students identified in the MANCOVA and subsequent simple effect test. Results of these planned comparisons are given in Table 19.

Table 19: Results of planned comparisons from MANCOVA for female special education students: Montessori vs. traditional

Dependent Variable	Contrast Estimate	Hypothesized Value	Difference	Standard Error	<i>p</i>
Math	-.219	0	-.219	.125	.079
Reading	-.396	0	-.396*	.131	.002

Note. *Significant at the .05 level

Significant differences were found between Montessori and traditional school settings in reading ($p=.002$), again, with Montessori students scoring higher. No significant differences were identified in math scores ($p=.079$). Again, the research questions established for this study did not address African American female students with learning disabilities specifically, but this finding is nonetheless relevant. The significant difference in reading scores is consistent with the results for the sample

overall. However, while African American students in Montessori programs significantly outperformed their peers in traditional school settings in math, this finding did not apply to African American female students with disabilities.

Stepdown Analysis

To ensure that these findings with regard to reading and math outcomes were accurate, the high level of correlation between reading and math scores must be taken into consideration. To account for the relationship between these two dependent variables, a Roy-Bargmann stepdown analysis was performed as a follow-up to the MANCOVA (Tabachnick & Fidell, 2013). Because the extant literature provides more support for a significant effect of Montessori in reading than in math, reading was given highest priority in the analysis, adjusted for OSS and absences. The Pillai's trace criterion was used. An alpha of .025 was used in each test to achieve an experimentwise alpha of .05. The combined dependent variables were significantly related to the combined covariates, approximate $F(4, 4278)=18.95, p<.001$, and to school setting, approximate $F(4, 4278)=28.26, p<.001$. After adjusting for differences on the covariates, school setting made a significant contribution to reading, the higher-priority dependent variable, stepdown $F(2, 2139)=27.92, p<.001$. The difference in adjusted mean math score by group was found to be statistically significant even after accounting for reading, stepdown $F(2, 2138)=28.77, p<.001$. These results are given in Table 20.

Table 20: Stepdown analysis of covariates and school setting for MANCOVA

IV	DV	Univariate F	df	Stepdown F	df	p
Covariates	Reading	27.86*	2/2139	27.86**	2/2139	<.001
	Math	32.12*	2/2139	10.34**	2/2138	<.001
School setting	Reading	27.92*	2/2139	27.92**	2/2139	<.001
	Math	42.68*	2/2139	28.77**	2/2138	<.001

*Significance level cannot be evaluated but would reach $p < .025$ in univariate context.

** $p < .001$

This indicates that school setting is significantly predictive of both reading and math scores, adjusted for OSS and absences, even after the relationship between reading and math scores is accounted for. Per the results of the planned comparisons, students in Montessori scored significantly higher on math and reading tests than students in traditional schools (RQ 3 and RQ 4). When compared to students in magnet schools, however, Montessori students performed significantly better in reading only; there was no difference in math (RQ 1 and RQ 2). The results of this stepdown analysis suggest that these significant results are not simply due to the correlation between reading and math scores. Thus, the MANCOVA suggests that the null hypothesis must be retained for RQ 1, but null hypotheses for RQ 2, RQ 3, and RQ 4 can be rejected.

MANOVA Results

A MANOVA was also conducted to include the additional 122 cases that were missing data for the covariates. The results of the MANOVA parallel those of the MANCOVA and point to the same answers for all four research questions. A between-subjects MANOVA was performed with a total of 2,266 cases using SPSS on reading and math scores, with school setting, gender, special education status, and gifted status as independent variables. Results from the multivariate analysis of the focal independent

variable and interactions with the other independent variables are reported in Table 21.

Using Pillai's trace, the combined dependent variables were again significantly affected by school setting, $F(4, 4498)=4.815, p=.001$. The effect size remained very small, partial $\eta^2=.004$ (Cohen, 1988).

Table 21: Summary of multivariate effects for MANOVA

Variable	Pillai's Trace	<i>F</i>	df	Error df	<i>p</i>
School setting	.009	4.815*	4	4498	.001
School setting*gender	.003	1.415	4	4498	.226
School setting*gifted status	.000	.070	4	4498	.991
School setting*special ed status	.002	1.215	4	4498	.302
Group*gender*gifted status	.000	.189	2	2248	.827
Group*gender*special ed status	.006	3.293*	4	4498	.011

Note. *Significant at the .05 level

The interaction of school setting, gender, and special education status was once again found to be significant using Pillai's trace, $F(4, 4498)=3.293, p=.011$. This effect was also very small, partial $\eta^2=.003$ (Cohen, 1988). A simple effect test was once again conducted to explore this interaction; the MANOVA was re-run for males and females separately. This test revealed that the interaction of school setting and special education status was once again only significant for female students, Pillai's trace, $F(4, 2348)=2.738, p=.027$. No other significant interactions between group and the other independent variables were detected.

As with the MANCOVA, the MANOVA is an omnibus test that confirms the presence of statistically significant differences, but does not identify where those differences occur. Planned comparisons were conducted to check for significant

differences in reading and math scores between the treatment group and the comparison groups to answer the research questions.

RQ 1 and RQ 2: Montessori vs. Magnet

The first planned comparisons were conducted on math and reading scores between Montessori and magnet school students to address RQ 1 and RQ 2, respectively. These results, given in Table 22, are similar to the planned comparisons conducted as part of the MANCOVA. Math scores were not significantly different ($p=.791$); this indicates that for RQ 1, the null hypothesis must be retained. Reading scores were found to be significantly different between Montessori and magnet school settings ($p=.011$), with Montessori students scoring higher. For RQ 2, then, the null hypothesis can be rejected.

Table 22: Results of planned comparisons from MANOVA: Montessori vs. magnet

Dependent Variable	Contrast Estimate	Hypothesized Value	Difference	Standard Error	p
Math	-.022	0	-.022	.081	.791
Reading	-.217	0	-.217*	.085	.011

Note. *Significant at the .05 level

Because a significant interaction of school setting and special education status for female students was identified in the MANOVA and subsequent simple effect test, planned comparisons were also conducted to determine how school setting impacted mean reading and math scores for female special education students. Table 23 contains results of these planned comparisons. Female special education students in Montessori scored significantly higher than their counterparts in magnet schools in reading ($p<.001$). No significant difference was found in math scores. While this finding does not relate

directly to a research question, it is consistent with the results for the overall sample of students in Montessori and magnet school settings.

Table 23: Results of planned comparisons from MANOVA for female special education students: Montessori vs. magnet

Dependent Variable	Contrast Estimate	Hypothesized Value	Difference	Standard Error	<i>p</i>
Math	-.171	0	-.171	.106	.107
Reading	-.414	0	-.414*	.111	.000

Note. *Significant at the .05 level

RQ 3 and RQ 4: Montessori vs. Traditional

The second planned comparison was conducted to address RQ 3 and RQ 4, comparing Montessori students to students in traditional schools in math and reading; these results are given in Table 24. Significant differences were identified between Montessori and traditional school settings in both reading ($p < .001$) and math ($p = .002$), with Montessori students scoring higher in both subjects. Thus, the null hypotheses for RQ 3 and RQ 4 can both be rejected.

Table 24: Results of planned comparisons from MANOVA: Montessori vs. traditional

Contrast	Contrast Estimate	Hypothesized Value	Difference	Standard Error	<i>p</i>
Traditional vs. Montessori					
Math	-.284	0	-.284*	.091	.002
Reading	-.408	0	-.408*	.095	<.001

Note. *Significant at the .05 level

Given the significant interaction of school setting and special education status for female students identified in the MANOVA and subsequent simple effect test, planned comparisons were also conducted to determine how mean reading and math scores for female special education students varied by school setting. Results of these planned comparisons are given in Table 25.

Table 25: Results of planned comparisons from MANOVA for female special education students: Montessori vs. traditional

Dependent Variable	Contrast Estimate	Hypothesized Value	Difference	Standard Error	<i>p</i>
Math	-.304	0	-.304*	.121	.012
Reading	-.443	0	-.443*	.126	.000

Note. *Significant at the .05 level

Significant differences were found between Montessori and traditional school settings in both reading ($p < .001$) and math ($p = .012$), with African American female Montessori students with learning disabilities scoring higher in both. While this finding does not relate directly to a research question, it is nonetheless important to note. This result is consistent with those of the overall comparison of African American students in Montessori and traditional school settings. However, it is different from that of the same planned comparison conducted as a follow-up to the MANCOVA, where no significant difference in math scores was found for this subgroup. This suggests that the statistically significant difference in math scores for African American female students with disabilities in Montessori and traditional school settings identified here disappears once absences and OSS are taken into account.

Female Special Education Students: Montessori vs. Average of Magnet and Traditional

A separate planned comparison was conducted to check for statistically significant differences between mean reading and math scores in Montessori school settings for female students with disabilities versus the average of scores across both magnet and traditional settings for math and reading. This was done under the umbrella of the MANOVA rather than the MANCOVA because covariates could not be included. The results of this comparison are given in Table 26. There was no significant difference in math ($p=.512$), but a significant difference was found in reading, with female special education students scoring higher on average than their counterparts in magnet and traditional settings combined. Again, this finding does not relate directly to the research questions established for this study, but is an important finding nonetheless.

Table 26: Results of planned comparison from MANOVA for female special education students: Montessori vs. average of magnet and traditional

Dependent Variable	Contrast Estimate	Hypothesized Value	Difference	Standard Error	<i>p</i>
Math	.039	0	.039	.059	.512
Reading	.190	0	.190*	.062	.002

Note. *Significant at the .05 level

Stepdown Analysis

A Roy-Bargmann stepdown analysis was again performed to account for the relationship between the two dependent variables (Tabachnick & Fidell, 2013). Again, reading was given highest priority, followed by math, using the Pillai's trace criterion. These results are given in Table 27.

Table 27: Stepdown analysis of school setting for MANOVA

IV	DV	Univariate F	df	Stepdown F	df	p
School setting	Reading	38.12*	2/2263	38.12**	2/2263	<.001
	Math	55.16*	2/2263	34.83**	2/2262	<.001

*Significance level cannot be evaluated but would reach $p<.025$ in univariate context.

** $p<.001$

The combined dependent variables were significantly related to school setting, approximate $F(4, 4526)=36.33, p<.001$. As expected, school setting made a significant contribution to reading, the higher-priority dependent variable, stepdown $F(2, 2263)=38.12, p<.001$. Mean math score was found to significantly vary by group even after accounting for reading, stepdown $F(2, 2262)=34.83, p<.001$. Thus, school setting is again shown to be significantly predictive of both reading and math scores, even after the relationship between reading and math scores is accounted for. These results reinforce the finding from the MANCOVA: students in Montessori performed significantly better than their peers in traditional schools on measures of both reading and math. There was no significant difference between Montessori students and magnet school students in math, but in reading, Montessori students fared significantly better.

Summary

This study examined reading and math achievement for African American students in Montessori, magnet, and traditional public schools who completed grade three between 2006-2007 and 2013-2014. A multivariate analysis of covariance was conducted to check for statistically significant differences in mean reading and math scores by school setting with a sample of 2,144 students. Gender, special education status, and gifted status were used as independent variables, while absences and days suspended out-

of-school served as covariates. A multivariate analysis of variance was also run without the covariates to include the 122 additional students who were missing data for absences and OSS. Both the MANCOVA and MANOVA identified statistically significant differences in reading and math achievement by school setting. Planned comparisons were conducted to determine which group differences were statistically significant. Roy-Bargmann stepdown analyses were also conducted to account for the relationship between the dependent variables.

The results from both the MANCOVA and MANOVA provide answers to the research questions posed at the beginning of this chapter. Both analyses pointed toward the same answers to these research questions. These results are summarized in Table 28.

Table 28: Results of hypothesis testing

Research Question	Null Hypothesis	Null Rejected
Montessori vs. Magnet		
1. Math	No significant difference	No
2. Reading	No significant difference	Yes
Montessori vs. Traditional		
3. Math	No significant difference	Yes
4. Reading	No significant difference	Yes

For each research question, a corresponding null hypothesis was formulated and tested.

The null hypothesis for RQ 1 asserted that there would be no significant difference in mean math scores between African American Montessori students and African American students in other school choice programs. Neither analysis provided justification for rejecting this null hypothesis, so it was retained. The null hypothesis for RQ 2 stated that there would be no significant difference in mean reading scores between the same two

groups of students. This null hypothesis was rejected, with Montessori students performing significantly better on the end-of-grade reading assessment than their peers in comparison magnet schools, although the effect sizes yielded in both analyses were very small. For RQ 3, the null hypothesis suggested that there would be no significant difference between mean math scores of African American students in Montessori schools and African American students in similar traditional schools. This null hypothesis was also rejected, with Montessori students outperforming their peers in traditional schools, although again, effect sizes were very small. The null hypothesis for RQ 4 posited that there would be no significant difference in mean reading scores between African American Montessori students and their peers at traditional schools. This null hypothesis was also rejected, as the Montessori students' mean reading score was found to be significantly higher than that of students in the traditional comparison schools. Lastly, a significant interaction was observed among school setting, gender, and special education status. Planned comparisons indicated that female, African American students with disabilities performed significantly better in reading than their counterparts in other school settings.

In the next chapter, these results are discussed and placed in the context of the larger literature. Limitations and implications of the study are considered. The study concludes with recommendations for policy, practice, and future research.

CHAPTER 5: DISCUSSION

Promoting academic achievement for African American students has been and remains a critical issue facing the American public school system (Lewis, Chambers, & Butler, 2012; Vanneman et al., 2009; Wilson, 2012). Advocates of the Montessori method have argued that the Montessori approach provides a potential model for school reform (Lillard, 2005), with some scholars suggesting that Montessori education could be particularly beneficial for African American students (Hall & Murray, 2011; Rambusch, 2007/1976; Rule & Kyle, 2009). This study was designed to see if this assertion could be supported by evidence; the purpose of this quasi-experimental, quantitative study was to evaluate the effectiveness of Montessori reading and math instruction for African American students in grade three in urban settings. Four research questions were developed to explore whether African American, third-grade students in public Montessori programs achieve at significantly different levels on standardized assessments of reading and math when compared to their counterparts at similar traditional and magnet schools. The results of two different multivariate analyses both suggest that African American, third-grade students in public Montessori schools score significantly higher in reading and math than their counterparts in similar traditional schools, though when compared to their counterparts in magnet schools, Montessori students perform better in reading, but fare the same in math. Though these differences were statistically significant, effect sizes were very small. These advantages were detectable in spite of the

“test prep advantage” articulated by Manner (2007) that students in the magnet and traditional settings may have had.

This chapter contains a discussion of these results and conclusions that can be drawn from this research. These results are interpreted in the context of both conceptual literature and previous empirical studies pertaining to Montessori for African American students. The limitations of this study are reviewed. Finally, recommendations are provided for policy, practice, and future research.

Discussion

The review of the literature provided in chapter two highlighted four key points that bear reiterating in this discussion of the study results. First, although African American students constitute a substantial portion of the public Montessori student body, few studies conducted at the elementary level have focused on outcomes for African American students specifically. Second, many of the studies that do focus on African American students are conducted exclusively with low-income populations, while the sample employed in the present study includes a more socioeconomically diverse population of African American students. Third, fidelity of implementation of the Montessori method varies widely in public school settings, though this school district exhibited several markers of high-fidelity Montessori programs. Lastly, though there is some evidence from prior studies that Montessori education at the elementary level may support achievement for African American students in reading and math, this evidence is inconsistent. Here, the answers to each research question are discussed in light of this body of literature.

RQ1: Montessori vs. Magnet, Math

The first research question posed was, is there a statistically significant difference between mean math scores for African American students at grade three in public Montessori schools versus African American students at grade three in similar school choice programs? Results from the multivariate analysis suggest that there was no statistically significant difference in mean math scores across these two groups. Looking at both the adjusted group means used in the MANCOVA and the unadjusted group means used in the MANOVA, students in both of these groups scored approximately half of one standard deviation above average. This contradicts the findings of Sciarra and Dorsey (1976) and Dawson (1987), who found statistically significant advantages for Montessori students in math at grade three, but is consistent with those of Stodolsky (1970), Moore (1991), and Mallett and Schroeder (2015), who found none. The study perhaps most relevant to this particular finding, however, is that of Lopata et al. (2005), because this study included a comparison of Montessori students to students in other school choice programs at grade four, just one year later. These authors found that a racially diverse sample of Montessori fourth-grade students performed slightly better in math when compared to students in an open-classroom magnet school, but found no difference between Montessori students and their peers in a highly structured magnet school. Both the work of Lopata et al. (2005) and the present study provide some evidence to suggest that the high performance of students in public Montessori schools in math is due not to the effect of the Montessori curriculum, but rather reflects self-selection among engaged and highly motivated families who seek out educational options for their children.

Conversely, it is worth noting that one of the magnet schools included in the magnet comparison group, Magnet 2, is a STEM school with an emphasis on math. Because this school was both the largest school in the magnet group and had the highest proportion of African American students, Magnet 2 contributed the largest number of cases in the magnet group. This means that Magnet 2's math scores had the most influence on the magnet group mean. Thus, another way of interpreting this finding of no significant difference between Montessori and other magnet students in math is that the Montessori schools were just as effective in promoting math achievement as other magnet schools, including one with an explicit focus on math. This is reminiscent of Curtis's (1993) study comparing public Montessori students in an urban district with students in a gifted and talented program. Curtis also found no significant differences in math achievement between the two groups, but one could argue that this finding reflects positively on the Montessori school, because those students performed at levels comparable to those of an all-gifted population. Similarly, retaining the null hypothesis for this research question suggests that Montessori students are at least competitive with students in other school choice programs in math, even if self-selection into magnet environments is also a factor. This finding of parity is particularly noteworthy because while standardized mathematics assessment tend to reflect operational proficiency, the Montessori math curriculum emphasizes conceptual understanding (McKenzie et al., 2011). This suggests that the Montessori method yields positive results in math even on measures that are not particularly well-suited to the conceptual focus of Montessori math instruction.

RQ2: Montessori vs. Magnet, Reading

The second research question posed was, is there a statistically significant difference between mean reading scores for African American students at grade three in public Montessori schools versus African American students at grade three in similar school choice programs? Results from both multivariate analyses indicated a statistically significant difference in reading scores between these two groups. This difference amounted to approximately one-fifth of a standard deviation, with Montessori students scoring higher than their counterparts in other school choice programs. The extant literature provided more evidence in favor of Montessori reading instruction than math instruction; the findings of this study are supported by those of Sciarra and Dorsey (1976), Dawson (1987), Moody and Riga (2011), and Duax (1989). Conversely, the findings of this study diverge from those that found no significant advantages for African American Montessori students in reading in the lower elementary level (Curtis, 1993; Mallett & Schroeder, 2015; Moore, 1991). Again, the study that is most relevant to this finding is that of Lopata et al. (2005), because of its explicit comparison of Montessori students to students in other magnet programs. These authors found no significant differences in reading achievement between Montessori students and students in the other magnet settings. The results of this study diverge from this finding, even if the effect size is small.

The presence of a statistically significant difference in reading between students in Montessori schools and students in other magnet programs calls into question the theory of self-selection articulated with regard to research question one. If math scores between Montessori and other magnets are no different because motivated and engaged families self-select into magnets, then logically, there would be no difference in reading

scores either. A significant difference in reading scores suggests that self-selection alone is an unsatisfactory explanation for the high achievement of African American students in the Montessori schools included in this study.

RQ 3: Montessori vs. Traditional, Math

The third research question posed was, is there a statistically significant difference between mean math scores for African American students at grade three in public Montessori schools versus African American students at grade three in similar traditional schools? Results from both multivariate analyses indicated the answer is yes. On average, African American Montessori students scored about one-fourth of a standard deviation higher than their counterparts in traditional schools on the end-of-grade math assessment. As stated previously, the literature indicates a lack of consensus about the advantages of Montessori math instruction for African American students, so this finding constitutes a valuable contribution to this ongoing discussion. In interpreting these results, it is important to remember that the traditional school comparison group contained one school, Traditional 2, that had a significantly higher level of FRL students than its Montessori counterpart, Montessori 2. Thus, poverty could be a confounding variable in this comparison. Since student-level data about SES was not available, this possibility cannot be confirmed. The self-selection theory is a possible explanation for this result as well; perhaps Montessori students come from more engaged and motivated families than children of families who attend their neighborhood schools. Lopata et al. (2005) found that Montessori students actually performed significantly *worse* in math than students in traditional school settings. This casts doubt on the self-selection theory, although it remains a possible explanation.

RQ 4: Montessori vs. Traditional, Reading

The fourth research question posed was, is there a statistically significant difference between mean reading scores for African American students at grade three in public Montessori schools versus African American students at grade three in similar traditional schools? In short, yes. Of the three statistically significant results in this study, this one was the most dramatic: on average, African American Montessori students scored between .37 (MANCOVA) and .40 (MANOVA) of a standard deviation higher than their counterparts in traditional schools in reading. Although this is the largest significant difference identified, the multivariate effect size overall was very small, indicating that school setting accounted for only .3-.4% of the variance in combined reading and math scores across the entire analysis (depending on whether the effect size from the MANCOVA or MANOVA is used). Again, previous studies of Montessori reading instruction for African American elementary students have produced contradictory results, though these results are slightly more favorable for Montessori in reading than in math. Again, poverty could be a confounding factor in this comparison. As with research question three, the self-selection hypothesis is equally applicable here; it is possible that students who self-select into Montessori are inherently more high-performing than students who do not. However, the fact that Montessori students performed significantly better in reading than both traditional *and* magnet students lends support to the idea that Montessori reading instruction is beneficial for African American students, regardless of the self-selection factor.

Interaction: School Setting, Gender, and Special Education Status

Though this finding did not pertain to a specific research question, a statistically significant interaction was observed among the independent variables school setting, gender, and special education status. This interaction was found to be significant for female students with disabilities in Montessori schools. The results of both the MANCOVA and MANOVA suggest that this subgroup of students exhibits significantly greater achievement in reading in Montessori settings than in other school settings. Several scholars have argued that Montessori is well-suited to students with learning disabilities (Cossentino, 2010; Lillard, 2005; McKenzie & Zascavage, 2011; McKenzie et al., 2011; Orem, 1969; Pickering, 2003), some with particular attention to reading (Lillard, 2005; Richardson, 1997). However, these authors have not identified a reason why this benefit would differ between male and female students. In fact, in previous studies that found different outcomes for students in Montessori by gender, this difference favored males (Miller & Bizzell, 1983, 1984). This finding is intriguing, and the unique combination of race, gender, special education, and Montessori observed here merits future investigation.

Implications

Overall, these results suggest that Montessori instruction at the lower elementary level is somewhat effective for African American students, especially in reading. Although this study does not explore how or why this might be, these findings lend support to Hall and Murray's (2011) assertion that the Montessori method overlaps significantly with research-based best practices for teaching African American students. Along with the work of Hall and Murray (2011) and others who have documented the use of the Montessori method with culturally diverse students, this study is part of a

counternarrative that challenges the prevailing misconception that Montessori is an elite pedagogy for predominantly White students in private schools (Murray, 2012). Another misconception identified by Murray (2012) is that Montessori is primarily an early childhood approach to education. This study indicates that the Montessori method has value for African American students in the elementary years as well. These results indicate that African American students in public Montessori schools at grade three perform *at least* as well as their peers on traditional measures of academic achievement in both reading and math. This suggests that concerns about promoting academic achievement are not a valid reason to discourage the use of Montessori instruction for African American students, especially given the many non-academic benefits the method may also confer.

The finding that African American students in public Montessori schools perform significantly better than their counterparts in traditional schools also seems to validate Rambusch's (2007/1976) argument that Montessori education could improve educational outcomes for these students, who historically have been underserved in American public schools. While this is not to say that Montessori is a panacea that will completely resolve the issue of inequitable outcomes for African American students, this study indicates that Montessori could be a viable tool to improve public education for these students. If future research can identify which aspects of the Montessori method are most valuable for African American students, these instructional techniques can perhaps be incorporated into non-Montessori classrooms as well. As discussed in chapter one, African American students are too often the victims of the opportunity gap, a racialized system of inequities in public education that results in reduced opportunities to learn. This study suggests that

public Montessori programs are somewhat effective in promoting achievement in reading and math for African American students in urban settings, and thus could be one tactic to address the opportunity gap in these environments. Specifically, this study shows that the Montessori method can impact literacy and numeracy for African American students at grade three, which are important predictors of later academic success and educational outcomes (Bailey et al., 2014; Fiestler, 2010; Hernandez, 2011; Ritchie & Bates, 2013). Literacy at grade three is especially important because after grade three, strong reading skills are essential to success in other subjects (Fiestler, 2010). The results reported here suggest that by bolstering literacy in the early elementary years, Montessori can set African American students up for success in other content areas in later years.

Providing these increased opportunities to learn at the elementary level could pay dividends later on in the form of increased rates of high school completion, college matriculation, and participation in the workforce for African American students. Providing African American students with the tools and opportunities to experience success in math in the early elementary years could be one step toward addressing the underrepresentation of African Americans in STEM fields. The finding that female, African American students with disabilities exhibit greater reading achievement in Montessori schools than their counterparts in other school settings is especially meaningful, as these students represent a particularly vulnerable subgroup. Finding ways to improve academic achievement for students of color will only become more pressing in coming years, as these students make up an increasingly large preponderance of the American public school population.

The results of this study provide evidence within the prevailing post-positivist framework of education reform in favor of expanding access to Montessori for African American students at the elementary level. Perhaps the positive outcomes related here help to explain why African American students make up such a large proportion of the public Montessori population. These results are also evidence in favor of high-fidelity implementation of the Montessori model in public school settings. Using the lens of critical theory, the results of this study suggest that public school Montessori programs could be a useful tool in effecting social change for African Americans through improved educational outcomes. This outcome would be very much in line with Dr. Montessori's original intentions, as she believed social change and advancement to be the ultimate purpose of education (Maria Montessori, 1971).

Recommendations

Based on these results and their implications, the researcher advances recommendations for policy, practice, and future research pertaining to public Montessori programs serving African American students in urban settings. These recommendations are summarized in Figure 3.

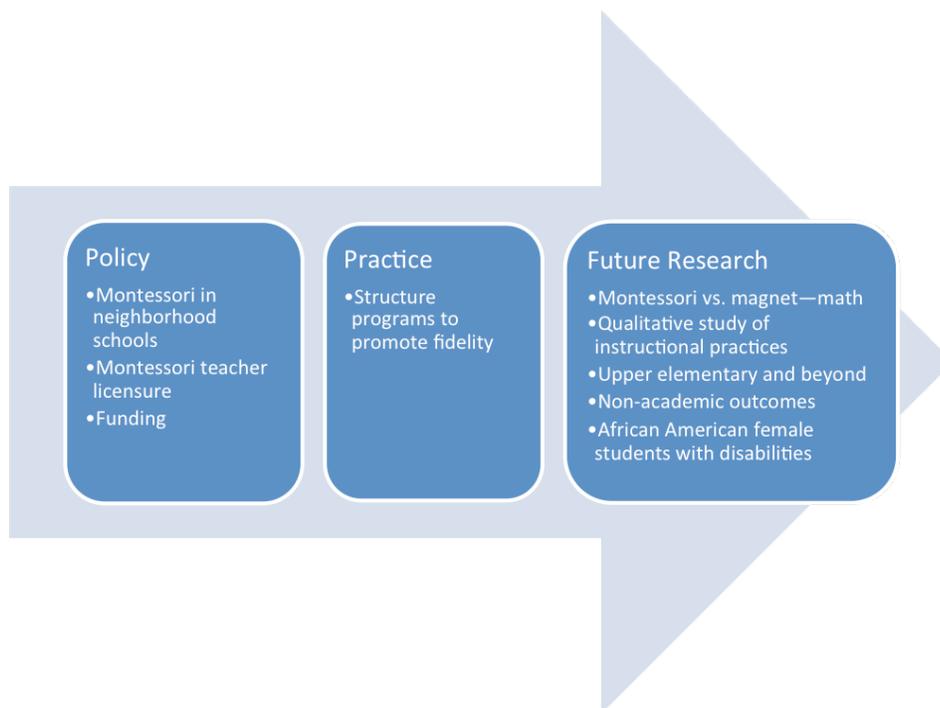


Figure 3: Recommendations for policy, practice, and future research

Policy

Montessori in neighborhood schools. These results suggest that increased access to Montessori lower elementary programs could be beneficial for African American students in urban settings. Currently, the vast majority of these programs are educational alternatives: magnets, like the schools in this study, or more commonly, charter schools (NCMPS, 2014c). While both charters and magnets are free public options, both can present barriers to entry, particularly for low-income students and families. Both charters and magnets frequently employ lotteries when the demand from the community exceeds available seats. In these instances, access to public Montessori programs is determined largely by luck. Additionally, charter schools do not always provide transportation and/or participate in the National School Lunch Program. As such, these schools are sometimes

inaccessible for families who lack the means to provide transportation for their children or who depend on free or reduced-price school lunches. These barriers to entry, along with the results of the Montessori versus traditional school comparison in this study, suggest that Montessori programs housed in neighborhood schools could potentially increase the impact of Montessori for African American students at the lower elementary level by making these programs more accessible. South Carolina provides a model for how this might be done; the vast majority of Montessori programs in this state are school-within-a-school programs, housed in neighborhood schools alongside traditional classrooms (The Riley Institute, 2014). This format provides a blend of accessibility and choice.

Montessori teacher licensure. In order to increase access to public Montessori programs, the Montessori teacher pipeline must be strengthened, as having Montessori-trained teachers is key to a high-fidelity program (AMS, n.d.a; NCMPS, 2014b). From a policy perspective, one challenge here is that most states do not recognize Montessori teacher training for the purposes of state licensure. As a result, teachers who want to work in public Montessori schools typically have to go through a traditional teacher preparation program in addition to Montessori teacher training. This makes it doubly difficult for public Montessori schools to recruit qualified teachers. Again, South Carolina provides a model for a possible policy solution. Here, teacher candidates who have completed Montessori teacher training, but have not completed a traditional teacher preparation program, can qualify for a special state teaching license that allows them to teach only in public Montessori schools (South Carolina Department of Education, n.d.).

Policies like this can help public Montessori schools recruit teachers outside of the current traditional teacher candidate pool.

Funding. Lastly, expanding access to public Montessori programs will require a conscious investment on the part of school districts that choose to offer this option. Many schools and districts fund part or all of the cost of Montessori teacher training for teacher candidates in exchange for a commitment from those teachers to remain in the school for a certain period of time. Montessori materials, which are also essential to an authentic Montessori program (AMS, n.d.a; NCMPS, 2014b), constitute an additional cost, for which provisions must be made.

Practice: Structure Programs to Promote Fidelity

The results of this study also provide some support for maintaining the structural elements necessary to promote high-fidelity public Montessori schools. With regard to this study, this includes:

- recruiting and retaining Montessori-trained teachers,
- providing teaching assistants for all classrooms,
- maintaining multiage classes with a three-year age span,
- outfitting classrooms with a full complement of Montessori materials,
- offering a two-and-a-half to three-hour independent work cycle daily, and
- providing principals with Montessori administrator training.

As discussed in chapter two, studies of low-fidelity Montessori programs have tended to yield non-significant results. The positive outcomes found in this study provide further evidence to suggest that these key structural elements, like multiage classrooms and Montessori-trained teachers, matter. Schools and districts offering Montessori programs

should be mindful of program fidelity in order to reap the benefits of the program for students.

Future Research

Montessori versus magnet—math. Though the research questions for this study were answered, the results of this study generate additional questions to be explored in future research. The finding that African American students in Montessori schools do better than their counterparts in magnet schools in reading, but not in math, is intriguing. This comparison should be conducted again in another district to determine if these findings can be replicated, or if the sample in this study was biased by the large number of students in a STEM magnet. The Montessori-traditional comparison should also be replicated across schools with more equal poverty levels to see if poverty was, in fact, a confounding variable in these results.

Qualitative study of instructional practices. Qualitative exploration of Montessori reading and math instructional practices is also warranted to determine what aspects of the Montessori method work for African American students. This could also help address the question of why significant benefits were found across both comparisons in reading, but not in math; what is different about the way math is taught from the way reading is taught in Montessori settings? Furthermore, while this study took programmatic indicators of fidelity into account, classroom-level indicators of authentic Montessori practices, such as teacher-student interactions and peer teaching, were not considered. A future mixed-methods study could combine classroom observation with student achievement data to determine what classroom-level indicators of Montessori practice are related to increased student achievement.

Upper elementary and beyond. This study focused on lower elementary Montessori, when students are developing key literacy and numeracy skills that will be highly predictive of their future academic success. In the future, researchers could also examine how African American students fare in upper elementary Montessori programs. Since previous studies have indicated that early Montessori instruction sometimes produces a “sleeper” effect, longitudinal studies should also examine how exposure to Montessori impacts African American students’ ability to survive and thrive throughout the remainder of their schooling careers. This could include looking at outcomes like high school completion, college matriculation, and degree attainment. Another possible line of study would be to examine outcomes for Montessori students after they transition to traditional school settings, since some studies suggests the benefits of Montessori may fade when students enter traditional schools (Sciarra & Dorsey, 1976), while other indicate these advantages persist (Dohrmann et al., 2007).

Non-academic outcomes. Furthermore, this study focused on a fairly narrow scope of schooling outcomes—namely, scores on standardized tests of reading and math. Future research should include study of not only other academic outcomes, like science and social studies, but also social-emotional and cognitive skills. Capacities like executive function, creativity, and critical thinking are important to success, both in school and beyond. Subsequent studies should consider how effectively Montessori education helps African American students develop these skills.

African American female students with disabilities. Lastly, the interaction of gender, special education status, and school setting observed here in an all-African American sample merits further investigation. Future studies should examine if this effect

can be replicated, and if so, how Montessori reading instruction supports learning for African American female students with disabilities in lower elementary school settings.

Limitations

As an evaluation of the Montessori method, this study is limited to the method's effectiveness in promoting math and reading achievement, as measured by standardized assessments. This study was cross-sectional rather than longitudinal, and as such, does not provide insight into student growth over time. Students were not randomly assigned to treatment and comparison groups, limiting the researcher's ability to infer causality. While an attempt was made to select comparison schools that were as similar as possible to the treatment schools, this comparison was imperfect. While SES was considered at the school level, student-level SES data was not available. Similarly, the sample was biased by a substantial quantity of missing data, which was not found to be missing at random. The markers of fidelity for the Montessori programs included in this study were largely at the programmatic level; classroom observations were not possible due to the retrospective design of the study.

Summary and Conclusion

The goal of this quasi-experimental, quantitative study was to evaluate the effectiveness of lower elementary Montessori education in reading and math for African American students at grade three. To this end, reading and math scores from standardized state reading and math tests from African American students in a large, urban district with three public Montessori schools were compared to those of students in similar magnet and traditional schools within the same attendance zones of the same district. Through multivariate statistical analysis, African American students in Montessori

programs were found to achieve at significantly higher levels in reading than students in both magnet schools and traditional schools. No significant differences were found between Montessori and magnet students in math, but Montessori students performed significantly better in math than their counterparts in traditional school settings. Though effect sizes were small, the results of this study suggest that Montessori may be fairly effective in promoting reading achievement for African American students at grade three, and somewhat effective in promoting math achievement. These results suggest that increased access to public Montessori programs could be beneficial for African American students.

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APPENDIX A: IRB



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Institutional Review Board (IRB) for Research with Human Subjects

Approval of Exemption

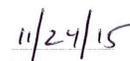
Protocol #	15-11-10			
Title:	Evaluating the Effectiveness of Montessori Reading and Math Instruction for Third Grade African American Students in Urban Elementary Schools			
Date:	11/19/2015			
Responsible Faculty	Dr. Chance	Lewis	Middle, Secondary, K12 Educ	
Investigator	Ms. Katherine	Brown	Middle, Secondary, K12 Educ	
Co-investigator	Dr. Chuang	Wang	Educational Leadership	

The Institutional Review Board (IRB) certifies that the protocol listed above is exempt under category 4 (45 CFR 46.101).

Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

This approval will expire one year from the date of this letter. In order to continue conducting research under this protocol after one year, the "Annual Protocol Renewal Form" must be submitted to the IRB. Please note that it is the investigator's responsibility to promptly inform the committee of any changes in the proposed research, as well as any unanticipated problems that may arise involving risks to subjects. Amendment and Event Reporting forms are available on our web site: <http://research.uncc.edu/compliance-ethics/human-subjects/amending-your-protocol> or <http://research.uncc.edu/compliance-ethics/human-subjects/reporting-adverse-events>


 Dr. M. Lyn Exum, IRB Chair


 Date

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