

ACADEMIC ACHIEVEMENT OUTCOMES: MONTESSORI AND
NON-MONTESSORI PUBLIC ELEMENTARY STUDENTS

A Thesis

by

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Submitted to the Office of Graduate Studies
of Texas A&M University-Commerce
in partial fulfillment of the requirements
for the degree of
MASTER OF PSYCHOLOGY
May 2013

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ABSTRACT

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Within the realm of elementary public schools, several pedagogical models of early childhood education are practiced in the United States (Lillard, 2005). The constructivist approach to early childhood education is illustrative of best practices based on current theory. One model of constructivist early childhood education is the Montessori Method founded in the early twentieth century by Maria Montessori, an Italian physician (Montessori, 1912/1964). Though the Montessori Method is aligned with research-based best practices espoused by constructivism, there are relatively few public Montessori schools currently in the United States.

A direct comparison is needed between the academic outcomes of public elementary school programs which implement the Montessori Method and those which implement a more traditional approach to early childhood education. The focus of this study is the academic achievement outcomes of Montessori public school students as compared to similar non-Montessori students. The Montessori students' Iowa Tests of Basic Skills (ITBS) Total Reading and Total Math scores in grades one and two were not statistically different than their non-

Montessori counterparts. In grade three, the Montessori students' Texas Assessment of Knowledge and Skills (TAKS) Reading and Math scores were not statistically different than those of the non-Montessori students. In grades four and five, the TAKS Reading and Math scores statistically favored Montessori students.

ACKNOWLEDGEMENTS

I sincerely thank my advisor, Dr. Jennifer Schroeder, for her guidance throughout the thesis process. My thesis committee, Dr. Jennifer Schroeder, Dr. Katy Denson, and Dr. Lacy Krueger, were supportive and encouraging. Their expertise and patience are limitless.

To the faculty and my colleagues at TAMUC, I offer my gratitude for the past several years spent together in class and in study. Every moment in your company has been a pleasure. Thanks to Beth Nikopoulos and Paweena Kosito in particular.

To my husband and children, your roots have given me wings. Thank you for demonstrating both independence and your need for me at just the right moments.

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Chapter 1

INTRODUCTION

Currently in the United States, the constructivist approach to early childhood education is most aligned with research. Constructivism is based on the ideas that students learn best by actively solving relevant problems through a combination of inner reflections and dialogues with both the teacher and peers (Gordon, 2009). Phillips (1995) also noted that effective learning is an integration of the child's internal cognition and his or her social interactions. One model of early childhood education is the Montessori Method developed in the early twentieth century by Maria Montessori, an Italian physician (Montessori, 1912/1964).

Statement of the Problem

Despite the parallels between constructivist ideals and Montessori practices, there are few public Montessori schools currently in the United States. According to the U.S. Department of Education Institute of Education Sciences (2007), there were 93,295 public elementary schools in the United States. The American Montessori Society (2011) counted the number of public Montessori elementary schools as slightly over 400. The low ratio of Montessori public schools to non-Montessori public schools is in part due to an absence of information; specifically, achievement data from Montessori students that might demonstrate the efficacy of the Montessori Method.

Purpose of the Study

A direct comparison is needed between the academic outcomes of public elementary school programs which implement the Montessori Method and those which implement a more traditional approach to early childhood education. The focus of this study was the academic achievement outcomes of Montessori elementary public school students in Texas as compared to

the academic achievement outcomes of non-Montessori elementary public school students in Texas. In this study, several facets of the Montessori Method which exemplify constructivism were considered holistically.

Hypotheses

Lacking in the current academic literature is a direct comparison of norm-based academic achievement scores between Montessori and non-Montessori students. The general research question was this: Does a Montessori education in grades one through five produce higher academic achievement test scores than a non-Montessori education on nationally or state-normed achievement tests?

The following ten null hypotheses were used:

1. For students in grade one, the Iowa Tests of Basic Skills (ITBS) Total Reading scores of Montessori students will be no different than those of non-Montessori students.
2. For students in grade one, the ITBS Total Math scores of Montessori students will be no different than those of non-Montessori students.
3. For students in grade two, the ITBS Total Reading scores of Montessori students will be no different than those of non-Montessori students.
4. For students in grade two, the ITBS Total Math scores of Montessori students will be no different than those of non-Montessori students.
5. For students in grade three, the TAKS Reading scores of Montessori students will be no different than those of non-Montessori students.
6. For students in grade three, the TAKS Math scores of Montessori students will be no different than those of non-Montessori students.

7. For students in grade four, the TAKS Reading scores of Montessori students will be no different than those of non-Montessori students.
8. For students in grade four, the ITBS Math scores of Montessori students will be no different than those of non-Montessori students.
9. For students in grade five, the TAKS Reading scores of Montessori students will be no different than those of non-Montessori students.
10. For students in grade five, the ITBS Math scores of Montessori students will be no different than those of non-Montessori students.

The following ten related alternative hypotheses were used:

11. Montessori students in grade one will have higher ITBS Total Reading scores than non-Montessori students.
12. Montessori students in grade one will have higher ITBS Total Math scores than non-Montessori students.
13. Montessori students in grade two will have higher ITBS Total Reading scores than non-Montessori students.
14. Montessori students in grade two will have higher ITBS Total Math scores than non-Montessori students.
15. Montessori students in grade three will have higher TAKS-Reading scores than non-Montessori students.
16. Montessori students in grade three will have higher TAKS-Math scores than non-Montessori students.
17. Montessori students in grade four will have higher TAKS-Reading scores than non-Montessori students.

18. Montessori students in grade four will have higher TAKS-Math scores than non-Montessori students.
19. Montessori students in grade five will have higher TAKS-Reading scores than non-Montessori students.
20. Montessori students in grade five will have higher TAKS-Math scores than non-Montessori students.

Significance of the Study

Constructivist education is a paradigm in which the child independently attempts to create meaning through solving realistic and relevant academic problems in a nurturing, prepared environment with the support of the teacher and the collaboration of peers. The Montessori Method is a multifaceted, constructivist approach to elementary education. While Montessori schools provide unique opportunities for socialization, they also provide a rigorous and structured academic curriculum. The moirés of the times in academia demand fact-based rigor; however, oftentimes, those parents who seek Montessori education for their children base the decision on qualitative factors rather than quantitative data. A direct comparison of the academic achievement of children for which school grade, gender, race, and socioeconomic status as determined by free, reduced, or paid lunch status are accounted and that differ only in the pedagogical model of the public school is warranted. Then, if the data reveal significant differences between the students in Montessori classrooms and those in non-Montessori classrooms, further dissection can be undertaken. This study was a direct comparison between Montessori and traditional elementary students in an urban public school district in the southwestern United States. It revealed the statistical significance between the academic

achievement of Montessori and non-Montessori students. In subsequent studies, the practical significance and other factors such as socialization could be explored.

Chapter 2

REVIEW OF LITERATURE

The Montessori Method

The Montessori Method has a child-centered focus that fosters the development of both academic and social skills (Lillard & Else-Quest, 2006). It is consistent with a constructivist approach to early childhood education. In order to make explicit the parameters of the Montessori Method in terms of constructivist principles, five constructivist conditions are outlined.

The literature reveals five conditions necessary for constructivist learning. The first is that learning be embedded in a complex, realistic, and relevant environment (Zubrowski, 2002). Montessori described teachers as “storytellers of the truth” and designed the curriculum as an integrated series of lessons across a broad spectrum of subject areas connected by narrative (Montessori, 1917/1973). The second recommendation is to provide the students with opportunity for social negotiation as well as shared responsibility for learning (Faulkenberry & Faulkenberry, 2006). Within Montessori classrooms, the age range of students and the three-year span of a child’s tenure in each classroom allow for collaborative learning (Montessori, 1912/1964). The third recommendation, support for multiple perspectives and the use of multiple representations of content (Zubrowski, 2002), is endemic to the Montessori Method as Montessori materials are both broad and deep in scope (Montessori, 1917/1973). The fourth recommendation is that the constructivist learning environment nurture both self-awareness and meta-cognition of the construction of knowledge (Alfieri, Brooks, Aldrich, & Tenenbaum, 2011). The freedom of movement encouraged by the Montessori Method provides opportunity for cognition and learning to be intertwined (Montessori, 1912/1964; Lillard, 2005). The fifth

recommendation is that children be given encouragement for taking ownership of their learning (Faulkenberry & Faulkenberry, 2006). As the Montessori Method prepares the environment for the nurturing of intrinsic rather than extrinsic motivation, encouragement of the child's ownership of his or her learning is a natural fit (Montessori, 1912/1964). The Montessori Method employs each of the recommendations for providing a constructivist classroom in an environment that is a microcosm of the world at large. This study aims to determine if the Montessori practices are more effective taken holistically than non-Montessori practices at the elementary school level.

Meaningful Context

Context can be considered both in terms of the holistic physical environment and the curricular scope and sequence. The Montessori environment is child-centered. The teacher prepares the physical environment so that it is safe, orderly, and well-equipped. Within the Montessori classroom, concepts are presented from general to specific, and skills are presented from specific to general (Montessori, 1912/1964). Montessori lessons are integrated into a scope and sequence that is framed by central narratives called Great Lessons. There are five Great Lessons for lower elementary students and five for upper elementary students as well as the Cosmic Lesson for all elementary children (Lillard, 2005). These lessons serve as both springboards and touchstones for all subsequent lessons. The materials in each of the subjects are designed both to nest and to align with others across curricular subjects.

While references to the Montessori Method are scarce in the current academic literature, relevant elements of constructivism are represented. Tanner (2008) completed a descriptive and non-experimental study to determine the relationship between school campus design and academic achievement. Using data from the Education Longitudinal Study of the National

Center for Education Statistics, the researcher identified four independent variables: school and classroom movement patterns, school community meeting places, lighting and views, and multi-use instructional areas. More descriptors were used for movement patterns and functionality of the instructional areas than for large group spaces and lighting. Movement patterns were categorized by circulatory patterns and access to various amenities like restrooms, hallways, and curricular areas within the classroom, and instructional areas were defined by the lesson type occurring within. The participants were third grade students. After accounting for socioeconomic status, Tanner determined that between 2% and 7% of the variance on academic achievement scores using the Iowa Test of Basic Skills could be attributed to these variables. Certainly the design and condition of the school campus is an important consideration in the quest for academic achievement improvement.

Camp and Oesterreich (2010) completed a case study of a teacher who incorporated constructivist practices in her practice despite the predominant strictures of the high-stakes testing era. Their participant was a White female who taught fifth grade in the southwestern United States in a public elementary school of predominantly Hispanic students. After two lengthy interviews, the researchers labeled her nontraditional and concluded that the multi-culturally rich, student-interest-based, problem-solving methods she employed were a welcome response to the teacher-scripted test preparation techniques characteristic of current education in this era of high-stakes testing. Camp and Oesterreich (2008) named negotiation of power, democracy, and multiculturalism as critical preferable components of excellent early childhood education. Again, the focus of the researchers was teacher behavior; no student data were included in this article.

Meaningful context for lessons is a constructivist goal for the scope and sequence of elementary curricula. Becker and Park (2011) completed a meta-analysis of integrated approaches to teaching science, technology, engineering, and mathematics (STEM); they analyzed twenty-eight studies with participants ranging from elementary to college-aged students. While this is a relatively small number of studies for a meta-analysis, there are few empirical studies and many opinion papers without hard data about this topic. Integrative approaches to STEM curricula showed the significantly greater effect sizes for elementary students than for college students, and integration of the four subjects had greater effect sizes than any other combination. However, weakness in this study relates to the comparability of all STEM education to all curricular subjects. Many of these studies used robotics as manipulative materials. Technical achievement improved more than the other areas. Effect sizes ranged among other STEM subjects. Becker and Park concluded that student learning is positively affected by integrating instruction of science, technology, engineering, and mathematics, but further empirical studies are needed.

Constructivist instruction has been specifically applied to elementary instruction. Wu and Tsai (2005) compared traditional and constructivist instruction in two classes of fifth grade students in Taiwan who were studying biological reproduction; each class received a different method of instruction. The classes had similar levels of science achievement prior to the experiment, and the teachers of each group were both male with only two years of science teaching experience. There were a comparable number of high and low achievers in the traditional and constructivist teaching groups. Students who received constructivist oriented instruction had greater conceptual understanding of the material than those in the traditional instruction group.

From these studies, it can be concluded that well-maintained and thoughtfully designed physical environments as well as carefully and logically integrated curricula are beneficial to elementary-aged students. The Montessori Method emphasizes an organized and child-centered classroom, and the Montessori curriculum is framed around central narratives (Lillard, 2005). This child-first focus coupled with connected, integrated lessons exemplifies the constructivist approach.

Multi-aged Classrooms

The differentiation of instruction and collaboration among peers is constructivist strategies that enhance learning. Montessori classrooms are multi-aged, with children in a three year span within each class (AMS, 2011; Lillard & Else-Quest, 2006; Montessori, 1912/1964). This heterogeneity of ages in classes affords opportunity for both differentiation and collaboration.

There are five age configurations of Montessori classes. Preprimary is for children from birth through three years of age. Primary is for young children between the ages of three and six years. Children between the ages of six and nine years attend lower elementary, and upper elementary is for children between the ages of nine and twelve. There is a Montessori model for children between the ages of twelve and fifteen though most Montessori schools extend through upper elementary school only (AMS, 2011; Montessori, 1912/1964).

This multi-aged grouping allows for differentiation of instruction as well collaboration among children as the range of available lessons is designed to span the child's three years in a single classroom (Montessori, 1917/1972). Materials and lessons in the Montessori classroom range from basic skill instruction to sophisticated research projects. As no child's development

is lock-step across the curriculum, the Montessori Method's broad range of curricular choices is available to meet individual need.

Collaboration is encouraged within the Montessori classroom as the older children lead the younger ones and are role models for them. Instruction is presented to individuals and small groups by both teachers and peers, with the teacher serving as a guide and a resource (AMS, 2011; Lillard, 2005; Lillard & Else-Quest, 2006; Montessori, 1912/1964). Such student-to-student collaborations are conducive to learning (Lillard, 2005, Lillard & Else-Quest, 2006). Indeed, peer collaboration is facilitated with heterogeneous grouping, and this is useful as an augmentation to direct instruction and individual effort, especially in math (Gupta, 2008). In a peer collaborative model of instruction, the teacher serves as a knowledgeable learning partner, structuring, assessing, and modeling rather than lecturing and assigning (Faulkenberry & Faulkenberry, 2006).

Multi-age grouping, a standard practice in Montessori classrooms, has received scant mention in the academic literature as a strategy for enhancing student achievement. Gabriele (2007) examined the effect of students setting goals for math problem solving. The researchers placed fourth and fifth grade students into dyads consisting of one low math achiever and one high math achiever. One group was guided in the setting of goals, and the other group was not. The interactions of the dyads were videotaped as they solved math problems. The researchers analyzed both the videotaped interactions and post test scores. The findings were that goal setting was related to the students' comprehension which increased the level of constructive activity thereby influencing post test scores for the better of the group that had set goals.

Additionally, several studies with inconclusive results are available. Gorrell (1998) examined the reading achievement data of a group of students in the third grade and again in the

fourth grade using the Stanford Achievement Test and found no difference. The students were in multi-aged classrooms. Luvisi and Miller (2001) described the classes of Kentucky's reading program as multi-graded and concluded that due to implementation issues the value of the multi-aged grouping component was inconclusive. While the three-year cycle within a single classroom is a basic premise of the Montessori Method (Montessori, 1912/1964), empirical studies regarding the efficacy of this practice are scarce.

Materials

The Montessori classroom invites the child to explore the world as a whole (Montessori, 1912/1964; Rambusch, 2010). The classroom space is an atmosphere created to enable the child to be free to learn through his or her own activity in peaceful and orderly surroundings. The materials are organized sequentially in aesthetically pleasing ways around the perimeter of the room on low, child-accessible shelving (Lillard, 2005). Lillard noted that the child benefits from an environment that is ordered temporally and spatially; the order extends beyond the materials through space and time. The space is functional and orderly; the schedule is uncluttered and flexible. The materials are arranged from left to right, from top to bottom, and from simple to complex difficulty levels (Lillard, 2005). Children choose from the shelves the work in which they are interested; choice signifies a commitment to attend to the work until it is completed (Montessori, 1917/1973).

Several current studies report the efficacy of using instructional manipulative materials for elementary instruction. Tournaki, Bae, and Kerekes (2008) compared math achievement of first grade students with learning disabilities; the control group received no instruction, the first experimental group received traditional instruction, and the second experimental group received instruction with a specialized math manipulative called rekenrek. The group of children who

received the instruction with the mathematics manipulative materials scored better on an addition and subtraction assessment compared to the children in the groups with no instruction and traditional instruction.

In another study of the role of manipulative materials in elementary math instruction, McNeil, Uttal, Jarvin, and Sternberg (2008) compared third graders' accuracy rates on math problems involving money. The experimental groups were given coinage while the control groups were not. The researchers examined error patterns in terms of conceptual and arithmetical mistakes. The groups with concrete manipulative materials in the form of play money solved fewer problems correctly than the groups with text only but had fewer conceptual errors and more arithmetic errors. It is relevant to the current study that conceptual errors occurred less frequently than arithmetical errors in any of the participants who had manipulative materials available.

The McNeil et al. study had weaknesses with both the sampling and the validity of the design. The sample size was small. In terms of the validity of the study's design, participants were not given any instructions as to the correct instructional use of the money manipulatives and were tested in groups rather than individually. In two extensive meta-analyses regarding the effects of constructivist or "discovery" learning, Alfieri, Brooks, Aldrich, and Tenenbaum (2011) concluded that while unassisted discovery is not beneficial, discovery learning in an environment which allows for the provision of examples, effort followed by feedback, and lesson scaffolding is beneficial. In other words, assisted discovery learning with the use of manipulative materials is a helpful constructivist practice.

The use of concrete manipulative materials impacts student performance on various types of math questions. Suh and Moyer (2007) studied math achievement in third graders comparing

the use of virtual and concrete algebraic mathematics manipulative materials. They incorporated three types of questions: word problems, symbolic problems, and pictorial problems. Groups with both virtual and concrete manipulative materials had gains on all three types of questions. There were greater gains on word problems and pictorial questions when the participants used virtual algebra balances and greater gains on symbolic questions when concrete algebraic balances were used. For this study, Suh and Moyer had no control group. These results parallel the McNeil, Uttal, Jarvin, and Sternberg (2009) study in that both concluded that more manipulative materials for mathematics problem solving resulted in fewer conceptual errors.

The Montessori Method is carried out with a comprehensive curriculum of particular, purposeful lessons requiring multi-sensory manipulative materials. The use of specialized manipulative materials in elementary education has received some attention in the academic literature with mixed results. In general, manipulative materials are effective as learning tools when paired with instruction as to their function and use.

Movement

The Montessori teacher's guiding principle is to follow the child (Montessori, 1912/1964). Both movement through the curriculum as well as the freedom of movement within the classroom exemplify constructivist ideals. The child is free to move through the sequence of works and materials as interests and abilities direct and may select from works for which he or she has had a lesson. This paradigm allows movement and cognition to be dynamically intertwined (Lillard, 2005). Thus, a child's academic progress is not dictated by the teacher's lesson plan or by the state's curriculum but rather by the child's own efforts and interests. This liberation from attachment to an adult-imposed plan of work frees the teacher to not interrupt an

engaged child's focus with the result being long time periods of deep engagement in active learning (Lillard, 2005; Lillard & Else-Quest, 2006).

Movement in the Montessori classroom is dependent on the child's self-determined needs. The child's movement through space and time is supported and structured by the guide as needed to maintain a peaceful environment. The child is not restricted to a stationary desk; rather, the chosen material determines whether work is completed on a rug, at a lap desk, on the white board, at the computer station, or at a table (Montessori, 1917/1973). The child has the liberty to move among the materials as necessary for work completion and to satisfy his or her physical needs (Montessori, 1912/1964, 1917/1973). The classroom is arranged with low shelving around the perimeter, a large empty floor space for work, and table spaces.

Tanner (2008) completed a descriptive study which examined the relationship between the physical environment of a school and academic achievement. The study considered four facets of school design: movement and circulation, group meeting places, lighting and views, and multi-use instructional areas. Of relation to this discussion is Tanner's attention to the flow of movement in the physical environment within the school setting. The researcher found that as school design scores increased, academic achievement increased, even after socioeconomic status was considered. Within a Montessori classroom, traffic patterns are considered as the furniture and materials are arranged.

Personal needs act as a source of movement in the Montessori classroom, but movement incorporated into academic lessons is also important. Shoval (2011) used movement in an experimental group of second and third graders to teach the geometric concept of angles while the control group received conventional instruction only. The academic achievement of the

experimental group was significantly greater than that of the control group; the researcher concluded that purposeful movement was the reason.

Motivation

Motivation is a component of the Montessori Method which takes two distinct forms: parental motivation and the child's intrinsic motivation. Parents are motivated to seek out this means of education as it is not uniformly available in all public schools. The child's intrinsic motivation is capitalized upon through the teacher's careful attention to match the lessons presented with the sensitive periods of the child the environment is prepared.

Parental motivation to seek out Montessori education indicates investment in the child's academic success. That parental involvement impacts the child's academic success is well-documented in the literature. Stylianides and Stylianides (2011) accessed the Education Longitudinal Study of the National Center for Education Statistics. They determined that the academic skills with which kindergarten children enter school predict subsequent academic achievement and found that children who had more parental attention in the home prior to kindergarten tended to achieve more in kindergarten.

Most relevant to the current research is a study of Graves and Wright (2011), who specifically examined the involvement of parents at the time that their children entered school. They concluded that European American parents were more likely to engage in home-based activities while African American parents were more likely to engage in school-based volunteer activities and that this parental involvement was only slightly related to reading achievement at school entry. They also concluded that in homes of any ethnicity, where there were rules for watching television, academic achievement was likely to be greater than in homes without such parameters. As parental involvement is positively correlated with academic achievement, it

follows that if parents are involved in their child's educational life, the child will score and behave better than peers without parental involvement.

Fan, Williams, and Wolters (2012) examined parental involvement across ethnicities also using the Education Longitudinal Study of the National Center for Education Statistics data. The researchers conceptualized parental involvement as multidimensional and found that some dimensions of parental involvement are related to the presences of a child's intrinsic motivation. The most significant dimension was the parents' dream for higher education for their child, and the effect was strong for African American, White, Asian American, and Hispanic participants in the study. Differences among ethnic groups warrant further research as the results were ambiguous in this study.

Montessori's concept of the absorbent mind explains early learning as a natural incorporation of the child's perception into a construction of meaning (Montessori, 1912/1964). Sensitive periods for learning, or times when a child is physiologically most suited for specific content or skills, are considered as classrooms are prepared, as is the child's absorbent mind (Montessori, 1912/1964). The timing of the presentation of lessons to coincide with the child's sensitive periods requires the teacher's keen observation as well as uninterrupted time to develop the child's concentration.

The classroom is a microcosm of the world at large; within the meaningful context it provides, deep learning is facilitated (Lillard, 2005). As concepts are presented during sensitive periods, or times during the physical development of the child when the child is the most neurologically ready to receive that instruction, and topics are most often selected by the child, motivation to work is enhanced (Lillard, 2005; Montessori, 1912/1964). Bagby and Sulak (2011) describe the prepared Montessori environment as a place that is structured in such a way

that the child is free to choose work, to plan a course of its completion, and to implement those plans. Children thus are guided into management of their own time, space, and materials. This process is called the work cycle, and an objective of Montessori education is for the child to independently complete several work cycles within the uninterrupted block of time provided which is usually three hours each morning (Montessori, 1912/1964). The child's motivation to self-select and then to complete assignments, or "works" in Montessori vernacular, and the child's freedom of movement in the prepared environment are two practices in a Montessori classroom that facilitate self-discipline (Montessori, 1912/1964; Rambusch, 2010). Self-discipline is a result of the awakening of the child's innate tendencies in a prepared environment with the teacher as model and guide rather than enforcer (Montessori, 1912/1964).

Self-education, which is the child's freedom to plan the work day and to access self-correcting materials, is a tenet of the Montessori Method (Montessori, 1912/1964). The limits set are the range of available materials the teacher has prepared, the calendar and clock restrictions imposed by the administration, and the child's personal ability to self-manage. Within the Montessori framework, the child's interest drives learning (Lillard, 2005; Montessori, 1912/1964). In fact, external rewards negatively impact motivation (Lillard, 2005; Montessori, 1912/1964). Ultimately, the most salient reward is a child's inner satisfaction (Montessori, 1912/1964). Work is framed as a privilege (Bagby & Sulak, 2011). In the absence of grades, the teacher's and peers' roles become more those of coaches and collaborators rather than judges and graders (Bagby & Sulak, 2011; Cossentino, 2005; Lillard & Else-Quest, 2006).

The child's intrinsic motivation is impacted positively by both the integration of curricular subjects and parental involvement. Mason, Mead, Hedin, and Cramer (2012) conducted a mixed-methods study to compare the motivation of fourth-grade students who

received either reading comprehension lessons or an integration of reading comprehension and written expression lessons. They found that students reported higher motivation to self-regulate their tasks when the reading and writing instruction were combined. Walker, Shenker, and Hoover-Oempsey (2010) noted that while improved achievement scores are a positive outcome of increases parental involvement, a more desirable outcome is development of the child's repertoire of internal resources or study skills.

Summary

The Montessori Method has five identifying features which distinguish it from traditional pedagogical models: meaningful context, multi-age classrooms, multi-sensorial materials, freedom of movement, and motivation source. Constructivist learning requires that skills and concepts be imbedded into a complex, realistic, and relevant environment, and the Montessori Method provides this feature. As Montessori classrooms are multi-aged, children are afforded many opportunities for curriculum differentiation and peer collaboration. The Montessori materials support the constructivist tenet of the provision of multiple representations of content. The emphasis of self-directed learning within the Montessori classroom and the transfer of responsibility from the teacher to the child are parallel with the constructivist idea of nurturing both self-awareness and meta-cognition. The freedom of movement in a Montessori classroom allows cognition and learning to be interwoven, facilitates full awareness, and produces a fully engaged child. These features align with constructivist principles, a theory supported by current academic literature.

Non-Montessori Education

Au (2011) describes the current state of K-12 education in the United States as based on a model designed to maximize the efficiency of curriculum delivery. There are five basic goals of

the No Child Left Behind legislation (Paige, 2006). First, the American people rightfully expect a return on their fiscal investment in public education. Second, academic accountability of the states and districts receiving federal dollars for public education is mandatory. Third, grade level achievement in reading and writing is expected of all students. Fourth, parents have choices regarding the academic environments of their children. Fifth, the American people have high academic expectations for all children. Paige further clarifies that NCLB gives the states latitude to follow the gist of the mandate.

Non-Montessori classrooms are structured with state standards in mind, and teachers are encouraged to plan according to district curriculum planning guides which encourage a group pace. The most prevalent mode of instruction within a non-Montessori classroom is teacher lecture directed at an entire class consisting of one age cohort with the textbook or basal reader as the curriculum guide (Au, 2011, Lillard, 2005). The teacher controls and manages the time and space based on district or state mandated curriculum planning guides rather than following the needs, abilities, and interests of the individual child. The teacher's role is as enforcer of discipline, dispenser of assignments, and defender of order (Au, 2011). Non-Montessori classrooms are uniformly equipped with child-sized furniture, but students typically are restricted to desks or tables arranged in forward-facing rows (Lillard & Else-Quest, 2006). In a non-Montessori classroom, pacing from lesson to lesson is teacher-directed, with lessons ranging from 20 to 45 minutes and the whole group changing focus at the same time as cued by bells or a teacher prompt (Lillard, 2005).

Montessori and Non-Montessori Education Comparisons

There exists in the scholarly literature some strong evidence for the efficacy of the Montessori Method as compared to non-Montessori practices. As random sampling in an early

childhood educational setting is not pragmatic or possible, true experimental research affording a comparison of the two approaches is problematic. Therefore, available quasi-experimental studies are reviewed.

Academic achievement outcomes resulting from Montessori and non-Montessori school experiences have yielded disparate results. Lopata, Wallace, and Finn (2005) compared the academic achievement of upper elementary (fourth grade) and middle school (eighth grade) students in both a Montessori setting and other more traditional public settings using state language arts and math standardized tests. The majority of the 543 participants, 187 boys and 156 girls, were both minority and of low socio-economic status. There were 291 fourth graders and 252 eighth graders. The achievement data collected did not support the hypothesis that Montessori education was correlated with higher academic achievement. Among the fourth graders tested, the language arts scores of Montessori students were not significantly different than those in the comparison groups, and the math scores of the Montessori students were higher than one of the comparison groups. Regarding language arts achievement scores, there were no significant differences between Montessori eighth graders and any of the other comparison groups, but Montessori students scored lower than non-Montessori magnet and traditional school students.

Peng (2009) conducted a study of children in Montessori and traditional elementary schools in China to compare their academic achievement and to track their progress over a period of three years. The researcher examined achievement data in the form of nationally-normed achievement test scores of nearly 200 students, half of whom had attended Montessori preschool and half of whom had attended traditional preschool in Taiwan. Peng examined the test scores of children enrolled in traditional first, second, and third grade classes in the subjects

of math, language arts, and social studies, comparing those of the Montessori students to the traditional ones. First grade students with Montessori preschool experience had statistically better Chinese language and math scores than those with other preschool experience. Second grade students with Montessori preschool experience had statistically better Chinese language scores than those with other preschool experience. Third grade students with and without Montessori preschool experience had no significant difference in math and social studies achievement scores but slightly better Chinese language scores. At the time of testing, the students were all in traditional elementary schools. Whereas the results show a lessening effect as the students in this study aged, it could be argued that the study's design did not effectively capture the cumulative effect of continuous years in Montessori instruction. Also, as Chinese is logographically-based and English is alphabetically-based, a direct comparison of their acquisition by children is moot.

Lillard and Else-Quest (2006) considered 53 traditional and 59 Montessori students on both academic and social skills measures; the groups were evenly divided among five-year-olds and eight-year-olds. Their measures were a combination of Woodcock Johnston III and researcher-authored measures of social skills. The social skills measures were vignettes presented to the students with choices as to how they would respond. The five-year-old Montessori students scored better than their non-Montessori peers on several of the reading subtests and in some social situations as measured by the researcher-created vignettes. The twelve-year-old Montessori students had stronger creative writing skills than their non-Montessori peers, but reading skills of the two groups were similar. Montessori students who were twelve years old had higher scores on the social skills measures than non-Montessori students.

Dohrmann, Nishida, Gartner, Lipsky, and Grimm (2007) compared the achievement data of high school graduates who had attended public Montessori school in grades kindergarten through fifth grade with graduates of the same high school who attended non-Montessori public elementary schools. Participants were matched for gender, race, socioeconomic status, and high school attended. Grade point averages, ACT scores, and state achievement test scores were compared. The results of the comparison indicated that Montessori students had significantly better math and science scores but similar language arts and social studies scores and grade point averages. This study is an isolated example of a direct comparison of long-term achievement outcomes of Montessori and non-Montessori public students.

Several other available studies lend insight into the efficacy of both academic and social aspects of Montessori education. Ervin, Wash, and Mecca (2010) implemented a mixed-methods longitudinal comparison of Montessori and non-Montessori students in kindergarten, first, and second grades. The researchers found that Montessori students have slightly higher mean scores on a measure of self-regulation as well as slightly higher mean reading and math achievement test scores. While these results are interesting, the measures used were primarily created by the researchers and are lacking normed references.

Shankland, Genolini, Franca, Guelfi, and Ionescu (2010) completed a longitudinal study of college students from varying alternative early educational experiences, among them Montessori education; they did not differentiate among the alternative methods. The researchers considered academic achievement and physical and psychological well-being. They found that students from alternative schools had greater academic achievement and life satisfaction or overall contentment and less anxiety and depression than students from traditional schools. In particular, academic achievement scores were significantly higher. Their conclusion was that

alternative early educational experiences were positively correlated to enhanced mental health and academic achievement in college.

While there is some evidence in the literature for the benefits of isolated aspects of the Montessori Method, there is lacking with the exception of Dohrmann, Nishida, Gartner, Lipsky, and Grimm (2007) a rigorous, data-based report regarding the academic achievement of Montessori students as compared to their non-Montessori peers. The metric of the day in these times of No Child Left Behind is the standardized achievement test. This study is an initial step towards quantifying the academic achievement of Montessori public school students and then examining similarities and differences of the academic achievement of non-Montessori peers.

Chapter 3

METHOD OF PROCEDURE

Participants

Participants in this study were 1,035 students from an urban public school district in the southwestern United States. As the data were de-identified, both the university Institutional Review Board and the participating school district's research department expedited the review and granted permission to proceed. Within this district, two of the campuses are Montessori schools for which students apply for admission from across the district. Of the 1,035 participants, 518 were Montessori students and 517 were non-Montessori students. Demographic data are presented in Table 1.

Table 1*Participant Characteristics*

Grade	Montessori		Gender		Race				Lunch Status			Total
	Yes	No	Male	Female	African American	Caucasian	Hispanic	Other	Free	Reduced	Paid	
1	106	106	100	112	60	56	70	12	56	14	142	212
2	109	109	94	124	62	40	84	32	74	22	122	218
3	98	98	74	122	56	44	82	2	86	0	110	196
4	103	103	76	130	60	42	80	24	66	14	126	206
5	102	101	67	136	48	27	114	14	76	30	97	203
Total	518	517	411	624	286	209	430	64	358	80	597	1035

In Table 1, *Yes* indicates enrollment in the Montessori program and *No* indicates enrollment in a non-Montessori, traditional program. Students in the large, urban public school

district in the southwestern United States whose data were accessed for this study are not randomly assigned to Montessori or non-Montessori programs. Parental choice and an application procedure are the required steps for enrollment in the public Montessori elementary schools. Enrollment in the public non-Montessori elementary schools is based on residence in a corresponding attendance zone. The school district providing data for this study is racially diverse. The races of participants in this study reflect that diversity. To gauge socioeconomic status, the lunch status of each participant was considered. The three categories of lunch status were *Free*, *Reduced*, and *Paid*.

Measures

For the students in grades one and two, the Iowa Test of Basic Skills (ITBS) (Hoover, Dunbar, Frisbie, Oberley, Bray, Naylor, Lewis, Ordman, & Qualls, 2003) is a nationally-normed achievement test administered in the spring of each year. The ITBS was most recently normed in 2000 with a sample of 170,000 students in the spring and 76,000 students in the fall (Engelhard & Lane, 2011). Engelhard and Lane reported internal consistency and equivalent forms reliability coefficients according to the Kuder-Richardson Formula 20 ranging from the middle .80s to the low .90s. Subtest reliabilities and reliabilities relating to younger children were reported as lower, but overall, reliability was satisfactory. While validity scores were not reported in their review, Engelhard and Lane did indicate that the caution and care that the authors have taken with item selection coupled with the long history of commendable use lend confidence when the test is interpreted. Reading Vocabulary and Reading Comprehension subtests results are combined to produce a Total Reading score, and Math Concepts and Math Computation subtests are combined to produce a Total Math score. For grades one and two in this study, the scores compared were Normal Curve Equivalents.

For students in grades three, four, and five, Texas Assessment of Knowledge and Skills (TAKS) Reading and Math percent correct scores were compared on each of the two tests. The TAKS is a state-developed achievement test administered according to state and district secure protocol. The Texas Education Agency (2011) established reliability and validity for the TAKS. Reliability is a measure of how consistently a test produces similar results in repeated administrations to the same sample. Kuder-Richardson 20 was used by the TEA to determine the internal consistency of the TAKS as it is appropriate for tests that are composed of multiple choice items. Validity is the degree to which the test relates to the construct that it purports to measure. The construct that is measured by the TAKS is the set of learning goals called the Texas Essential Knowledge and Skills (TEKS). The TEA (2011) cites its content validation process as the comparison of TAKS test items with the TEKS by educators familiar with the TEKS.

Setting

Both the ITBS and the TAKS were administered according to district mandated protocols by certified teachers in same-grade group settings, typically classrooms. State-certified teachers read from secure scripts and were monitored throughout the testing dates by district administrators to insure that the protocols were strictly implemented.

Procedure

After securing Texas A & M University-Commerce IRB approval, data collection began. The data were de-identified before they were obtained by the researcher and were considered in aggregate form. For each grade level, the most current data were from the 2011 administration of the ITBS for grades one and two and the TAKS for grades three, four, and five. While the total

number of participants was 1,035, there were approximately 100 Montessori and 100 non-Montessori students at each grade level.

The statistical analysis for this project involved several steps. Multiple regressions were conducted to remove the effects of gender, race, prior academic achievement, and socio-economic status. Prior academic achievement was determined by each participant's achievement scores on the same measures from the prior year. Socio-economic status was determined by free, reduced, or paid lunch assignment. At the first and second grade levels, the dependent variables were Total Reading and Total Math Normal Curve Equivalent (NCE) scores on the ITBS. At the third, fourth, and fifth grade levels, Reading and Math percent correct on the TAKS reading and math subtests were the dependent variables. A residual score was saved and, for easier comparison, was converted back to an NCE-like score for ITBS tests and a percent-like score for TAKS tests. The new scores were then used in a one-way ANOVA using a .05 significance level. The independent variable for each analysis was school type, Montessori or non-Montessori, and the dependent variable was the residual test score. Separate analyses were conducted by grade and subject.

Chapter 4

RESULTS

For each grade and subject, the residual scores of Montessori and non-Montessori students were used in a series of one-way ANOVA at the .05 significance level. The means and standard deviations are presented in Table 2. The ANOVA statistics are presented in Table 3.

Table 2*Academic Achievement Scores by Grade and School Type*

		Montessori	Non-Montessori
		Mean(SD)	Mean(SD)
Grade 1	Total Reading NCE	49.01(21.03)	50.98(21.16)
ITBS	Total Math NCE	48.89(23.67)	51.10(23.80)
Grade 2	Total Reading NCE	52.86(19.80)	47.39(21.93)
ITBS	Total Math NCE	51.97(13.66)	48.20(15.13)
Grade 3	Reading Percent Passing	78.62(16.57)	75.39(24.29)
TAKS	Math Percent Passing	70.19(14.12)	68.58(22.13)
Grade 4	Reading Percent Passing	80.93(13.35)	73.83(23.20)
TAKS	Math Percent Passing	76.72(11.38)	70.67(19.77)
Grade 5	Reading Percent Passing	80.91(12.29)	73.03(24.34)
TAKS	Math Percent Passing	76.96(10.88)	69.98(21.55)

Table 3

ANOVA Result for Academic Achievement Analyses by Grade and Subject

		<i>F</i>	<i>p</i>	η^2
Grade 1 ITBS	Total Reading	.397	.529	.002
	F(1,182)			
Grade 2 ITBS	Total Reading	3.035	.083	.017
	F(1,177)			
Grade 3 TAKS	Reading	1.130	.289	.006
	F(1,183)			
Grade 4 TAKS	Math	.371	.543	.002
	F(1,204)			
Grade 5 TAKS	Reading	7.182	.008	.034
	F(1,192)			
Grade 5 TAKS	Math	7.182	.008	.034
	F(1,192)			
Grade 5 TAKS	Reading	7.977	.005	.040
	F(1,192)			
Grade 5 TAKS	Math	7.977	.005	.040
	F(1,192)			

There were ten null hypotheses and ten alternative hypotheses. Of the ten null hypotheses, the first six pertained to there being no difference between the achievement test scores of Montessori and non-Montessori students in grades one, two, and three. These hypotheses fail to be rejected. The final four null hypotheses regarding the achievement outcomes of Montessori and non-Montessori fourth and fifth graders were rejected. The details are outlined below.

In grades one and two, all participants' ITBS Total Reading and Total Math scores were considered. Grades one and two ITBS Normal Curve Equivalent Scores are presented in Figure 1. The mean ITBS Total Reading score for non-Montessori students in grade one was 50.98 with a standard deviation of 21.16. The mean ITBS Total Reading score for Montessori students in grade one was 49.01 with a standard deviation of 21.03. A one-way ANOVA showed that there

was no significant difference between groups [$F(1, 182) = .397; p = .529$]. The null hypothesis was not rejected. The effect size (η^2) was 0.002, indicating little practical significance.

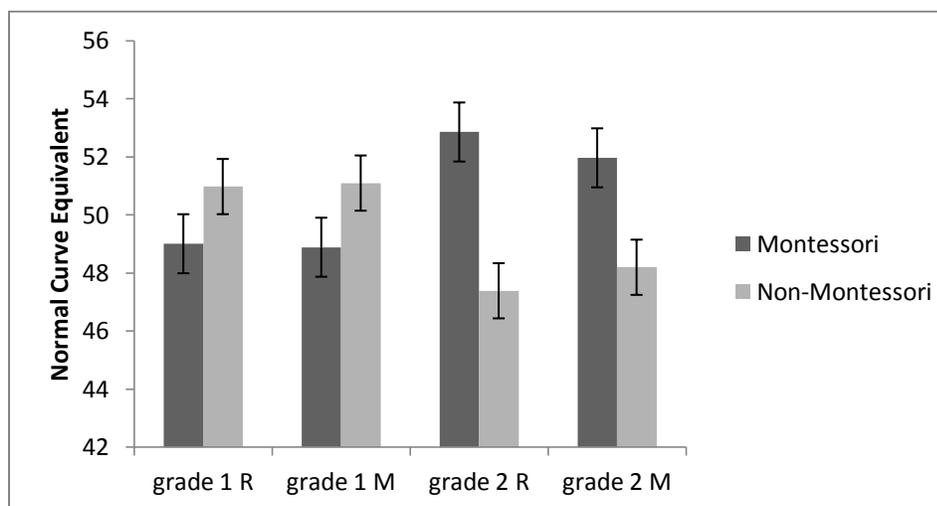


Figure 1

Grades 1 and 2 ITBS Achievement NCE Scores

The mean ITBS Total Math score for non-Montessori students in grade one was 51.10 with a standard deviation of 23.80. The mean ITBS Total Math score for Montessori students in grade one was 48.89 with a standard deviation of 23.67. A one-way ANOVA showed that there was no significant difference between groups [$F(1, 182) = .397; p = .529$]. For grade one, the null hypotheses were not rejected. The effect size (η^2) was 0.02, indicating little practical significance.

The mean ITBS Total Reading score for non-Montessori students in grade two was 47.39 with a standard deviation of 21.93. The mean ITBS Total Reading scores for Montessori students in grade two was 52.86 with a standard deviation of 19.80. A one-way ANOVA showed that there was no significant difference between groups [$F(1, 177) = 3.035; p = .083$]. These results

suggest that the null hypothesis should fail to be rejected. The effect size (η^2) was 0.017. Using Cohen's (1992) conventions, this effect size indicates a small practical significance.

The mean ITBS Total Math score for non-Montessori students in grade two was 48.20 with a standard deviation of 15.13. The mean ITBS Total Math score for Montessori students in grade two was 51.97 with a standard deviation of 13.66. A one-way ANOVA showed that there was no significant difference between groups [$F(1, 177) = 3.035; p = .083$]. For grade two, the null hypotheses were not rejected. The effect size (η^2) was 0.017. Using Cohen's (1992) conventions, this effect is small.

In grades three, four, and five, participants' TAKS Reading and TAKS Math percent correct scores were considered and are presented in Figure 2. The mean TAKS Reading percent correct for non-Montessori students in grade three was 75.39 with a standard deviation of 24.29. The mean TAKS Reading score for Montessori students in grade three was 78.62 with a standard deviation of 16.57. A one-way ANOVA showed that there was no significant difference between groups [$F(1, 183) = 1.130; p = .289$]. This suggests that the null hypotheses should fail to be rejected. The effect size (η^2) was 0.06. Using Cohen's (1992) conventions, this effect is a very small one.

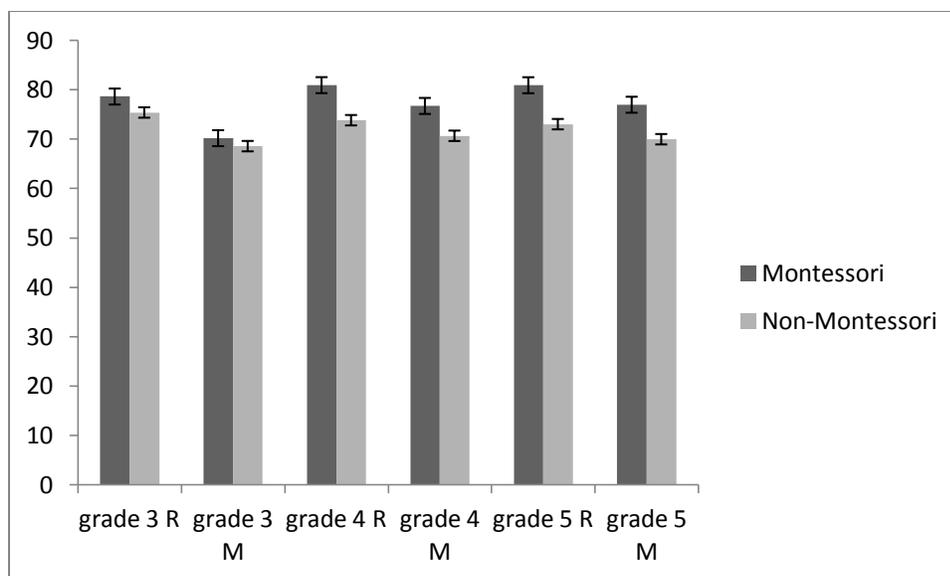


Figure 2

Grades 3, 4, and 5 TAKS Percent Correct Scores

The mean TAKS Math percent correct for non-Montessori students in grade three was 68.58 with a standard deviation of 22.13. The mean TAKS Math percent correct for Montessori students in grade three was 70.19 with a standard deviation of 14.12. A one-way ANOVA showed that there was no significant difference between groups [$F(1, 183) = .371; p = .543$], suggesting that the null should not be rejected. The effect size (η^2) was 0.002. Using Cohen's (1992) conventions, this effect size has little or no practical importance.

The mean TAKS Reading percent correct for non-Montessori students in grade four was 73.84 with a standard deviation of 23.20. The mean TAKS Reading score for Montessori students in grade four was 80.93 with a standard deviation of 13.35. A one-way ANOVA showed that there was significant difference between groups [$F(1, 204) = 7.182; p = .008$]. The null hypotheses were rejected. The effect size (η^2) was 0.034. Using Cohen's (1992) conventions, this effect is a very small one.

The mean TAKS Math percent correct for non-Montessori students in grade four was 70.67 with a standard deviation of 19.77. The mean TAKS Reading score for Montessori students in grade four was 76.72 with a standard deviation of 11.38. A one-way ANOVA showed that there was significant difference between groups [$F(1, 204) = 7.182; p = .008$], suggesting that the null hypotheses are rejected. The effect size (η^2) was 0.034. Using Cohen's (1992) conventions, this effect is small.

The mean TAKS Reading percent correct for non-Montessori students in grade five was 73.03 with a standard deviation of 24.34. The mean TAKS Reading score for Montessori students in grade five was 80.91 with a standard deviation of 12.29. A one-way ANOVA showed that there was significant difference between groups [$F(1, 192) = 7.977; p = .005$], suggesting that the null hypotheses should be rejected. The effect size (η^2) was 0.04. Using Cohen's (1992) conventions, this effect is small to medium -sized.

The mean TAKS Math percent correct for non-Montessori students in grade five was 68.98 with a standard deviation of 21.55. The mean TAKS Reading score for Montessori students in grade five was 76.96 with a standard deviation of 10.88. A one-way ANOVA showed that there was significant difference between groups [$F(1, 192) = 7.977; p = .005$]. The null hypothesis was rejected. The effect size (η^2) was 0.04. Using Cohen's (1992) conventions, this effect is a small one.

In grade one, the academic achievement of Montessori and non-Montessori students was not significantly different. In fact, the mean score for non-Montessori first grade students was slightly higher than Montessori students on both the ITBS Total Reading and Total Math scores. While Montessori and non-Montessori results in this study at the first grade level were not significantly different, they slightly favored non-Montessori instruction. At the two public

Montessori schools whose data were accessed for this study, 50% of the incoming first graders were new to the Montessori program. The achievement tests were administered in the spring of each school year. Therefore, first grade achievement test scores reflected the results of seven months of Montessori or non-Montessori instruction.

A slight practical significance was observed favoring Montessori education in grade two on the ITBS Total Reading and Total Math scores though there was no statistical significance. In grade three, the TAKS Reading and Math scores of Montessori and non-Montessori students were not significantly different. At the two public schools whose data were accessed for this study, less than 10% of the incoming second and third graders were new to the Montessori program. Achievement scores thus reflect nearly two years of Montessori instruction at the second grade level and nearly three years of Montessori instruction at the third grade level. While Montessori and non-Montessori results at the second and third grade were not significantly different, they slightly favored Montessori instruction.

In grades four and five, Montessori students had statistically significantly better TAKS Reading and Math scores than their non-Montessori counterparts though the effect size was small. In grades four and five, approximately 5% of the students were new to Montessori. Therefore, fourth and fifth grade Montessori students had received fairly consistent Montessori instruction for several years prior to the administration of the TAKS tests.

Chapter 5

DISCUSSION

The results of the current study are similar to the findings of Lopata, Wallace, and Finn (2005), whose younger participants demonstrated no significant differences in achievement but whose older participants showed divergences. Lopata et al., showed no statistical difference among fourth grade Montessori participants' language arts and math scores and any of the comparison groups. Among the eighth grade participants, Montessori students had lower language arts scores and similar math scores. This pattern contrasts with the current study in that the divergence in the current study favored Montessori students in both reading and math achievement scores at the fourth and fifth grade levels.

Among students who experienced Montessori preschool, Peng (2009) found that the differences between Montessori and non-Montessori achievement were greater for first graders than third graders. While this finding might appear to be in contrast with the current study, the participants in the Peng study were not enrolled in Montessori elementary schools at the time of their achievement testing. Thus, the Peng study might demonstrate that the effects of a Montessori preschool experience diminish over time spent in a non-Montessori classroom. In the current study, the participants had continued in a Montessori elementary program through the time of the administration of the measures.

Lillard and Else-Quest (2006) found that Montessori students had higher academic skills than non-Montessori counterparts, and this finding paralleled the findings of the current study. However, their sample size was small and the measure of academic achievement was a series of individually administered tests. The larger sample size of the current study lends power to the Lillard and Else-Quest findings. This observation is also true of the Ervin, Walsh, and Mecca

(2010) study as the measures used in the current study were norm-referenced and the sample sizes were comparatively large.

Dohrmann, Nishida, Gartner, Lipsky, and Grimm (2007) compared high school students with and without preschool and elementary Montessori experience. They found higher achievement for Montessori students than non-Montessori students in math and science but not in language and social studies as measured by grades, ACT scores, and state achievement tests. While the current study found higher reading and math scores, it did not measure social studies or science. Both the explanations for similar language achievement levels and comparisons for science and social studies results are areas for further study.

Limitations

There were two primary limitations of this study. The first concerns the measures used in this study: the Iowa Test of Basic Skills (ITBS) and the Texas Assessment of Knowledge and Skills (TAKS). The second limitation is that students were not randomly assigned to Montessori or non-Montessori programs.

The first limitation concerns the measures used in this study. Two different measures of achievement were used: the ITBS for grades one and two and the TAKS for grades three, four, and five. The ITBS was administered only for grades one and two in the district with public Montessori schools used for this study, and TAKS scores were the available metric in grades three, four, and five. Consistent use of a single measure is preferable. Also, different subtests of the ITBS were used in first grade and second grade. As there is no ITBS Total Reading score for kindergarten, the ITBS Language Total was used in the regression analysis as a measure of prior achievement for the first graders. Scores from varying grade levels of the same subtest would be preferable.

Another limitation was the application process for admission to the Montessori program. While the criteria are not particularly rigid and are primarily based on interest rather than aptitude, the mere existence of the selection process, coupled with the popularity among families for the program, results in a tendency for students in the Montessori schools to have active, attentive parents. Graves and Wright (2011) concluded that parental involvement positively impacted student achievement. A possible means of addressing this issue in further studies is to compare the academic achievement of students from the Montessori schools to that of students who applied and were eligible for admission, but were placed on a waiting list due to space constraints.

Implications

Implications of this study include the observation that the gap between the academic achievement of Montessori and traditional students widens in favor of Montessori students as the number of years in Montessori education grows. There is increasing divergence favoring Montessori instruction between Montessori and non-Montessori students in both reading and math achievement test scores. It could be that time in the Montessori classroom is the factor that leads to significant differences. The impact of Montessori education on academic achievement might be a cumulative effect which comes to fruition with sustained time in a Montessori classroom.

Recommendations

In particular, the results of this study suggest that consistent, comprehensive tracking of the academic achievements of Montessori students across the span of their school years is needed. In the district that provided data for this study, there are middle schools which share campuses with the two Montessori schools. In these two middle schools, 50% of the students are

from the adjoining Montessori elementary schools, and 50% are from non-Montessori neighborhood schools. Further research might address the achievement of Montessori students in grades six, seven, and eight compared to non-Montessori students. Additionally, the academic achievement of Montessori students might be tracked through high school and college.

Shankland, Genolini, Franca, Guelfi, and Ionescu (2010) concluded that alternative early educational experiences were positively correlated to enhanced mental health and academic achievement in college. They did not differentiate among Montessori and other non-traditional educational experiences. Continued research might extend this work by specifically examining the secondary and higher educational outcomes of students who completed the Montessori preschool through middle school program accessed for this study.

A topic regarding Montessori education unaddressed in this study is the social benefit of a Montessori education. The affective outcome comparisons of Montessori and non-Montessori educational experiences are beginning to receive attention in the literature. Lillard (2012) compared the executive functions and social problem-solving skills as well as reading, math, and vocabulary achievement of preschool children enrolled in Classic Montessori, Supplemented Montessori, and Conventional programs. Pretest data indicated similar levels on the measures utilized in the study for children in all of the conditions. At the conclusion of the study, children in the Classic Montessori experimental condition fared better in each of the areas assessed than students in the Supplemented Montessori condition or the Conventional preschool program. The young participants in Lillard's study were primarily White, and most of their mothers had college degrees. Further work exploring affective and social effects of Montessori education with diverse populations and older children is warranted.

Conclusions

There are strong parallels between the Montessori Method and constructivism. Learning embedded in meaningful context, multi-aged classrooms, multiple representations of content, intrinsic motivation, and freedom of both physical and curricular movement are aspects of the Montessori Method with empirical bases for claims of efficacy. This study demonstrates that the academic achievements of public school elementary-aged students who participate in Montessori programs diverge favorably from those of non-Montessori students. This divergence becomes statistically significant in later elementary grades. As upper elementary students in the Montessori public school program are experienced Montessori students and are rarely new to the program, an implication is that longer time in a Montessori program yields significant academic achievement. The long-term effect of study in a Montessori classroom is an area for further study.

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