

Comparison of Academic Achievement Between Montessori and Traditional Education Programs

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Abstract. The purpose of this study was to compare the academic achievement of 543 urban 4th- (n=291) and 8th- (n=252) grade students who attended Montessori or traditional education programs. The majority of the sample consisted of minority students (approximately 53 percent), and was considered low income (approximately 67 percent). Students who attended a public Montessori school were compared with students who attended structured magnet, open magnet, and traditional non-magnet public schools on standardized measures of math and language arts. Results of the study failed to support the hypothesis that enrollment in a Montessori school was associated with higher academic achievement. Implications and suggestions for future research are provided.

Maria Montessori developed the first Montessori school in 1907 to serve children who were economically disadvantaged, as well as children with mental retardation (Pickering, 1992). Her work included development of specific educational methods and materials based on her belief about how children learn. Although Montessori programs have historically ended at age 6, elementary Montessori programs became more prevalent in the 1990s, with middle and secondary programs slowly emerging (Seldin, 2002-03). The Montessori movement received a boost when federal funding was released for magnet programs that allowed public funding for Montessori programs (Chattin-McNichols, 1992). Montessori programs are currently found in a variety of settings, including inner-city and affluent areas, large urban magnet programs, preschools for children at risk,

and early childhood and child care centers (Haines, 1995). At present, there is an estimated 4,000 private Montessori programs and more than 200 Montessori-styled public schools serving students from infancy to 8th grade (North American Montessori Teachers' Association, 2003).

According to Ryniker and Shoho (2001), the Montessori approach is based on the tenet that children learn most effectively when information is developmentally appropriate. Central to this approach is the notion that children's natural tendencies "unfold" in specially designed multi-age environments that contain manipulative self-correcting materials (North American Montessori Teachers' Association, 2003). Montessori reportedly identified genetically programmed "sensitive periods" in which children have exaggerated capacity and eagerness to acquire skills and information

(Crain, 1992). Because each child's development is different, the individual child is allowed to choose activities, "trusting the child's sensitive periods will guide him to choose the work for which he is ready" (Pickering, 1992, p. 92).

In this approach, children learn at their own pace through manipulation of objects. As such, personal independence, self-discipline, and initiative are essential for learning and motivation, with motivation purportedly fostered through interactions in the environment (Kendall, 1993). Harris and Callender (1995) contend that the emphasis on these aspects leads to "inner discipline." In the Montessori approach, teachers do not "direct learning," but respect the children's efforts toward independent mastery (Crain, 1992). Instruction is based largely on sensory materials developed by Montessori (Ryniker & Shoho, 2001).

Montessori and traditional education programs reportedly differ in several ways, including physical environment, instructional methodology, and classroom attitude. For example, Montessori classrooms employ an open-concept in which desks are arranged in "rafts" to promote individual and small-group learning and students' age range across a three years, whereas traditional classrooms have desks oriented in one direction for whole-group instruction and consist of same grade students (Chattin-McNichols, 1992). In Montessori classrooms, students typically spend three to four hours per day in self-selected individual and small-group work and spend less than one hour per day in whole-group instruction (Baines & Snortum, 1973). This is in contrast to traditional classrooms where students follow teacher-directed work (Chattin-McNichols, 1992). In addition, traditional education programs have been identified as placing greater emphasis on dispensing and delivering information (Ryniker & Shoho, 2001).

Instructionally, Montessori programs use manipulative materials designed by Montessori as an instructional methodology, whereas traditional classrooms use materials as teacher presentation aids.

Furthermore, Montessori is distinct in that it does not use textbooks, worksheets, tests, grades, punishments, or rewards (Haines, 1995). Differences in classroom attitudes and management also have been noted. According to Chattin-McNichols (1992), Montessori classrooms are based on cooperation, while traditional classrooms are based on competition. In Montessori classrooms, "Teachers promote inner discipline in children by letting students direct their own learning instead of upholding an outer discipline where teachers act as authoritarians, dictating to students how to behave and what to do" (Harris & Callender, 1995, p. 134). Montessori teachers reportedly have "faith that the children will freely choose the tasks that meet their inner needs at the moment" (Crain, 1992, p. 65). In addition, Montessori programs target the development of "human potential ... beyond the more narrow focus of skill development and transmission of societal values which shape the traditional educational system" (Kendall, 1993, p. 65).

Another important characteristic of the Montessori approach is the practitioner's assertion that the approach produces superior academic achievement outcomes (e.g., Daux, 1995; Dawson, 1987; Takacs, 1993 cited in Seldin 2002/03). Despite this contention, quantitative evidence to support the claim is limited. For example, Daux (1995) followed the performance of 36 "broadly middle-class" students from a private Montessori school from 2nd through 8th grade on annual standardized achievement testing. The students' initial 2nd-grade testing indicated that the group was above average when the study began. Gains exceeding the pretest were reported in the areas of total reading and total math against the national norm. Despite the lack of reported statistical analyses in the article, Daux (1995) claimed that the results provide "quantitative evidence that Montessori schools produce greater than expected academic achievement in students" (p. 147). Substantial methodological limitations, including the lack of a comparison group, absence of appropriate tests of significance,

and numerous potential threats to internal validity, call into question these assertions and conclusions.

Other examples of commonly cited studies that examined the efficacy of Montessori programs include studies by Glenn (1996) and Dawson (1987). Glenn (1996) conducted a 10-year longitudinal follow-up study of Montessori students on measures of academic achievement, as well as such personality characteristics as self-control, self-direction, spontaneity, and creativity. Results indicated that students who attended Montessori programs were “as successful as the general public” and that years in a Montessori program were not related to personality characteristics.

The study by Dawson (1987) examined mean grade equivalent scores on the Iowa Test of Basic Skills (ITBS) and the Metropolitan Achievement Test (MAT) for minority Montessori students in grades 1 through 5 against national norms. Results of the descriptive comparison indicated higher mean grade equivalents for minority students in the Montessori program as compared to national norms. Dawson also compared Montessori ITBS and MAT test scores against matched “conventional schools” (matched on ethnicity) in the district for grades 1 through 4. Results indicated that Montessori scores were significantly higher on nearly all grade level comparisons.

Although Dawson was able to discount screening as a potential confound due to the program being non-selective (admission based on date of application), no data was provided on pre-programming levels to indicate whether the groups differed prior to enrollment in the Montessori program. In addition, no statistical control procedures were applied to control for potential demographic confounds such as gender and economic status. Lastly, Dawson noted that parental selection “could not be ruled out” as a rival explanation.

Miller and Bizzell (1984) examined the long-term effect of Montessori preschool programs, as well as other preschool programs on the 9th- and 10th-grade performance of low-income African American

students. No statistically significant differences on math and reading achievement scores (Comprehensive Tests of Basic Skills) were found between students who attended Montessori versus other preschool programs. Although the researchers noted higher performance for male students who attended Montessori programs, the higher scores paralleled student IQ scores. Such a finding does not allow achievement differences to be attributed to instructional programming (i.e., Montessori preschool).

Beyond these studies, proponents have made additional assertions regarding the effectiveness of Montessori programs. For example, Pickering (1992) contended that Montessori programs help students develop attention, organization/order, visual and auditory perception, written language skills, fine and gross motor skills, mathematical skills, and personality. However, there is a lack of empirical support for Pickering’s (1992) assertions regarding the areas positively affected, or the claim that Montessori materials have been “scientifically” validated. Some of the lack of evidence may be due to Montessorians’ view that standardized tests provide little information on student progress and do not assess the skills and attributes promoted in Montessori programs (Haines, 1995). As a result, it was not until recently that Montessorians encountered pressure to collect research data (Seldin, 2002/03). “Even though Montessorians may be averse to the notion of evaluation, they will need to show results—quantifiable measures of student learning” (Haines, 1995, p. 118).

Substantial methodological flaws in the existing literature suggest that more controlled empirical research is necessary. Studies such as those previously described highlight a range of problems, such as a lack of comparison groups, statistical controls, and empirical testing for group comparisons. In a review of the literature, Seldin (2002/03) claimed that much of the existing research has been inconclusive or contained severe methodological flaws, and is limited in terms of age range. Additionally, little research has been conducted with elemen-

tary and latency age children (Glenn, 1996; Kendall, 1993). To overcome these weaknesses, the current study empirically tested whether students in a Montessori school outperformed non-Montessori students using standardized measures of math and language arts. Specifically, 4th- and 8th-grade students who attended a Montessori school were compared to matched-samples of students in structured magnet, open magnet, and traditional non-magnet schools in a large urban district.

Method

Sample

The sample for the current study consisted of 543 4th- and 8th-grade students (i.e., 291 4th-graders and 252 8th-graders) in a large urban district in western New York. Four public schools were selected for participation: Montessori, Open Magnet (OM), Structured Magnet (SM), and Traditional Non-Magnet (TNM) schools. Schools were selected based on grossly similar school profiles provided by the New York State Education Department. To control for demographic differences between school types, schools were matched on gender, ethnicity, and socio-economic status (SES). SES was determined using the federal formula for free and reduced lunch. Based on the formula, students were categorized by the district as “low income” or “not low income.” Overall, approximately 67 percent of the total sample was identified as low income (i.e., 69 percent of grade 4 and 64 percent of grade 8). White students constituted approximately 47 percent of the sample, with African American, Hispanic, and Other students comprising the category of “Minority.” Demographic characteristics are presented in Table 1.

Schools selected for comparison with Montessori were chosen based on salient differences in instructional environment. A brief description of each school’s orientation is provided. The Montessori school provided curricular content through a prepared learning environment that meets the needs and interests of children in multi-age

classrooms using Montessori instructional materials. The role of the teacher was described as one of observer and facilitator in student learning. This child-centered approach emphasized the “total development of the child,” and learning over work products. Specifically, the school focused on the process of learning instead of work output. Behavioral reinforcement and/or consequences were not employed to manage student behaviors. The stated goal of the Montessori school was development of strong self-directed young adults who pursue a lifetime love of independently learning.

Two separate non-selective magnet schools (i.e., no admissions requirements/tests) were chosen for comparison to reduce the potential confound of parental selection and choice. The magnet programs required parental selection and enrollment procedures that paralleled those of the Montessori school. Specifically, parents had contacted the district’s magnet office and identified three possible magnet schools of interest. Student placement was determined by lottery.

The Structured Magnet (SM) school emphasized back-to-basics curricular content, driven by New York State standards. Instruction was described as teacher-directed, with drill-and-practice used to develop skills and curricular proficiency. Instructional materials regularly included textbooks, workbooks, and worksheets, and students completed assigned work at their desks. There was also a strong school-wide emphasis on structured classrooms and discipline, including consequences for modifying inappropriate behavior.

The school described as an Open Magnet (OM) had large community spaces and shared open areas characteristic of “open education” concepts. The open environment allowed for team-teaching, as well as small-group and individual instruction in multi-age groups that reportedly fostered students’ sense of interdependence and responsibility. The instructional approach of the school was identified as exploratory and discovery-oriented, with units designed to

be thematic. Schedules and routines were described as flexible. Discipline relied on naturalistic social opportunities, and school meetings to identify conflict resolution approaches.

The 4th school was identified as a Traditional Non-Magnet (TNM). Students enrolled in the TNM attended that school based on proximity to home, with no parental selection. The TNM emphasized basic curricular standards to improve test scores. Instruction was based on structured direct instruction, including an emphasis on drill-and-practice using textbooks and worksheets. Students performed seatwork at their desks and were expected to adhere to a strict code of discipline. The structured school environment included the use of behavioral consequences for modifying inappropriate behavior.

Instruments

Academic achievement was assessed using 4th- and 8th-grade math and language arts scores from two separate standardized measures: the New York State Mathematics and English/Language Arts (ELA) exams, and the Math and Language Arts portions of the TerraNova (McGraw Hill, 2002).

Mathematics Achievement. The content of the New York State Mathematics Exam was designed to parallel the New York State Learning Standards. Both the 4th- and 8th-grade exams assess the general mathematical areas of procedural knowledge, conceptual understanding, and problem solving. Specific subtests include mathematical reasoning, number and numeration, operations, modeling/multiple representations, measurement, uncertainty (i.e., estimation), and patterns/functions (New York State Education Department, 2004a).

The Mathematics portion of the TerraNova (McGraw-Hill, 2002) also was used to assess mathematics achievement at the 4th- and 8th-grade levels. The two primary areas assessed were identified as mathematics (e.g., estimation, number and number sense, numeration, number theory, data interpretation, and measurement) and

mathematics concepts (e.g., isolated computations and operations).

Language Arts Achievement. The New York State English/Language Arts exam, conducted at the 4th- and 8th-grade levels, was designed to parallel the New York State Learning Standards and provides a comprehensive assessment of language arts achievement. The 4th-grade exam assessed the areas of reading, listening/writing, and reading/writing, and the 8th-grade exam assessed reading, reading/writing, listening/writing, and independent writing (New York State Education Department, 2004b). Examples of language arts skills assessed at the 4th-grade level included drawing inferences and conclusions, identifying main ideas and supporting details, locating information to solve a problem, and knowledge of story structure and elements. At the 8th-grade level, examples of skills included using text to understand vocabulary, drawing conclusions to make inferences, interpreting characters, settings, and themes, comparing and contrasting information, determining the meaning of literary devices, and recognizing points of view.

The TerraNova (McGraw-Hill, 2002) also was used to assess language arts achievement. The skill areas assessed were identified as language (e.g., ability to understand the structure of words, how words are connected to form sentences, how sentences and paragraphs are connected to convey ideas, and language conventions) and language mechanics (e.g., editing and proofreading).

Procedures

Data for the present study were provided by the school district. Achievement test data were compiled as part of each school's annual evaluation of students. Data records were provided to the researchers anonymously, using only district assigned numbers and no personally identifying information. Data were then analyzed to evaluate the academic performance of Montessori students compared to students in magnet and non-magnet schools.

Results

At each grade level, a multivariate analysis of covariance (MANCOVA) tested the hypotheses that students in the Montessori school had higher language arts and mathematics achievement than students in magnet and traditional non-magnet schools. Planned contrasts were performed between the four school types at each grade level. Montessori was compared to Structured Magnet (SM), Open Magnet (OM), and Traditional Non-Magnet (TNM) schools on language arts and mathematics achievement. To control for demographic differences between students, demographic

characteristics (gender, ethnicity, and SES) were used as covariates in all analyses.

Covariate Results

Correlations among the measures are presented in Table 2. The relationship between language arts and mathematics was fairly strong for both grade 4 ($r=.65$) and grade 8 ($r=.64$). Gender was not significantly related to mathematics achievement at either grade level, but was related to language arts achievement. Female students had higher language arts scores than male students in both grades four and eight. Ethnicity and SES were significantly

Table 1
Demographic Characteristics of the Study Sample (n = number of students)

Grade 4	MEP	SM	OM	TNM	Total
Gender					
Male	30	33	53	50	166
Female	19	22	45	39	125
Race					
White	21	23	41	50	135
Minority	28	32	57	39	156
Low Income					
Yes	31	0	63	70	203
No	18	15	36	19	88
Grade 8					
Gender					
Male	15	26	34	46	121
Female	24	33	43	31	131
Race					
White	16	21	30	51	118
Minority	23	38	47	26	134
Low Income					
Yes	21	31	51	59	162
No	18	28	26	18	90

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related to both outcome measures. Minority and low-income students had significantly lower mathematics and language arts achievement than White students and those not identified as low-income, respectively. These relationships were consistent for both grade levels. The multivariate tests of significance showed that the set of three covariates was significantly related to the achievement measures at grade 4 ($F(6, 546)=19.0, p<.001$) and grade 8 ($F(6, 476)=13.9, p < .001$).

Grade 4 Results

Results of the overall tests of significance for grades 4 and 8 are summarized in Table 3. A significant multivariate main effect of school type was found at grade 4 ($F(6,546)=7.35, p<.001$). Univariate tests of significance showed differences among the four school types for both language arts ($F(3,274)=2.53, p<.05$) and mathematics outcomes ($F(3,274)=14.55, p <.001$). Planned contrasts between school types tested the specific hypotheses that students attend-

Table 2
Correlations Among Study Variables

Variable	Gender ^a	Low Income ^b	Language	Math	Race ^c
Gender ^a	1.00	0.11	0.14*	0.001	-.003
Low Income ^b	0.02	1.00	-.33 **	-.37 **	0.31 **
Language	0.18 *	-.32 **	1.00	0.64 **	-.38 **
Math	-.06	-.27 **	0.65 **	1.00	-.36 **
Race ^c	0.06	0.31 **	-.36 **	-.44 **	1.00

Note. Correlations for grade 4 variables appear below the diagonal. Correlations for Grade 8 variables appear above the diagonal.

a 1=male; 2=female. b 1=no; 2=yes. c 1=white; 2=minority. * $p<.05$; ** $p<.001$

Table 3
Summary of Multivariate and Univariate Contrasts

	Multivariate			Univariate		
	F	Effect Size ^a	T	Language Effect Size	Mathematics T	Effect Size
Grade 4						
SM-MEP	1.41	0.34	-.54	-0.11	-1.60	-0.32
OM-MEP	5.97 **	0.62	-1.32	-0.24	-3.35 **	-0.60
TNM-MEP	2.10	0.38	.93	0.17	2.02 *	0.37
Grade 8						
SM - MEP	10.47 **	0.95	3.74	0.77 **	-0.13	-0.03
OM - MEP	6.87 **	0.74	1.88	0.37 +	-1.63	-0.32
TNM - MEP	8.59 **	0.86	2.85	0.59 **	-0.94	-0.19

Note. All effects controlling for gender, race, and income.

^aMultivariate effect sizes reported are Mahalanobis Distance statistics.

+ $p<.06$; * $p<.05$; ** $p<.001$

ing the Montessori school would outperform students in magnet and traditional non-magnet schools. Results showed no significant differences between students in the Montessori school and any of the other three types of schools on language arts achievement.

No significant difference on mathematics achievement was found between the Montessori and SM schools, but Montessori was higher in math achievement than OM by .60 standard deviations. In contrast, Montessori students had significantly lower math achievement than TNM students; the effect size was .37 standard deviations.

Grade 8 Results

A significant multivariate effect of school type was also found at grade 8 ($F(6,476)=4.54, p<.001$). Univariate tests of significance showed that school types differed on language arts achievement ($F(3,239)=5.24, p<.01$), but not on mathematics ($F(3,239)=1.33, p<.27$). Results from the planned contrasts showed significant differences between the Montessori and other school types in language arts, but not in mathematics. Montessori students had significantly lower language arts achievement than students attending both the SM and TNM schools. The language arts differences were substantial; SM and TNM students scored higher than Montessori by .77 and .59 standard deviations, respectively. The OM students also had higher language arts achievement than Montessori, although this difference did not reach statistical significance ($p<.06$).

Discussion

Conflicting evidence and assertions, limited empirical research, and methodological weaknesses in the existing research illustrated the need for further study involving the effectiveness of Montessori schools. The current study tested the hypothesis that students attending a Montessori school would demonstrate higher math and language arts achievement compared to magnet and traditional non-magnet school students. Overall, the results were mixed

and failed to support the general hypothesis that Montessori students demonstrate superior academic performance. Of the 12 specific contrasts that were tested, students from the Montessori school had significantly higher achievement on 1 contrast, significantly lower achievement on 4 of 12 contrasts, and showed no difference from other schools on 7 of the 12 specific contrasts.

In the area of language arts, 4th-grade Montessori students did not significantly differ from the structured magnet, open magnet, or traditional non-magnet schools. At the 8th-grade level, however, Montessori students had lower achievement than students in structured magnet, open magnet, and traditional non-magnet schools. For math achievement, 4th-grade Montessori students demonstrated significantly higher scores than students in the open magnet, no difference from students in the structured magnet, and significantly lower scores than students in the traditional non-magnet schools. In grade 8, however, no significant differences in mathematics achievement were found between the Montessori and magnet or traditional schools.

While the present study did not identify a consistent pattern of performance across grade levels, the lack of significantly higher scores for students in the Montessori school suggests that assertions regarding the academic achievement efficacy of Montessori programs should be viewed with caution. Current results contradict those of other studies that found Montessori students' demonstrated superior academic growth and achievement (e.g., Daux, 1995; Dawson, 1987). Minimally, results of the current study suggested that Montessori students were similar in the majority of achievement comparisons to students from magnet and traditional non-magnet schools. A more critical finding, however, was that 8th-grade students from the Montessori school demonstrated substantially lower language arts achievement than students from the other three programs.

Several limitations in the current study warrant mention. Data for the current

study were gathered on one school from each program type. As such, school differences might reflect idiosyncratic building level differences, rather than the effect of a particular program orientation. In addition, students in the study had been in existing programs and program implementation and fidelity were not experimentally controlled. Although random assignment was not possible, matching procedures at the building level, as well as statistical controls (i.e., covariance), were used to minimize potential student differences between schools that might have accounted for performance variability. In addition, no subject data was available on duration of enrollment in a specific program. Although Glenn (1996) found that number of years in a Montessori program was not associated with the demonstration of "Montessori qualities," the potential impact of duration in any of the programs may be related to the efficacy of the program.

While proponents of Montessori programs maintain both social and academic advantages for students, prior research has not adequately tested these assertions. This investigation empirically tested whether a Montessori school had academic benefits over other school programs. Despite mixed results, the hypothesis that Montessori programs are associated with superior academic achievement was not supported. This was especially evident in the lower language arts achievement among 8th-grade Montessori students. Although the Montessori approach is unique and may have benefits for both teachers and students that extend beyond academics, the potential advantages should be demonstrated empirically before assumed as a positive outcome.

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