A comparison of academic achievement of students taught by the Montessori method and by traditional methods of instruction in the elementary grades
by John Robert Fero

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Education
Montana State University
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Abstract:
The problem of this study was to determine if there is a significant difference between the academic achievement scores of students in grades 2 through 5 who are taught with the Montessori method of instruction and those students who are taught with traditional methods of instruction in the Helena Public Schools. Analyses used a two-way ANOVA; method and gender as well as method and aptitude were examined. The level of significance was set at alpha = .05. A matching technique was used to match Montessori students with students from traditional classrooms by the independent variables of grade, aptitude, gender, socioeconomic conditions, and handicapping conditions. The study also examined if there was a significant difference between the aptitude of all students in Montessori classrooms and all students in traditional classrooms.

The population studied was second, third, fourth, and fifth grade students during the spring of 1996. A total of 120 students was used in the study of academic achievement.

There were 145 F-tests conducted in this study. At the second grade level, students from traditional classrooms scored significantly higher than students in Montessori classrooms in mathematics computation and mathematics concepts and applications. Also at the second grade, when aptitude was taken into consideration, Montessori low aptitude students scored significantly higher in vocabulary than low aptitude students in traditional classrooms. There were no significant findings in any of the subtests at the third and fourth grade levels. At the fifth grade level, Montessori students scored significantly higher in language expression and social studies. Interaction was found with aptitude in language expression and with gender in science. A comparison of the aptitude of all Montessori students to all students from traditional classrooms revealed that Montessori students scored significantly higher.

The overall results of this study show that the Montessori method of instruction and the traditional method of instruction provide students with comparable achievement test scores. A longitudinal study is recommended to examine the long-term effects of academic achievement of those students taught by the Montessori method of instruction.

A COMPARISON OF ACADEMIC ACHIEVEMENT OF STUDENTS TAUGHT BY THE MONTESSORI METHOD AND BY TRADITIONAL METHODS OF INSTRUCTION IN THE ELEMENTARY GRADES

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This thesis has been read by each member of the graduate committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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ABSTRACT

The problem of this study was to determine if there is a significant difference between the academic achievement scores of students in grades 2 through 5 who are taught with the Montessori method of instruction and those students who are taught with traditional methods of instruction in the Helena Public Schools. Analyses used a two-way ANOVA; method and gender as well as method and aptitude were examined. The level of significance was set at alpha = .05. A matching technique was used to match Montessori students with students from traditional classrooms by the independent variables of grade, aptitude, gender, socioeconomic conditions, and handicapping conditions. The study also examined if there was a significant difference between the aptitude of all students in Montessori classrooms and all students in traditional classrooms.

The population studied was second, third, fourth, and fifth grade students during the spring of 1996. A total of 120 students was used in the study of academic achievement.

There were 145 F-tests conducted in this study. At the second grade level, students from traditional classrooms scored significantly higher than students in Montessori classrooms in mathematics computation and mathematics concepts and applications. Also at the second grade, when aptitude was taken into consideration, Montessori low aptitude students scored significantly higher in vocabulary than low aptitude students in traditional classrooms. There were no significant findings in any of the subtests at the third and fourth grade levels. At the fifth grade level, Montessori students scored significantly higher in language expression and social studies. Interaction was found with aptitude in language expression and with gender in science. A comparison of the aptitude of all Montessori students to all students from traditional classrooms revealed that Montessori students scored significantly higher.

The overall results of this study show that the Montessori method of instruction and the traditional method of instruction provide students with comparable achievement test scores. A longitudinal study is recommended to examine the long-term effects of academic achievement of those students taught by the Montessori method of instruction.

CHAPTER 1

INTRODUCTION

Two paradigms have dominated the general philosophy in public schools in the United States over the past 40 years. In the 1960s and 70s, the predominate philosophy used for instruction was heavily reliant on behaviorist theory. In the 1980s and 90s, there has been an emergence of the constructivist theory, the foundations of which are rooted in the writings of Jean-Jacques Rousseau, Friedrich Froebel, Johann Pestalozzi, and John Dewey, and in Jean Piaget's research and writings. Carson (1994) noted that

> at present, education worldwide is witnessing a sea of change, adapting the constructivist paradigm with its emphasis on the learner, the uniqueness of each learner, on discovering learning, on hands-on experience, on gentler and more subtle forms of discipline, and on the increasing use of cooperative learning as a means of facilitating the social construction of knowledge. (p. 1)

Another person whose philosophy coincides very closely with Carson's description of constructivism was an Italian medical doctor named Maria Montessori. She was one of the pioneers in research on early childhood development and related instructional practice. Dr. Montessori felt that the early years of child development were extremely important to a child's learning. Dr. Montessori and

several other leading early childhood advocates put their teaching theories into practice in the 1800s and early 1900s.

Dr. Montessori's observations of children, which took place between 1896 and 1906, led her to conclude that children could learn at a much younger age than previously thought. Her methods are supported by an environment that is favorable to children and conducive to the way they learn. Today, as a result of her teaching, there are thousands of "Montessori Schools" in existence worldwide.

"Montessori" is a very common word in America today. In order to understand Montessori education, it is necessary to understand that it represents many things to many people. According to Joy Turner (1992), Montessori is "a person, but also a social movement, a philosophy, a theory of development, a curriculum model, and a set of methodological strategies. Montessori called her approach either a 'method' or a 'system' of education" (p. 19).

Dr. Montessori believed that there are four stages of child development between birth and adulthood. These stages are similar to those described by Rousseau and more recently by Piaget. The development of these four stages centers around motor education, sensory education, and language. Consequently, her instructional methods centered around the development of these three areas. Dr. Montessori (1964) stated the following in her own handbook:

> The technique of my method as it follows the guidance of the natural physiological and psychical development of the child may be divided into three parts: motor education, sensory education, and language. The care and management of the environment itself afford the principal means of motor education, while sensory education and the education of language are provided for by my didactic material. (p. 17)

This underlying philosophy coupled with the importance of an internal reward system and the use of manipulative materials formed the foundation for her methods of instruction.

Montessori schools emerged from Dr. Montessori's research and writings in the early 1900s. The current reemergence of Montessori schools in the United States began in the late 1950s and early 1960s. The Montessori method of instruction grew in popularity in what Kornegay (1981) called the "wake of Sputnik" (p. 38). At that time, parents began looking for a different way to have their children educated. The movement has been growing steadily in both the private and public sectors ever since.

Today public schools are faced with increasing pressure to provide alternative methods of instruction. In over 100 communities across the United States, parents have successfully lobbied to get the Montessori method of instruction incorporated into their public schools (Schapiro, 1995). Through articles, word of mouth, and preschool Montessori programs, Montessori is discussed as an alternative method of instruction. Many parents are

convinced that their children will achieve at a higher level if they are taught by the Montessori method. One study shows that students who attend a Montessori preschool do better in the early elementary years than those who have had a traditional preschool experience (Jones & Miller, 1979). Some parents believe that continued Montessori education in the elementary grades will give their children a better education. The question arises: Is setting up a Montessori classroom and training Montessori teachers worth the expense? This question and many like it are asked each time a school board considers instituting a Montessori program into its public schools. State legislatures and local school boards are demanding that schools be more accountable and demonstrate success through increasing academic achievement test scores. It is only reasonable that each program, including Montessori, be accountable to the standards set by these legislatures and school boards.

Statement of the Problem

The problem of this study was to determine if there is a significant difference between the academic achievement scores of students in grades 2 through 5 who are taught with the Montessori method of instruction and those students who are taught with traditional methods of instruction in the Helena, Montana public schools.

Significance of the Study

The purpose of this study was to determine whether students taught by the Montessori method of instruction achieve at an equal or significantly higher level than those students taught with traditional methods. In addition, this study has added to the research base on academic achievement of students taught by the Montessori method of instruction in a public school setting. It is considered possible by some that students taught in a Montessori environment may achieve at a higher level than those taught with traditional methods. If this is true, the Montessori method of instruction would be a feasible alternative method of instruction in any public school setting to assist students to achieve at a higher level than if taught by a traditional method of instruction.

Today many public school districts are examining alternative instructional methods. This movement for change has been brought about by increased public awareness of accountability through the publication of A Nation at Risk (National Commission on Excellence, 1983) in the early 1980s and the more recent attention on the national education goals. Though none of these have any direct connection to the Montessori movement in this country, they did bring an increased awareness of the need for change. Prior to the emergence of the magnet school concept, there

were very few alternatives available to parents other than to send their children to private or parochial schools.

The number of Montessori schools has been increasing in the private sector since 1958. Beginning in 1965 with the first public Montessori school, there has been slow but continued interest in making this an alternative for parents selecting an instructional program for their children. This slow development has been due to four major factors: lack of understanding of Montessori programs, the specialized training needed for Montessori teachers resulting in a lack of qualified Montessori teachers, the initial expense of setting up a Montessori classroom, and a lack of research in the area of academic achievement by students taught by the Montessori method.

The lack of understanding of the Montessori method of instruction is the same today as it was during the early 1900s and during its reemergence in the late 1950s. Applebaum (1971) said, "Lay interpretations of the Montessori system are that there is not enough stress on imagination, too little music, not enough discipline, and other such similar arguments to those used fifty years ago" (p. 209). Today, the complaints are very similar. In a chapter written by Katz (1992) in Loeffler's book, Montessori in Contemporary American Culture, the main concerns listed are little emphasis on children's social development, teaching that is too controlling, distant

teachers, the use of the same materials all year long, and little value placed on imagination.

In order to teach in a Montessori classroom in a public school, a teacher must be both certified by the state and Montessori trained. In most cases it takes an additional year of schooling beyond a bachelor's degree to become Montessori certified. For the majority of teachers, being trained in Montessori also means leaving home and attending one of the 115 training centers across the United States (Schapiro, 1995). Currently the American Montessori Society (AMS) requires 300 academic contact hours plus a year's internship for certification at any one of three levels recognized by AMS (Barron, 1992). In addition, teachers need to be trained at different levels in order to be certified by the AMS to teach more than one level. Currently AMS certifies in preschool (3-6 years of age), elementary (6-9 years of age), and intermediate (9-12 years of age).

Purchasing specific instructional materials makes starting a Montessori classroom relatively expensive. According to Chattin-McNichols (1992b), one of the most commonly asked questions is, "Is this Montessori education basically a traditional nursery school with hideously expensive Dutch toys, or is it really different?" (p. 16). Because the startup costs for these "hideously expensive Dutch toys" (estimated at $11,000 per classroom) is a

concern for school boards, implementing the Montessori method often does not get full consideration as an alternative to the traditional methods normally used in schools. However, it should be noted that once a classroom is equipped for use, the cost of maintaining a Montessori classroom is no more than for a traditional classroom.

Montessori education in the public schools is relatively new in this country, and very few studies have focused on student academic achievement. A dissertation search found that since 1958 there have been 121 dissertations written on some aspect of Montessori in the world. Only three of these focused on academic achievement of Montessori students within the public schools. In addition to the dissertations, several studies have been conducted by school districts or individuals examining academic achievement by Montessori students in private, parochial, and public schools. Most of the studies are concerned with academic achievement of students in schools that have been started as a result of desegregation or the creation of a magnet alternative. Most research has dealt with preschools or the primary grades. There has been very little research conducted on public school Montessori programs to justify claims by Montessori advocates that students taught by Montessori methods achieve at levels equal to or higher than students taught by traditional methods. Chattin-McNichols (1992b), who is a member of the

American Montessori Society Board, said, "We need to make more research on Montessori a priority in our schools and through our associations" (p. 17).

The Helena Public School District has added five classrooms of Montessori instruction since 1990. Each year the Helena parent group interested in Montessori education has requested additional classrooms. The Helena Board of Trustees has debated the advantages and disadvantages each year. The startup cost for classroom supplies and the expense of training Montessori teachers are considerations in adding classrooms and maintaining the current classrooms. There is a need for research on whether the Montessori program is better than or equal to traditional classrooms in the area of student academic achievement. In addition, taking classroom space for a Montessori classroom in an already crowded school system has been met with mixed acceptance. If the classrooms were not being used by Montessori students, these students would be in regular classrooms throughout the district or in private schools, freeing these rooms for traditional classrooms or for other school programs.

This study compares the academic achievement of students in Montessori classrooms with that of students in traditional instructional programs in elementary grades 2 through 5 in order to analyze whether there is a significant difference between the two groups. First grade

Montessori students are excluded from this study because of their limited exposure to the Montessori program. The Helena Public School System does not have a kindergarten Montessori program. At the conclusion of this study, recommendations are made on whether the additional expense of Montessori startup and training is worthwhile, whether current classrooms should be maintained, and whether new classrooms should be created. This study also gives other researchers new information about Montessori student academic achievement in the public school environment.

Definition of Terms

Montessori Method: A method of instruction used by teachers trained and certified by the American Montessori Society.

Traditional: A classroom environment that has a behavioral orientation, characterized by management by objectives, behavior modification, and learning through reinforcement.

Multigrade: A designation given a classroom comprised of students from more than one grade level.

Level: The grade configurations given to Montessori classrooms. Students go through levels rather than traditional grades. The most common level names are preprimary, primary, and intermediate.

General Questions to be Answered

This study was designed to answer four questions.

1. Is there a difference in aptitude between those children whose parents elect to have their children placed in a Montessori classroom and all other students in traditional classrooms?
2. Do students in Montessori classrooms achieve at significantly higher levels in academic achievement than those in traditional classrooms?
3. Do the method of instruction given to students and the genders of the students interact on academic achievement scores?
4. Do the method of instruction and the aptitude of the student interact on academic achievement scores?

CHAPTER 2

REVIEW OF LITERATURE

Introduction

This study reviewed the historical development of Dr. Montessori's work in the area of child development and the teaching methods used in Dr. Montessori's classrooms. The study also traced the emergence of Montessori schools and classrooms in the United States. It examined the literature that describes the movement and the reasons for its rise in popularity.

Additionally, this study reviewed the literature on all known studies collected on academic achievement of Montessori versus traditional methods of instruction of students in public Montessori schools, private Montessori schools, and parochial Montessori schools. A comparison was made between this study and all known studies on student achievement.

Historical Development of the Montessori Method of Instruction in the Public Schools in the United States

The Montessori method of instruction was created at the beginning of this century by Dr. Maria Montessori (1870-1952), Italy's first female medical doctor. In 1896,

after graduating from medical school, she obtained a position at the Orthophrenic Clinic in Rome. There she began to study and observe the growth and development of children. Dr. Montessori was not trained as an educator but as a scientist. Through her observations, she concluded that the teaching methods being used were not appropriate for, or even adequate to meet, the needs of young children's development. Dr. Montessori's outstanding success with retarded (handicapped) or "defective" children, as she called them (Stephenson, 1992), led her to believe that there was a better way to educate children than the methods used to teach handicapped children at that time.

In 1907, after having served as Professor of Pedagogical Anthropology at the University of Rome, Dr. Montessori opened the Casa dei Bambini (Children's House) for normal children in the poorest section of Rome. This school served children from three to seven years of age (Brehony, 1994). Her school, and others that followed and used her techniques, almost immediately gained Dr. Montessori worldwide attention.

Dr. Montessori's techniques and methods quickly spread from Europe to the United States. The first Montessori School in the United States was established in Tarrytown, New York in 1911. By 1915, there were over 40 Montessori Schools in existence in the United States. The Montessori

method had broad support as an alternative to traditional types of instruction. Samuel McClure made Montessori known throughout educational circles in the United States with several articles in McClure's Magazine. These articles espoused the Montessori method of instruction. In a trip sponsored by McClure, Dr. Montessori visited the United States for the first time in 1913. Her arrival was greeted enthusiastically by disciples who had trained under her in Europe and by prominent supporters such as Alexander Graham Bell and Thomas Edison (Hainstock, 1986).

In early 1913, William Heard Kilpatrick at Columbia Teacher's College, known as the million-dollar professor, nearly killed the Montessori movement with a speech before the annual meeting of the International Kindergarten Union. In 1914, Kilpatrick added to his criticism by writing a book entitled The Montessori System Examined in which he declared that Dr. Montessori's ideas were not new. This attack, coupled with the emerging pedagogy of Professor John Dewey, helped bring an end to the Montessori movement in the United States almost as fast as it had begun (Hunt, 1964). During the height of the first Montessori movement in the United States, there were 104 Montessori schools in the United States in 29 states (Applebaum, 1971), but by 1925 these schools were nearly non-existent (Chattin-McNichols, 1992c). However, in Europe the Montessori

movement continued to thrive as an alternative method of instruction, especially for preschool children.

The second Montessori movement did not appear in the United States until 1958, six years after Dr. Montessori's death. The first school was started by Nancy McCormick Rambusch in Whitby, Connecticut, in what Hainstock (1986) called correct timing for this reemergence. McCormick Rambusch in subsequent years founded the American Montessori Society and wrote the book Learning How To Learn: An American Approach to Montessori. This book helped parents understand the Montessori approach to education.

In 1965, the first Montessori Head Start program was formed in Philadelphia (Duax, 1993a); that same year the first Montessori public school was started in Cincinnati (Hainstock, 1986). Although most of the expansion of Montessori schools was in the private preschool sector, new programs were beginning to appear in public schools as well. In the mid 1970s, Montessori public schools receive a big boost from federal funds used to create the magnet schools that assisted in desegregation. In the 1980s there was an increased interest in early childhood education and in providing choice for parents. All these movements created more opportunities for the Montessori method to move into the public schools (Cohen, 1989).

Today over 110 public school districts and over 190 public schools have Montessori programs. It is estimated that there are over 3000 Montessori schools in public, private, and parochial sectors (Schapiro, 1995).

The biggest problem in starting a Montessori program, according to Chattin-McNichols (1992a), is hiring public school teachers qualified to teach Montessori. Although there are over 100 training programs in the United States, it is often very difficult to find a teacher who is certified by the state and who is also Montessori trained (G. J. Turner, 1992). According to Duax (1993b), Montessori programs are being added to public school systems at a rate of five school systems per year. Even with this small growth rate, there does not appear to be a serious lack of interest in the Montessori movement in the public schools in this country.

A new development in public education is Montessori in the middle schools. At the beginning of the 1995-96 school year there were 13 Montessori public middle schools in the United States. Only three of these schools are over five years old. The oldest Montessori middle school is the E. M. Dagget Montessori Middle School in Fort Worth, Texas, which began operations in 1984. All but one of these schools are either housed within a traditional middle school or junior high school or within a K-8 Montessori building. Only the Renaissance Montessori School in Grand

Rapids, Michigan is a self-contained Montessori middle school (Gordon, 1995).

The newest form is the Montessori charter school. This new development in Montessori public schools began in Minnesota in 1993. This type of school allows those applying for a charter to create their own school with public funds. The first Montessori charter school in the United States was the Bluffview Montessori School in Winona, Minnesota (Gordon, 1994). The basic concept of these schools is that state funding goes directly to the school. Today (1995) there are eight Montessori charter schools, located in Arizona, Georgia, and Minnesota (Schapiro, 1995).

Studies of Academic Achievement of Students Taught by the Montessori Method

Montessori held the strong belief that the child's early years were the most critical in his or her development. Most of the Montessori schools in the United States and around the world are devoted to the education of very young children. Of the 3,000 plus Montessori schools in the United States today (Schapiro 1995), most are structured to serve the three- to six-year-old child (Chattin-McNichols, 1992c). Studies conducted in the last 38 years have concentrated on the theoretical philosophy of Dr. Montessori and on how well children scored on academic

achievement tests in school after having attended a Montessori preschool. Many of the studies in both private and public schools report that students who attend a Montessori program do as well as or better than students who attended a traditional classroom. Epstein (1990) noted, "The Montessori method has proved its effectiveness. Nationwide, students in public Montessori programs score 10 to 20 points higher on California Achievement Tests than students in traditional classrooms" (p. 20). Though this may be true in some districts, other research cited in this paper indicates that there is little difference between students taught by the Montessori method and students taught by traditional methods.

There is very little research in the area of student academic achievement by students who have attended public school Montessori programs (Chattin-McNichols, 1992c; Cisneros, 1994; Claxton, 1982; Meuwese-Ribberink, 1977). In the most recent study on Montessori academic achievement, Cisneros (1994) found that most research has been conducted in the private sector and only limited studies have been completed in the public sector. This may be attributed to the fact that of the 3,000 Montessori schools in the United States today, only about 200 are in public school systems.

In the area of student behavior, Baines and Snortum (1973) stated, "For over 60 years the Montessori method has

posed a radical alternative to traditional teaching practices, but there has been little documentation of the impact of this approach upon classroom behavior" (p. 313). Though this observation is over 20 years old, it is still true: little research has been completed on behavioral changes resulting from Montessori programs, particularly in the public school setting.

A majority of the research on the Montessori method of instruction has been conducted in preschools and the private sector. Although the preschool studies are not directly applicable to this research study, they do add to the understanding of the effectiveness of the Montessori method of instruction. The study that contributed the most in the preschool area was the longitudinal study by Miller and Dyer (1975). This study and follow-up studies by Jones and Miller (1979) and Miller and Bizzell (1984) considered four different types of preschool programs including Montessori programs. The results of these studies showed some gains by Montessori students.

Though agreement on whether a Montessori preschool experience is better than other preschool programs cannot be obtained, there are many studies that state there are advantages to the Montessori program. In the 15 Montessori preschool studies reviewed, most reported favorably on the positive academic effects of a Montessori preschool experience compared to other preschool programs.

In the private Montessori school setting, there have been studies on student academic achievement that can be compared with the studies in the public setting. Ongoing studies, like the 18-year longitudinal assessment study being conducted at the Franciscan Montessori Earth School in Portland, Oregon, can bring added information to the research (Glen, 1993). This study, now in its 10th year, has found that Montessori students achieve at above average levels on academic achievement tests; however, the researcher in this project had to rely on parents voluntarily submitting their child's scores after these children left the Franciscan Montessori Earth School.

More recently, Duax's (1995) study in a private elementary school has contributed to the body of knowledge on student academic achievement by students taught by the Montessori method. He conducted a study of academic achievement of students in a private school in a Milwaukee suburb. Students were given the Stanford Achievement Test at the completion of the eighth grade. Students in this longitudinal study showed steady gains from second grade to eighth grade. Duax (1995) concluded that "Montessori elementary education can take high-achieving students and produce even higher academic results when compared to other students through national academic achievement norms" (p. 147).

The movement of Montessori education in the public schools has been most affected by desegregation and by the creation of magnet schools. Though there are some studies on the effectiveness of these programs in the urban environment, there are very few studies of student academic achievement of Montessori students in other school environments. However, the few studies conducted have contributed to the literature on the effectiveness of Montessori in the public school setting.

One of the earliest and most comprehensive studies was conducted in Cincinnati in the late 1960s and the 1970s. This study was known as the Sands Project. Three separate reports on its success were made over a six-year period and were relevant to the effects of Montessori instruction on student academic achievement. The first year report, completed by Banta (1968), compared four groups of students. These groups included two experimental classes of non-graded primary classrooms and two control groups of students who received traditional methods of instruction. The two experimental groups consisted of a Head Start preschool and a Montessori preschool. The report concluded that the non-graded primary with preschool exhibited the best results regardless of whether Montessori or Head Start were used.

A more comprehensive evaluation of the Sands Project was conducted by Gross, Green, and Clapp (1970). After

three years, evaluation of the above-mentioned classes showed that Montessori students ranked highest on 10 of the 13 measurements. Though students in the Montessori classes did well, no statistical significance in academic achievement was noted.

The third study on the Sands School Project was conducted by Sciarra and Dorsey (1976). Their results were similar to the first two studies with "no statistically significant results obtained" (p. 8). They did find, however, that students taught by the Montessori method scored higher on all seven of the subtests on the Metropolitan Achievement Test than a control group.

In a study completed by Dawson (1987) in the Montessori Magnet School in Houston, Texas, academic achievement by race was examined. Dawson found that the Montessori method of instruction was effective for all races but was especially effective for Hispanics. Seventy percent of the test scores were significant. However, it should be noted that the Montessori classrooms were at a 1:13 teacher/student ratio with an aide in each class. In addition, Dawson (1987) stated that the screening or selection was for "more able and motivated students" (p. 3).

A more comprehensive study based on gender and ethnicity was conducted by Curtis (1993) and analyzed student academic achievement in a Montessori program.

Curtis's results did not agree with Dawson's results. Curtis found that both Anglo-Americans and African-Americans did significantly better than Hispanic-Americans on most subtests of the Metropolitan Achievement Test.

One of the most current studies on academic achievement in the public school setting is being conducted by the Kansas City School District in Kansas City, Missouri. Two separate evaluations were conducted by Moore (1991a, 1991b). A summative evaluation of the Faxon Montessori Magnet Elementary School and a formative evaluation of the Holliday Montessori Magnet Elementary School were completed. Both schools are operating under a court-ordered desegregation plan. A comparison of ITBS scores between Faxon Montessori students and traditional K-3 students was statistically analyzed using an ANCOVA procedure and, when a covariant was not available, with an ANOVA procedure. There was a significant difference favoring those taught by the Montessori method in second grade reading and third grade language. Students taught by traditional methods did significantly better in first grade language; traditional kindergarten students did significantly better in math. Other results in reading, language, and math were inconclusive.

At the Holliday Montessori Magnet Elementary School, Moore (1991b) did not do a statistical analysis as he had at Faxon, but he did find that minority students scored

below the national norms while majority students exceeded the national norms. Only kindergarten was examined since this was the first year of Holliday School's implementation of a Montessori method plan.

The first dissertation study comparing student academic achievement in the public school setting was completed by Claxton (1982). Prior to her study, Meuwese-Ribberink (1977) had completed a study of five-year-old children in a private Montessori school. Claxton (1982) did her study in a metropolitan school district in north Texas, comparing the academic achievement scores of kindergarten, first, second, and third grade students taught by the Montessori method to those students taught by traditional methods. A two-way analysis of covariance was used as the statistical technique. The tests used included the Bilingual Syntax Measure, the California Achievement Test, the Iowa Test of Basic Skills, and the Metropolitan Readiness Test. Claxton found no significant difference at the kindergarten, second, and third grade levels, but did find a significant difference at the first grade level. The absence of a difference at the second and third grade levels indicates that overall academic achievement was not affected by Montessori instruction.

In a more recent dissertation, Cisneros (1994) studied third grade students in the Dallas Public Schools. She used the Iowa Test of Basic Skills as a pretest and the

Norm-referenced Assessment Program for Texas as the post test. Her study analyzed the data from test scores in both reading and mathematics. The test scores of the students in grade 3 were statistically analyzed using the multiple regression technique. She found no significant difference between students taught by the Montessori method of instruction and those taught by traditional methods. In reading she found that the mean of the Montessori group of students was higher than the mean of the non-Montessori group, but that the mean scores of the Montessori group declined in reading over a one-year period while those of the non-Montessori group increased. Similarly, in mathematics, she found that the Montessori group scored much higher than the non-Montessori group but that the non-Montessori group's scores had increased gains made from one year to the next while the scores of the Montessori group declined.

Thus it can be seen that the literature on the effectiveness of student academic achievement by students taught by the Montessori method of instruction indicates that most results are not significant. In general, studies conducted at the preschool levels and at the elementary school levels have shown that students taught with the Montessori method achieve at a rate equal to or greater than those taught with the traditional method of instruction in some subjects, but not in others. However,

those who conducted these studies appear to be most interested in whether or not students achieve at a level equal to or above the district mean on the academic achievement tests and not whether there is a significant difference in test scores.

During 1996, four dissertations were completed that had to do with Montessori education. Those dealt with Christian communication for children and the curriculum connection to Montessori; Lensgrinder's study and its application to the Montessori learning-teaching model; a study of Plato, Piaget, and Montessori developmental theories; and the value of a public school Montessori parenting program. However, none of these dissertations added to the knowledge base on student achievement in Montessori education.

There does continue to be a considerable amount of attention to and writing on the Montessori method. Most of the literature is written by Montessori advocates. According to Lakshimi Kripalani (1997), who was trained by Dr. Montessori and is a Montessori trainer and consultant,

> Montessorians claim that they have the answers, and are quick to differentiate themselves from others and lump them as traditionalists. This results in alienation and creates barriers and antagonism. It not only closes minds of other educators but results in constant battles of who is right or who is wrong.
>
> Not only must Montessorians engage in more productive discussions with other educators to test their answers, they must look within to see

> how well they and their colleagues are putting into practice the insights that have been handed over to them within the framework of the Montessori approach. (p. 2)

If the Montessori method of instruction is to be seriously considered as an alternative for parents in the public school setting, this attitude must be a part of the ongoing discussion about Montessori in the public school setting. Openly examining the academic achievement of Montessori students is one of the many areas that should be examined. This study has added to that body of knowledge.

CHAPTER 3

METHODOLOGY

Introduction

This chapter describes the procedures by which data were collected and analyzed to determine if there was a significant difference between students taught by the Montessori method of instruction and those taught by traditional methods of instruction in the Helena Public Schools. The major sections of this chapter are as follows: (1) theoretical framework, (2) explanation of the Montessori method, (3) population description and sampling procedure, (4) hypotheses, (5) method of collecting data, (6) analysis of data, (7) control over extraneous variables, and (8) limitations and delimitations.

Theoretical Background

The theoretical base of this study on student academic achievement of students taught by the Montessori method of instruction comes from two backgrounds. Dr. Montessori credits the foundations of her methods to the works of Jean-Marc-Gaspard Itard (1775-1838), a physician in Paris who worked with deaf mutes, and Edouard Seguin (1812-1889),

a student of Itard's who developed a series of exercises to aid retarded students (Hainstock, 1986). Montessori studied these works and those of Giuseppe Sergi, her anthropology teacher, to help her develop skills in scientific investigations.

However, it was not just through these individuals that she developed her theoretical foundation. According to Hainstock (1986), the groundwork for Dr. Montessori's ideas was rooted in the work of Jean-Jacque Rousseau and, before him, John Locke. Another person given considerable credit for Dr. Montessori's methods is Friedrich Froebel, a disciple of Johann Pestalozzi. Standing (1984) sums up this background by stating that

> it would be absurd to suppose that Montessori, who was for ten years a lecturer at her women's training college at Rome, was ignorant of that other--that mainstream of educational development--which flowed through Rousseau, Pestalozzi, Herbart and Froebel. She could not have read through, as one of the examiners, "all those 150 theses on all possible pedagogical authors from the best known to the most forgotten" without becoming acquainted with their ideas. (p. 59)

Dr. Montessori's work is often compared with that of Friedrich Froebels, the founder of kindergarten. Standing (1984) goes on to say that, "It cannot be doubted that Froebel's spiritual approach to childhood and the emphasis he laid on the training in infancy prepared the soil in which later Montessori's ideas were to take root and flourish" (p. 321).

When the stages of growth that Rousseau espoused are compared with those of Montessori, striking similarities can be noted. Both Montessori and Froebel placed emphasis on self-directed activities. By combining these similarities and comparing them to the earliest writings on early childhood development by John Locke, a clear picture of the philosophical foundations of Dr. Montessori's work can be seen. Though no one person can be credited with all the methodology seen in her work, one can trace many of her concepts to individual educational philosophers of the past four centuries.

Population Description and Sampling Procedure

The population which was used in this study was composed of second, third, fourth and fifth grade students enrolled in the Helena Public Schools in Helena, Montana. Helena is a capital city in which the chief employer is the State of Montana. Located in the west central part of the state, Helena and the surrounding area have a population of approximately 30,000. The community has a rich history of mining and government.

The Helena Public Schools enrollment is 8,372 students (Appendix A) and the certified staff number 628. The student population is 95% white, 4% Native American and 1% other. The socioeconomic status of the population is measured by the free and reduced lunch formula established

by the federal government. The overall average ratio of those students receiving free or reduced-priced lunched to the total population is 16.7%. The average household income in Helena is $25,462.

Currently there are five Montessori classrooms in Helena serving 107 students. The student population in these five multigrade classrooms is composed of 24 first graders, 24 second graders, 23 third graders, 23 fourth graders, and 13 fifth graders. The three primary classroom student populations are composed of first, second, and third grade students. The two intermediate classrooms serve fourth and fifth grade students. First grade students were not included in this study because they had not had a minimum of two years in the program.

The Helena Public Schools Montessori program is in its sixth year of operation. All classrooms are located in traditional rooms at Central or Jefferson Elementary Schools. All classes participate in normal school-wide activities and programs. Funding for supplies and operating expenses is the same for Montessori classrooms as it is for traditional classrooms. Within the Montessori classroom setting, all students are taught by the Montessori method. Only Montessori students that were in grades 2 through 5 at the end of the 1995-96 school year and had been in the Montessori classrooms for a minimum of

two consecutive years were included in the statistical analysis outlined in this study.

The Montessori classrooms are open to all students in grades 1 through 5. Selection is made through an open lottery held once each year for those entering the first grade. Notifications are placed in the Helena newspaper and in school flyers. There are no preferences shown for any students, including those who have siblings in the program. However, once a student is selected, he/she may stay in the program as long as the parent wishes or until the child moves to the middle school. Those students not selected in the lottery are put on a seniority waiting list until there is an opening. There are currently 15 students in the Helena Schools who have applied for the Montessori program through the lottery but who are not in the program. They include one second grader, three third graders, four fourth graders, and five fifth graders.

The sampling technique used in this study was a matched pair design. This design was selected to control as many variables as possible. According to Kerlinger (1973), the matched pair design can be a very desirable technique when all variables can be matched. In this study, the researcher matched each student on the five independent variables of grade level, gender, aptitude, handicapping condition, and family socioeconomic conditions. Each Montessori student in grades 2 through 5

was matched by grade level, gender, aptitude, handicapping condition, and family socioeconomic status to another student from the school district who had been taught in a traditional classroom. Aptitude was measured by the Test of Cognitive Skills (TCS/2) (Test of Cognitive Skills Technical Report, 1993). Socioeconomic status was matched according to students on free lunch, students on reduced lunch, and those not on assisted lunch. Handicapping conditions were matched by a handicapping label for cases in which a Montessori student has been identified as handicapped.

Matching was accomplished by selecting students taught by traditional methods of instruction through computer data alignment. The computer was programmed to select students from the total population by matching the independent variables listed above. When more than one student matched a Montessori student, the first on the list was used as the matched pair. If an exact TCS/2 aptitude score did not match a Montessori student, the researcher moved up one point at a time until a match was made. The sample from the total traditional population was complete when all Montessori students in grades 2 through 5 were matched. Since this study used a very small number of Montessori students at each grade level, the match of the listed independent variables was imperative.

Hypotheses

The null hypotheses for this study are:

1. No statistically significant differences exist between the aptitude scores of those children whose parents elect to have their children in a Montessori classroom and all other children in traditional classrooms in grades 2, 3, 4, and 5 in the Helena Public Schools.
2. No statistically significant differences exist between the academic achievement scores of students taught by the Montessori method of instruction and those students taught by traditional methods of instruction in grades 2 and 3 in vocabulary, reading comprehension, language mechanics, language expression, math concepts and application, math comprehension, word analysis, and spelling.
3. No statistically significant differences exist between the academic achievement scores of students taught by the Montessori method of instruction and those students taught by traditional methods of instruction in grades 4 and 5 in vocabulary, reading comprehension, language mechanics, language expression, math concepts and application, math comprehension, spelling, science, social studies, and study skills.

4. The method of instruction given to the students and the gender of the students in this study do not interact on academic achievement scores.
5. The method of instruction given to the students and the aptitude of the students in this study do not interact on academic achievement scores.

Montessori Method Used in Helena Public Schools

The Montessori program in the Helena Public Schools follows the American Montessori Society (AMS) model. All teachers in the program have been trained to use AMS techniques. There are currently five Montessori teachers serving 107 students. Three of the five Montessori teachers have master's degrees. In the traditional elementary classrooms, 44% of the teachers have master's degrees and another 30.2% have bachelor's degrees plus 45 hours of additional course work.

Class size for all Montessori classrooms in the Helena Public Schools is set at the Montana state accreditation standard level for multi-aged classrooms. These class sizes are 20 students for grades 1, 2, and 3 and 24 students for grades 4 and 5. In the five full years that the Montessori program has been in the Helena Schools, all classes have been filled to the maximum level allowed by these standards. Numbers of traditional classrooms in the Helena Public Schools do not exceed the levels set by

the state accreditation standards. These standards for single grade classrooms are 20 students for grades 1 and 2, 28 students for grades 3 and 4, and 30 students for grade 5. Actual class sizes in Helena vary from school to school depending upon school enrollment. Multi-aged classrooms are occasionally used for traditional classrooms as well as for Montessori classrooms.

The Montessori model is based on the ideal teaching program as espoused by Dr. Montessori. However, Montessori classrooms today in the Helena Public Schools and other public schools are not identical to original Montessori schools. According to Chattin-McNichols (1992c),

> Some writers on Montessori have chosen to comment on Montessori's original writings, rather than focusing on current practices in American schools today. While this has the advantage of certain authenticity, it neglects the changes that have come about in Montessori practice since 1907. (p. v)

The underlying philosophy of the Montessori program consists of an environment that is carefully planned to assist students in developing independent learning styles and self-direction. All classes are multigrade and emphasize learning through the students' own discovery. The method of instruction in the Montessori classroom is highly individualized and student-driven. Students progress through the content of the curriculum at their own pace with the teacher acting as a facilitator. Careful records are kept on student progress. In the Helena Public

Schools, there is a very high number of thematic presentations. The classroom environment exhibits a constructivist orientation that places great importance on discovery, manipulation, broad concepts, student-driven instruction, current meaningful problems, a curriculum that is adaptive to student needs, and an assessment program that helps guide student learning. According to Loeffler (1992),

> Montessori's prepared learning environment--with self-selection and free choice for the child as its major components, coupled with interesting manipulable objects as stimulation for activity, and a three-year age span for social and intellectual collaboration and challenge--provides an ideal setting for the child's self-construction process. (p. 102)

There are vast differences between the Montessori method of instruction and traditional methods. The differences center around the classroom environment, the didactic materials used for student learning, the role of the teacher, and the development of the individual.

The environment of a Montessori classroom is structured much differently than a traditional classroom. There are areas in the room that have special meaning to the Montessori method. These include areas for practical life, sensorial life, math, language, and cultural subjects (science and social studies). The didactic materials are very important to the environment of the classroom. Instead of being oriented by means of traditionally-arranged desks,

the above-mentioned areas are divided into sections or areas by specialized shelving, child-sized tables and chairs and other instructional materials. According to Chattin-McNichols (1992c), "Indeed the classroom is obviously not designed for long periods of direct whole group instruction" (p. 51). In a Montessori classroom, the floor is an area that is a regularly used "station" for learning. It is the environment and didactic materials that set the foundation for the Montessori method. Both serve very specific purposes that together encourage the child to be self-directed.

The child is the center of a Montessori classroom. In the Montessori classroom the teacher is not the most important component. The teacher in a Montessori classroom is taught to observe and assist the child in using materials that are highly organized and sequenced and give a meaningful learning experience. According to Dr. Montessori, in her own book, The Montessori Method, (1964), "The fundamental principle of scientific pedagogy must be, indeed, the liberty of the pupil; such liberty as shall permit a development of individual, spontaneous manifestations of the child's nature" (p. 28). Though this sounds like a classroom in which the child does what he or she wants at any time, in fact, the classroom is highly structured through design by the teacher. The teacher is a facilitator or guide for the students. Whole group

instruction typically takes up only 20 to 40 minutes in any half day (Chattin-McNichols, 1992c). Techniques of observation and intervention are part of the Montessori training program.

Montessori advocates believe that children taught by their method of instruction are not only more successful academically, but also are more successful in other areas of development. In a study completed by Neubert (1992), 200 Montessori teachers were randomly selected and surveyed about what they considered the most important overall goals of the Montessori method of instruction. The goal given the highest overall rating was independence. This was followed by self-confidence, respect for others, joy of learning, self-respect, creativity, self-control, concentration, and developing the child's potential. Additionally, Neubert asked these teachers what their goals were for the children in their classrooms. The top six responses were love of learning, socialization, independence, self-esteem, self-confidence, and respectfulness. Further analysis of the results obtained by Neubert indicated that teachers reported that students spent 63% of their time working independently, 23% their time involved in total group work, and 14% their time involved in transitional activities.

Today Montessori classrooms in the public schools have adapted to the needs of the schools, the teachers, and the

students. Though the Montessori philosophy is the same, adaptations have been made to meet the needs of the child. Chattin-McNichols (1992c) stated that, "The program is, then, the result of one teacher's interpretation of the model in which she has been trained. That model is derived from Montessori's ideas, both those written in books and those given primarily in training programs" (p. 8). Barron (1992) summarized this by stating that

> the aim of Montessori education is to develop each person's abilities to the fullest extent while celebrating and enhancing his or her uniqueness and cultural background. The goal of education is the development of autonomous, competent, responsible (to themselves, other human beings, and the environment), adaptive citizens--lifelong learners and problem solvers. Respect, competency, responsibility, self-initiative, and self-management are valued. (p. 268)

The above statement is very similar to the mission statement and goals of the Helena School District No. 1 (1996). This mission statement is as follows:

> The mission of the Helena Public Schools is to challenge and empower each student to maximize individual potential and become a competent, productive, responsible, caring citizen.
>
> This mission will be supported through the wise use of resources to meet students' needs, regardless of interest and talents. Students, families, educators, and community are committed to sharing the responsibility for creating a student-centered educational community that acknowledges learning as a lifelong process. (p. 1).

In addition to this mission statement, Goal Number One of the Helena Public Schools (1996) is to "challenge all

students to learn and achieve at their maximum potential and provide students with the necessary skills and knowledge to success in the 21st Century" (p. 3).

Since academic achievement is a primary goal of the Helena Board of Trustees for all students, analysis of data on all students is used to measure the success of the instructional programs. This study examined the difference between the academic achievement scores of those students taught by the Montessori method of instruction and those taught by traditional methods of instruction in grades 2 through 5. The study was limited to examining the academic achievement of Montessori students and traditional students who have spent a minimum of two consecutive years in either traditional or Montessori programs. It is important to note that although the methods used in the Montessori classrooms are quite different from those of the traditional classroom, the language, mathematics, and other curriculum areas are not. According to an independent evaluation of the Helena Montessori curriculum and the Essential Skills and Content List (ESCL) of the Helena Public Schools by Dr. Gerald Kulm of JK Associates (1996),

> The content outlined for the Montessori program is comprehensive, covering all the topics outlined by the Helena ESCL. The Montessori Language and Mathematics curricula are very close to the ESCL Communication Arts and Mathematics lists. It is clear that in these two important areas, the Montessori curriculum meets district guidelines. (p. 5)

Traditional Method Used in Helena Public Schools

The traditional method of instruction in the Helena Public Schools is representative of that used in schools across the state of Montana. Teachers follow the approved district curriculum guides using a variety of approaches. The most common method of instruction is following the teachers' guides in the adopted textbooks with questions, exercises, and evaluations taken from the guides. Teachers adapt the guides to their individual styles and interests. The teaching strategy most commonly used resembles the Madeline Hunter model of Instructional Theory Into Practice (ITIP). This model, as used in most classrooms in the Helena Public Schools, resembles a behaviorist orientation that is representative of direct instruction. The model is characteristic of generally teaching a behavioral objective, attempting to teach at a level appropriate for the students, monitoring and adjusting instruction, and using reinforcement as a motivation. Though both Montessori and non-Montessori based classrooms follow the district curriculum guides, the Montessori classrooms also sequence the Montessori material using the techniques established by Dr. Montessori.

Method of Data Collection

Two instruments were used as the primary method of data collection. These instruments measured student academic achievement and student aptitude. The validity and reliability coefficients and norms of these two instruments were established through national stratified random samples.

The Comprehensive Tests of Basic Skills, Fourth Edition (CTBS/4) was the primary instrument used to gather academic achievement data on both Montessori students and students from traditional classrooms. According to the Hopkins review in The Eleventh Mental Measurements Yearbook (1992), "The CTBS/4 continues to be among the very best general academic achievement test batteries" (p. 217). This test was selected from among other major tests by the Helena Public Schools, upon the recommendation of the district-wide testing committee, because it best matched the curriculum of the school district (Appendix B). Only one form of the test was used for all students. The test is designed to measure academic achievement of basic skills in the areas of reading, language, spelling, mathematics, study skills, science, and social studies. For this study, the full batteries were given only to fourth and fifth grades. Grades 2 and 3 were given the subtests in vocabulary, reading comprehension, language mechanics,

language expression, math concepts and application, math comprehension, word analysis, and spelling.

The reliability of the CTBS/4 was established using the Kuder-Richardson Formula 20 (KR20) for internal consistency. The split-half coefficient was obtained by correlating one-half of the test with the other half of the test, then adjusting the correlation with the Spearman-Brown so that it would apply to the whole test (Comprehensive Tests of Basic Skills [CTB], 1991). The correlation, as shown in Table 1, indicates that at all grade levels used in this study the total battery has a KR20 correlation of 0.94, or 0.95, depending on the grade level.

Table 1. Kuder-Richardson correlation for CTBS/4 total battery.

	Number Items	Mean	SD	Average P-Value	SEM	KR20
Grade 2	120	83.1	18.6	.69	4.2	.95
Grade 3	120	80.9	17.7	.67	4.3	.94
Grade 4	120	73.8	19.4	.62	4.5	.95
Grade 5	120	74.4	18.9	.62	4.6	.94

The aptitude test that was used as the instrument to match traditional students with Montessori students was the Test of Cognitive Skills (TCS/2). This is a test that measures the academic aptitude of all students in the areas

of verbal, nonverbal, and memory abilities. The subtests covered sequencing, analogies, memory, and verbal reasoning. Standardization of the test was completed in 1991 with samples from approximately 7,300 students in 42 schools representing 17 school districts geographically dispersed across the United Stated (CTB, 1993).

According to the TCS/2 technical report (CTB, 1993), this version of the TCS has the same basic structure as the 1981 version with revisions which include the addition of new items and of a new high school level. In addition, verbal reasoning in level one is now in a textual format and the obscure words to nonsense in the memory subtest have been changed to nonsense words. Both Keith's and Sternberg's reviews in The Ninth Mental Measurements Yearbook (1985) of the TCS/1 were very supportive of the test, except for the lack of technical data available for both reliability and validity. This has been corrected in the TCS/2 technical manual. Both TCS/1 and TCS/2 rely on the Item Response Theory to ensure freedom from bias and to require higher level abstract reasoning skills. According to Keith (1985), "Based in part on Item Response Theory (IRT), reportedly rigorously tested to ensure freedom from bias, and requiring primarily higher level, abstract reasoning skills, the TCS appears a promising addition to the group intelligence test market" (p. 1555). The reliability of the TCS/2 is reported using the KR20 for

internal consistency. The KR20 at all tested grades range from 0.68 to 0.79. Test-retest reliability shows a total test correlation at grade 2 of 0.84 and at grade 4 of 0.90. The second and third grades use level one and the fourth and fifth grades use level two.

The validity of the TCS/2 was established by experts in the field who did a review of items for both bias and content. According to CTB (1993),

> The purpose of the content review was to examine the items' face validity for measuring the cognitive abilities intended to be measured. The goal was to eliminate any items that were not optimum measures of the cognitive abilities being assessed by TCS/2. (p. 7)

The TCS/2 was designed specifically to use with the CTBS/4 achievement test. CTB has established an intercorrelation coefficient between the TCS/2 and the CTBS/4. Since both were administered at the same time and to all students in the Helena Public Schools, all test scores were current and complete.

A concern of the researcher was the question of whether Montessori students have had as much experience in paper-and-pencil activities as traditional students. Students need this experience in order to be successful in standardized test taking. Interviews with three different Montessori teachers were conducted to assess whether this possible lack of experience would have an effect on Montessori students' standardized tests scores. The three

teachers interviewed had taught a combined total of 45 years in the Helena Public Schools in traditional classrooms prior to teaching in the Montessori classrooms. All three teachers felt that ample paper-and-pencil tasks were completed throughout the school year in the Montessori classrooms. These tasks were comparable to those undertaken in traditional classrooms. All three teachers felt that the context alignment was equal to that of traditional classrooms. Tina Veroulis (personal conversation, October 15, 1996), a Montessori teacher, stated,

> Students complete more paper-and-pencil tasks in the second through fifth grade than those students in the first grade. The first grade students have a more difficult time taking the standardized achievement test than those in the other Montessori grades. We do enough paper-and-pencil work that is so similar to that done in the regular classrooms that I feel our Montessori students are as well prepared to take the tests as those in regular classrooms. The tests and the format are not foreign to the Montessori students.

Analysis of Data

This study compared the academic achievement scores of students taught by the Montessori method of instruction to those of students taught by the traditional method of instruction in grades 2 through 5.

Careful selection was used to match traditional students with Montessori students in terms of grade,

gender, socioeconomic status, aptitude, and handicapping condition if applicable. The researcher used a two-factor analysis of variance to analyze the data. In addition to the method of instruction, the researcher examined whether gender and method of instruction interact and whether aptitude and method of instruction interact. The analysis allowed the researcher to look at more than one independent variable at a time. According to Kerlinger (1973), "It can be argued that, of all methods of analysis, multivariate methods are the most powerful and appropriate for all behavioral scientific and educational research" (p. 149).

The two-way analysis of variance was used to test Hypotheses 2, 3, 4, and 5. Raw scores on the CTBS test were used as the dependent variable in the statistical analysis. The alpha selected for this study was at the .05 level. McNemar (1969) states,

> There is the balancing of risks: that of accepting the null hypothesis when to do so may mean the overlooking of a real difference against that of rejecting the null hypothesis which may lead to the acceptance of a chance difference as real. (p. 66)

In this study, the researcher was trying to protect against both Type I and Type II errors by balancing the risk with a .05 alpha. A Type I error would involve rejecting the null hypotheses; this rejection would imply a significant difference between students taught by the Montessori method and students taught by traditional methods, when in fact

there is no such difference. Since adding classrooms would cause an additional expense for the district in terms of materials and teacher training, this study intended to guard against rejecting a true null. In a Type II error, the null hypothesis would be falsely retained; this retention would imply that there is not a significant difference between students taught by the Montessori method and students taught by traditional methods, when in fact there is a difference. If error occurred true, there might be a likelihood that the district would not add classrooms to the Montessori program and therefore deny some parents the choice of the Montessori program as an alternative method of instruction for their children.

The two-way analysis of variance was used to test Hypotheses 4 and 5 for interaction. The researcher was interested in knowing if gender and method or method and aptitude interact on achievement.

Control Over Extraneous Variables

This study was centered around the Montessori classrooms in the Helena Public Schools. The students in these classrooms participated in all school activities, and followed all schedules and school-wide programs, but functioned independently in terms of the instructional methods used. This research design made every effort to

adhere to what Kerlinger (1973) calls the "maxmincon" principle. Kerlinger states,

> According to this principle, by constructing an efficient research design the investigator attempts (1) to maximize the variance of the variable or variables of his substantive research hypothesis, (2) to control the variance of extraneous or "unwanted" variables that may have an effect on his experimental outcomes, but in which he is not interested, and (3) minimize the error or random variance, including so-called errors of measurement. (p. 306)

Specifically, this study reported the maximization of the active variable. As reported in this chapter in the section explaining the Montessori method, the instruction is very controlled and well-monitored. In order to maximize this active variable in both method and time, all Montessori students considered in the study had to have had a minimum of two years of Montessori instruction. Outside evaluation was conducted on both the program and on teacher adherence to the Montessori method by Kulm of JK Associates (1996) to determine if the Montessori method of instruction was adhered to.

Controlling the extraneous independent variables in this study is of extreme importance. Though it is impossible to control every variable that has an effect on student academic achievement, minimizing the effects of the independent variable becomes critical to measuring academic achievement scores.

The researcher had no control over the selection of students who are taught by the Montessori method. Selection is through a parental choice to enter a child into the yearly lottery held at the first grade level. As was described in the sampling section, a child who is in the program may stay until he or she goes to grade 6. However, using the techniques described by Kerlinger (1973), the researcher took every precaution to eliminate or control independent variables. Specifically, Montessori students were matched, through randomization as described in the section on Sampling, to the independent variables of grade, gender, aptitude, socioeconomic status, and handicapping conditions. The goal of this method of analysis was to ensure that the two groups were as homogeneous as possible. Additionally, since there was no control over gender in the Helena Public Schools, this variable was built into the study and its effects analyzed.

This study minimized the error variance through two methods. First, the researcher used two reliable instruments, the CTBS/4 and TCS/2 as reported in the Method of Data Collection section of this study. Second, individual differences or systematic error variance was controlled by using the Montessori method since the Montessori teaching method itself is very controlled.

This study has taken every precaution to control threats to internal validity. Of the eight factors that

have been identified by Campbell and Stanley (1963) as threats to internal validity, one seemed germane to this study. This threat was a result of the fact that students were selected using the methods discussed above and in the Population Description and Sampling Procedure section of this chapter.

Additionally, the researcher was aware that there may have been a threat to compensatory equalization of treatment caused by the use of highly motivational and structured materials for the Montessori classes. The materials are significantly different from normal school materials. There is an abundance of "expensive," well-organized wooden materials that are of very high interest to children. However, since these instructionally-related materials are part of the method of instruction, any effect was treated as part of student gains in academic achievement.

The researcher in this study examined the threats to external validly and his ability to generalize across the population. According to Cook and Campbell (1979), "Generalizing to well-explicated target populations should be clearly distinguished from generalizing across the population" (p. 71). This study generalized to the population of students in grades 2 through 5 who had had a minimum of two years of Montessori instruction in a public school.

Limitations and Delimitations

The limitations and delimitations of the study were as follows:

1. This study was limited to those students who were accepted into Montessori classes after parental applications were approved.
2. The review of student gains measured by academic achievement tests of Montessori students was delimited to the ERIC computer search for materials dated from 1966 though March 1996 and the dissertation search for dissertations written between 1958 and 1996.
3. This study was limited to public school Montessori students in the Helena Public Schools who had had at least two years of instruction with the Montessori method.
4. This study was limited to Helena Public School students in grades 2, 3, 4, and 5.
5. This study was limited to academic achievement of Montessori students taught by the Montessori method of instruction as compared with the academic achievement of students taught by traditional method of instruction.
6. This study is limited to students who are similar to the population of the control group and the Montessori group used in this study.

CHAPTER 4

FINDINGS AND INTERPRETATIONS

Introduction

The purpose of this study was to determine whether there is a significant difference in academic achievement between students taught by the Montessori method of instruction and those students taught by traditional methods of instruction in elementary grades 2 through 5. In addition, the researcher examined whether there was a difference in aptitude between students whose parents selected the Montessori method of instruction and all other students in grades 2 to 5. The researcher also examined interaction of achievement with gender and interaction of achievement with aptitude. This chapter includes the statistical analysis that answers these questions.

The chapter is arranged in the following order: student population, statistical analysis used, a statistical analysis of Hypothesis 1, and a statistical analysis of Hypotheses 2-5.

Population and Sample

All the students who comprised the population used in this study were either Montessori students or students from traditional in grades 2 through 5. In Hypothesis 1, all students in grades 2 through 5 who had a TCS score were used for the statistical analysis.

In Hypotheses 2 though 5, students used in this study were Montessori students or students in traditional classrooms in grades 2 through 5 in the Helena Public Schools; all of them had had at least two years of instruction in one of these instructional configurations. The sampling used was Montessori students matched to a control group of students by grade, aptitude, gender, socioeconomic condition, and handicapping condition if applicable. Aptitude, for the analysis of Hypothesis 1 and for matching purposes in Hypotheses 2-5, was determined by using the TCS test described in Chapter 3. A total of 60 students from Montessori classrooms and a total of 60 students from traditional classrooms were used in the analysis of Hypotheses 2-5. A summary of the totals for all grades in the Helena Public Schools is listed in Appendix A. A summary of those students used in Hypotheses 2-5 is listed in Table 2.

Table 2. Summary of student population used in Hypotheses 2 through 5.

	Males	Females	H Apt.	M Apt.	L Apt.	Total
Grade 2						
Control	7	14	7	7	7	21
Montessori	7	14	7	7	7	21
Total	14	28	14	14	14	42
Grade 3						
Control	7	10	6	6	5	17
Montessori	7	10	6	6	5	17
Total	14	20	12	12	10	34
Grade 4						
Control	8	4	6		6	12
Montessori	8	4	6		6	12
Total	16	8	12		12	24
Grade 5						
Control	4	6	5		5	10
Montessori	4	6	5		5	10
Total	8	12	10		10	20

Descriptive Statistical Analysis

The hypotheses were tested using an analysis of variance statistical procedure (ANOVA). The experimental group was composed of the students in the Montessori program. The control group was composed of the students matched according to those independent variables listed above. Five hypotheses were analyzed with the results presented in Tables 3 through 19. A simple effects comparison was run for any interaction that was statistically significant. These results are presented in Tables 20 through 22. An additional analysis was conducted

on the composite scores of reading, language, mathematics, and total battery. Significant findings are presented in Table 23.

In all statistical analyses an alpha level of .05 was used to determine the level of rejection or retention of the null hypothesis. The p-values are listed in the tables for all statistical analyses that pertain to each hypothesis. The p-values indicate the statistical probability of the differences occurring by chance alone.

All scores used in the analysis of each hypothesis were derived from the use of raw scores from the CTBS test and the aptitude scores from the TCS test.

Hypothesis 1

Hypothesis 1 was not directly related to student achievement; however, the researcher was interested in analyzing the aptitude scores of the students in Montessori as compared to those students in traditional classrooms. Hypothesis 1 states that no significant difference exists between the aptitude scores of those students whose parents elect to have their children placed in a Montessori classroom and all other children placed in traditional classrooms in grades 2, 3, 4, and 5 in the Helena Public Schools. An ANOVA was run comparing the 60 Montessori students currently in the program and the 12 students who applied for the program and were not accepted due to full

classrooms to the other 2,221 students in traditional classrooms in grades to 2 through 5. The results are listed in Table 3.

Table 3. ANOVA of aptitude scores of all students in grades 2 through 5 who were part of the system-wide testing.

	df	SS	MS	F-Ratio	P-Value
Between Groups	1	7305.1	7305.1	30.8	.0000
Within Groups	2291	542,743.9	236.9		

The results of Table 3 indicate that the null hypothesis for the dependent variable of student aptitude as measured by the TCS was rejected at alpha = .05. The mean score for the control group was 104.7 and the mean score for the Montessori group and those not accepted into the program was 114.9. This analysis indicates that students in Helena whose parents elect to submit their child's names for the Montessori lottery have a significantly higher aptitude than all other students in grades 2 through 5.

Aptitude Classification

Aptitude for statistical analysis as described in Hypothesis 5 was determined by dividing the students used in the study into three groups in grades 2 and 3. In

grades 2 and 3 these groups were categorized as high (top third), medium (middle third), and low (low third) as listed in Table 2. In grades 4 and 5, the students were divided into two groups: a high half and a low half. The number of students used at each grade level is listed in Table 2. Only two groups were used in grades 4 and 5 because of a small n. The purpose of this classification was to determine whether there was any significant interaction between aptitude and method of instruction.

Grade 2

Hypothesis 2 states that no statistically significant differences exist between the academic achievement scores of students taught by the Montessori method of instruction and students taught by traditional methods of instruction in grades 2 and 3 in vocabulary, reading comprehension, language mechanics, language expression, math concepts and application, math comprehension, word analysis, and spelling.

Hypothesis 4 states that the method of instruction given to students and the gender of the student do not interact on academic achievement scores.

Hypothesis 5 states that the method of instruction and the aptitude of the student do not interact on achievement scores.

The results of the analysis for Hypotheses 2, 4, and 5 are found in Tables 4 and 6. The means for these three hypotheses are found in Tables 5 and 7.

Table 4. Summary of analysis of variance comparing effect of method of instruction and gender on academic achievement at grade 2.

Source	df	SS	MS	F-Ratio	P-Value
Reading Vocabulary					
Method of Instruction	1	22.881	22.881	.93	.3689
Method * Gender	1	12.190	12.190	.44	.5108
Reading Comprehension					
Method of Instruction	1	7.713	7.713	.32	.5751
Method * Gender	1	6.857	6.857	.28	.5971
Language Mechanics					
Method of Instruction	1	.095	.095	.00	.9560
Method * Gender	1	14.583	14.583	.47	.4956
Language Expression					
Method of Instruction	1	1.928	1.928	.07	.7928
Method * Gender	1	34.714	34.714	1.26	.2688
Mathematics Computation					
Method of Instruction	**1**	**282.880**	**282.880**	**9.45**	**.0039***
Method * Gender	1	3.048	3.048	.10	.7515
Mathematics Concepts and Application					
Method of Instruction	**1**	**201.520**	**201.520**	**4.82**	**.0343***
Method * Gender	1	.583	.583	.01	.9066
Word Analysis					
Method of Instruction	1	.381	.381	.01	.9086
Method * Gender	1	.762	.762	.03	.8710
Spelling					
Method of Instruction	1	16.095	16.095	.41	.5244
Method * Gender	1	105.190	105.190	2.70	.1087

* Bold type indicates a statistical significance at alpha = .05.

Table 5. Mean achievement of method of instruction and gender and method of instruction by gender at grade 2.

Source	Means		Means
Reading Vocabulary			
Control	24.86	Montessori	26.33
Control * Male	25.29	Montessori * Male	28.29
Control * Female	24.64	Montessori * Female	25.36
Reading Comprehension			
Control	30.19	Montessori	31.05
Control * Male	31.29	Montessori * Male	33.29
Control * Female	29.64	Montessori * Female	29.93
Language Mechanics			
Control	20.05	Montessori	19.95
Control * Male	19.57	Montessori * Male	21.14
Control * Female	20.29	Montessori * Female	19.36
Language Expression			
Control	29.48	Montessori	29.90
Control * Male	29.14	Montessori * Male	29.64
Control * Female	32.14	Montessori * Female	28.79
Mathematics Computation			
Control	**25.00***	Montessori	**19.81***
Control * Male	26.71	Montessori * Male	22.29
Control * Female	24.14	Montessori * Female	19.57
Mathematics Concepts and Application			
Control	**34.67***	Montessori	**30.29***
Control * Male	38.00	Montessori * Male	33.29
Control * Female	33.00	Montessori * Female	28.79
Word Analysis			
Control	23.90	Montessori	24.10
Control * Male	24.29	Montessori * Male	24.86
Control * Female	23.71	Montessori * Female	23.71
Spelling			
Control	15.67	Montessori	16.90
Control * Male	15.43	Montessori * Male	21.14
Control * Female	15.79	Montessori * Female	14.79

* Bold type indicates a statistical significance at alpha = .05

Table 6. Summary of analysis of variance comparing effect of method of instruction and aptitude on academic achievement at grade 2.

Source	df	SS	MS	F-Ratio	P-Value
Reading Vocabulary					
Method of Instruction	1	22.881	22.881	1.43	.2390
Method * Aptitude	**2**	**107.760**	**53.881**	**3.38**	**.0453***
Reading Comprehension					
Method of Instruction	1	7.714	7.714	.56	.4585
Method * Aptitude	2	3.857	1.927	.14	.8695
Language Mechanics					
Method of Instruction	1	.095	.095	.00	.9449
Method * Aptitude	2	60.619	30.310	1.54	.2274
Language Expression					
Method of Instruction	1	1.927	1.927	.11	.7421
Method * Aptitude	2	21.571	10.786	.61	.5463
Mathematics Computation					
Method of Instruction	**1**	**282.880**	**282.880**	**14.58**	**.0000***
Method * Aptitude	2	45.762	22.881	1.18	.3190
Mathematics Concepts and Application					
Method of Instruction	**1**	**201.520**	**201.520**	**7.69**	**.0087***
Method * Aptitude	2	19.476	9.738	.37	.6921
Word Analysis					
Method of Instruction	1	.381	.381	.02	.8856
Method * Aptitude	2	9.191	4.595	.25	.7775
Spelling					
Method of Instruction	1	16.095	16.095	.47	.4980
Method * Aptitude	2	87.048	43.524	1.27	.2939

* Bold type indicates a statistical significance at alpha = .05.

Table 7. Mean achievement of method of instruction and aptitude and method of instruction by aptitude at grade 2.

Source	Means		Means
Reading Vocabulary			
Control	24.86	Montessori	26.33
Control * High	**29.43**	Montessori * High	**29.71***
Control * Medium	**26.14**	Montessori * Medium	**24.43***
Control * Low	**19.00**	Montessori * Low	**24.86***
Reading Comprehension			
Control	30.19	Montessori	31.05
Control * High	34.14	Montessori * High	34.57
Control * Medium	31.14	Montessori * Medium	31.57
Control * Low	25.29	Montessori * Low	27.00
Language Mechanics			
Control	20.05	Montessori	19.95
Control * High	23.00	Montessori * High	25.14
Control * Medium	21.29	Montessori * Medium	17.86
Control * Low	15.86	Montessori * Low	16.86
Language Expression			
Control	29.48	Montessori	29.90
Control * High	33.14	Montessori * High	34.29
Control * Medium	30.43	Montessori * Medium	28.86
Control * Low	24.86	Montessori * Low	26.57
Mathematics Computation			
Control	**25.00**	Montessori	**19.81**
Control * High	28.14	Montessori * High	25.14
Control * Medium	26.29	Montessori * Medium	18.29
Control * Low	20.57	Montessori * Low	16.00
Mathematics Concepts and Application			
Control	**34.67**	Montessori	**30.29**
Control * High	39.14	Montessori * High	36.57
Control * Medium	35.57	Montessori * Medium	29.71
Control * Low	29.29	Montessori * Low	24.57
Word Analysis			
Control	23.90	Montessori	24.10
Control * High	27.00	Montessori * High	28.29
Control * Medium	25.00	Montessori * Medium	24.00
Control * Low	19.71	Montessori * Low	20.00
Spelling			
Control	15.67	Montessori	16.90
Control * High	17.43	Montessori * High	22.57
Control * Medium	16.71	Montessori * Medium	15.00
Control * Low	12.86	Montessori * Low	13.14

* Bold type indicates a statistical significance at alpha = .05.

Analysis of Grade 2 Data

An analysis of all subtests at grade 2 show that there is a significant difference between the achievement of those students taught by the Montessori method of instruction and those students taught by traditional methods of instruction in mathematics computation and mathematics concepts and application. On both of these subtests, those students taught by the traditional method of instruction had a mean achievement score that was significantly higher than those taught by the Montessori method of instruction. The mean score for those taught by the traditional method of instruction in mathematics computation was 25.00 and the mean score for the students taught by the Montessori method was 19.81. In mathematics concepts and application, the mean score for those students taught by the traditional method of instruction was 34.67 and the mean score for those students taught by the Montessori method was 30.29.

Null Hypothesis 4 was retained. There were no significant interactions between method and gender at the second grade level.

When the interaction between aptitude and method at the second grade level was analyzed for Hypothesis 5, one significant finding emerged. There was an interaction between the method of instruction and aptitude in the

subtest vocabulary. The interaction was disordinal, with the Montessori low aptitude group having a mean of 24.86, the Montessori middle group having a mean of 24.43, and the Montessori high group having a mean of 29.71. The low control group had a mean of 19.00, the medium control group had a mean of 26.14, and the high control group had a mean of 29.43. An analysis of these means indicated that vocabulary development for low students may be better in a Montessori classroom at the second grade level than in a low group of students for traditional classrooms.

Grade 3

Hypothesis 2 states that no statistically significant differences exist between the academic achievement scores of students taught by the Montessori method of instruction and those students taught by traditional methods of instruction in grades 2 and 3 in vocabulary, reading comprehension, language mechanics, language expression, math concepts and application, math comprehension, word analysis, and spelling.

Hypothesis 4 states that the method of instruction given to students and the gender of the student do not interact on academic achievement scores.

Hypothesis 5 states that the method of instruction and the aptitude of the student do not interact on achievement scores.

The results of the analysis for Hypotheses 2, 4 and 5 are found in Tables 8 and 10. The means for these three hypotheses are found in Tables 9 and 11.

Table 8. Summary of analysis of variance comparing effect of method instruction and gender on academic achievement at grade 3.

Source	df	SS	MS	F-Ratio	P-Value
Reading Vocabulary					
Method of Instruction	1	12.971	12.971	.78	.3835
Method * Gender	1	1.615	1.615	.10	.7571
Reading Comprehension					
Method of Instruction	1	47.059	47.059	1.05	.3145
Method * Gender	1	41.427	41.427	.92	.3448
Language Mechanics					
Method of Instruction	1	1.441	1.441	.08	.7846
Method * Gender	1	12.430	12.430	.66	.4243
Language Expression					
Method of Instruction	1	11.765	11.765	.28	.6013
Method * Gender	1	1.721	1.721	.04	.8757
Mathematics Computation					
Method of Instruction	1	47.059	47.059	1.37	.2510
Method * Gender	1	11.027	11.027	.32	.5752
Mathematics Concepts and Application					
Method of Instruction	1	28.265	28.265	.58	.4516
Method * Gender	1	26.471	26.471	.54	.4662
Word Analysis					
Method of Instruction	1	23.059	23.059	.84	.3664
Method * Gender	1	61.313	61.313	2.24	.1452
Spelling					
Method of Instruction	1	2.941	2.941	.10	.7543
Method * Gender	1	12.430	12.430	.42	.5210

Table 9. Mean achievement of method of instruction and gender and method of instruction by gender at grade 3.

Source	Means		Means
Reading Vocabulary			
Control	25.29	Montessori	26.53
Control * Male	25.71	Montessori * Male	26.43
Control * Female	25.00	Montessori * Female	26.60
Reading Comprehension			
Control	31.41	Montessori	31.06
Control * Male	33.43	Montessori * Male	33.71
Control * Female	33.40	Montessori * Female	29.20
Language Mechanics			
Control	20.35	Montessori	19.94
Control * Male	21.00	Montessori * Male	19.14
Control * Female	19.90	Montessori * Female	20.50
Language Expression			
Control	38.06	Montessori	39.24
Control * Male	38.00	Montessori * Male	39.71
Control * Female	38.10	Montessori * Female	38.90
Mathematics Computation			
Control	28.53	Montessori	26.18
Control * Male	29.43	Montessori * Male	25.71
Control * Female	27.90	Montessori * Female	26.50
Mathematics Concepts and Application			
Control	34.29	Montessori	32.47
Control * Male	35.29	Montessori * Male	35.57
Control * Female	33.60	Montessori * Female	30.30
Word Analysis			
Control	24.47	Montessori	22.82
Control * Male	26.43	Montessori * Male	21.57
Control * Female	23.10	Montessori * Female	23.70
Spelling			
Control	17.65	Montessori	18.24
Control * Male	18.29	Montessori * Male	17.43
Control * Female	17.20	Montessori * Female	18.80

Table 10. Summary of analysis of variance comparing effect of method instruction and aptitude on academic achievement at grade 3.

Source	df	SS	MS	F-Ratio	P-Value
Reading Vocabulary					
Method of Instruction	1	12.971	12.971	1.19	.2837
Method * Aptitude	2	.363	.181	.02	.9834
Reading Comprehension					
Method of Instruction	1	47.059	47.059	1.36	.2542
Method * Aptitude	2	41.508	20.754	.60	.5569
Language Mechanics					
Method of Instruction	1	1.441	1.441	.09	.7618
Method * Aptitude	2	2.725	1.363	.09	.9155
Language Expression					
Method of Instruction	1	11.765	11.765	.41	.5277
Method * Aptitude	2	13.502	6.751	.23	.7924
Mathematics Computation					
Method of Instruction	1	47.059	47.059	1.67	.2074
Method * Aptitude	2	4.041	2.021	.07	.9312
Mathematics Concepts and Application					
Method of Instruction	1	28.265	28.265	.78	.3841
Method * Aptitude	2	24.002	12.001	.33	.7203
Word Analysis					
Method of Instruction	1	23.059	23.059	1.04	.3172
Method * Aptitude	2	2.175	1.087	.05	.9524
Spelling					
Method of Instruction	1	2.941	2.941	.15	.7051
Method * Aptitude	2	75.975	37.988	1.89	.1702

Table 11. Mean achievement of method of instruction and aptitude and method of instruction by aptitude at grade 3.

Source	Means		Means
Reading Vocabulary			
Control	25.29	Montessori	26.53
Control * High	27.50	Montessori * High	28.67
Control * Medium	26.00	Montessori * Medium	27.50
Control * Low	21.80	Montessori * Low	22.80
Reading Comprehension			
Control	31.41	Montessori	31.06
Control * High	36.00	Montessori * High	35.83
Control * Medium	33.67	Montessori * Medium	31.73
Control * Low	30.00	Montessori * Low	24.40
Language Mechanics			
Control	20.35	Montessori	19.94
Control * High	22.33	Montessori * High	22.67
Control * Medium	20.50	Montessori * Medium	19.83
Control * Low	17.80	Montessori * Low	16.80
Language Expression			
Control	38.06	Montessori	39.24
Control * High	41.33	Montessori * High	44.00
Control * Medium	39.00	Montessori * Medium	38.67
Control * Low	33.00	Montessori * Low	34.20
Mathematics Computation			
Control	28.53	Montessori	26.18
Control * High	31.67	Montessori * High	30.17
Control * Medium	27.33	Montessori * Medium	24.83
Control * Low	26.20	Montessori * Low	23.00
Mathematics Concepts and Application			
Control	34.29	Montessori	32.47
Control * High	38.17	Montessori * High	38.33
Control * Medium	34.67	Montessori * Medium	30.83
Control * Low	29.20	Montessori * Low	27.40
Word Analysis			
Control	24.47	Montessori	22.82
Control * High	27.50	Montessori * High	26.33
Control * Medium	24.17	Montessori * Medium	22.67
Control * Low	21.20	Montessori * Low	18.80
Spelling			
Control	17.65	Montessori	18.24
Control * High	18.50	Montessori * High	22.83
Control * Medium	18.67	Montessori * Medium	18.50
Control * Low	15.40	Montessori * Low	12.40

Analysis of Grade 3 Data

All hypotheses tested at the third grade level were retained in every instance. This indicates that third grade students achieve equally well in either a Montessori classroom or a traditional classroom for all areas listed in Hypothesis 2.

Grade 4

Hypothesis 3 states that no statistically significant differences exist between the academic achievement scores of students taught by the Montessori method of instruction and those students taught by traditional methods of instruction in grades 2, 3, 4, and 5 in vocabulary, reading comprehension, language mechanics, language expression, math concepts and application, math comprehension, spelling, study skills, social studies, and science.

Hypothesis 4 states that the method of instruction given to students and the gender of the student do not interact on academic achievement scores.

Hypothesis 5 states that the method of instruction and the aptitude of the student do not interact on achievement scores.

The results of the analysis for Hypotheses 3, 4 and 5 are listed in Tables 12 and 14. The means for these three hypotheses are listed in Tables 13 and 15.

Table 12. Summary of analysis of variance comparing effect of method instruction and gender on academic achievement at grade 4.

Source	df	SS	MS	F-Ratio	P-Value
Reading Vocabulary					
Method of Instruction	1	5.042	5.042	.26	.6164
Method * Gender	1	6.021	6.021	.31	.5843
Reading Comprehension					
Method of Instruction	1	.375	.375	.06	.8085
Method * Gender	1	9.187	9.187	1.48	.2383
Language Mechanics					
Method of Instruction	1	12.042	12.042	.86	.3660
Method * Gender	1	14.083	14.083	1.00	.3291
Language Expression					
Method of Instruction	1	10.667	10.667	1.12	.3032
Method * Gender	1	2.08	2.080	.22	.6455
Mathematics Computation					
Method of Instruction	1	60.167	60.167	1.43	.2462
Method * Gender	1	4.083	4.083	.10	.7588
Mathematics Concepts and Application					
Method of Instruction	1	.667	.667	.02	.8797
Method * Gender	1	33.333	33.333	1.17	.2914
Spelling					
Method of Instruction	1	1.042	1.042	.04	.8512
Method * Gender	1	111.020	111.020	3.85	.0638
Word Study Skills					
Method of Instruction	1	8.167	8.167	.50	.4889
Method * Gender	1	25.521	25.521	1.55	.2271
Science					
Method of Instruction	1	4.167	4.167	.50	.4871
Method * Gender	1	2.083	2.083	.25	.6221
Social Studies					
Method of Instruction	1	40.042	40.042	2.48	.1309
Method * Gender	1	24.083	24.083	1.49	.2361

Table 13. Mean achievement of method of instruction and gender and method of instruction by gender at grade 4.

Source	Means		Means
Reading Vocabulary			
Control	34.00	Montessori	34.92
Control * Male	34.38	Montessori * Male	36.00
Control * Female	33.25	Montessori * Female	32.75
Reading Comprehension			
Control	46.00	Montessori	46.25
Control * Male	44.88	Montessori * Male	46.00
Control * Female	48.25	Montessori * Female	46.75
Language Mechanics			
Control	28.83	Montessori	30.25
Control * Male	27.88	Montessori * Male	30.38
Control * Female	30.75	Montessori * Female	30.00
Language Expression			
Control	42.92	Montessori	44.25
Control * Male	42.75	Montessori * Male	44.50
Control * Female	43.25	Montessori * Female	43.75
Mathematics Computation			
Control	35.08	Montessori	38.25
Control * Male	36.75	Montessori * Male	40.50
Control * Female	31.75	Montessori * Female	33.75
Mathematics Concepts and Application			
Control	43.25	Montessori	43.58
Control * Male	43.63	Montessori * Male	45.62
Control * Female	42.50	Montessori * Female	39.50
Spelling			
Control	24.00	Montessori	23.58
Control * Male	22.63	Montessori * Male	25.25
Control * Female	26.75	Montessori * Female	20.25
Study Skills			
Control	24.08	Montessori	25.25
Control * Male	23.88	Montessori * Male	26.50
Control * Female	24.50	Montessori * Female	22.75
Science			
Control	34.50	Montessori	35.33
Control * Male	35.13	Montessori * Male	36.37
Control * Female	33.25	Montessori * Female	33.25
Social Studies			
Control	32.33	Montessori	34.92
Control * Male	32.25	Montessori * Male	36.25
Control * Female	32.25	Montessori * Female	32.25

Table 14. Summary of analysis of variance comparing effect of method instruction and aptitude on academic achievement at grade 4.

Source	df	SS	MS	F-Ratio	P-Value
Reading Vocabulary					
Method of Instruction	1	5.041	5.041	.33	.5704
Method * Aptitude	1	1.041	1.041	.07	.7958
Reading Comprehension					
Method of Instruction	1	.375	.375	.06	.8053
Method * Aptitude	1	1.042	1.042	.17	.6816
Language Mechanics					
Method of Instruction	1	12.042	12.042	1.26	.2742
Method * Aptitude	1	5.042	5.042	.53	.4753
Language Expression					
Method of Instruction	1	10.667	10.667	1.88	.1859
Method * Aptitude	1	6.000	6.000	1.06	.3165
Mathematics Computation					
Method of Instruction	1	60.167	60.167	1.86	.1876
Method * Aptitude	1	16.667	16.667	.52	.4810
Mathematics Concepts and Application					
Method of Instruction	1	.667	.667	.03	.8671
Method * Aptitude	1	2.667	2.667	.11	.7382
Spelling					
Method of Instruction	1	1.041	1.041	.03	.8538
Method * Gender	1	7.042	7.042	.24	.6326
Study Skills					
Method of Instruction	1	8.167	8.167	.69	.4156
Method * Aptitude	1	.167	.167	.01	.9066
Science					
Method of Instruction	1	4.167	4.167	.44	.5150
Method * Aptitude	1	6.000	6.000	.63	.4357
Social Studies					
Method of Instruction	1	40.042	40.042	3.11	.0929
Method * Aptitude	1	.041	.041	.00	.9552

Table 15. Mean achievement of method of instruction and aptitude and method of instruction by aptitude at grade 4.

Source	Means		Means
Reading Vocabulary			
Control	34.00	Montessori	34.92
Control * High	36.00	Montessori * High	37.33
Control * Low	32.00	Montessori * Low	32.50
Reading Comprehension			
Control	46.00	Montessori	46.25
Control * High	47.00	Montessori * High	47.67
Control * Low	45.00	Montessori * Low	44.83
Language Mechanics			
Control	28.83	Montessori	30.25
Control * High	30.50	Montessori * High	32.83
Control * Low	27.17	Montessori * Low	27.67
Language Expression			
Control	42.92	Montessori	44.25
Control * High	44.17	Montessori * High	46.50
Control * Low	41.67	Montessori * Low	42.00
Mathematics Computation			
Control	35.08	Montessori	38.25
Control * High	39.83	Montessori * High	41.33
Control * Low	30.33	Montessori * Low	35.17
Mathematics Concepts and Application			
Control	43.25	Montessori	43.58
Control * High	45.83	Montessori * High	46.83
Control * Low	40.67	Montessori * Low	40.33
Spelling			
Control	24.00	Montessori	23.58
Control * High	25.33	Montessori * High	26.00
Control * Low	22.67	Montessori * Low	21.17
Study Skills			
Control	24.08	Montessori	25.25
Control * High	26.50	Montessori * High	27.50
Control * Low	21.67	Montessori * Low	23.00
Science			
Control	34.50	Montessori	35.33
Control * High	34.50	Montessori * High	36.33
Control * Low	34.50	Montessori * Low	34.33
Social Studies			
Control	32.33	Montessori	34.92
Control * High	34.50	Montessori * High	37.00
Control * Low	30.17	Montessori * Low	32.83

Analysis of Grade 4 Data

All hypotheses tested at the fourth grade level were retained in every instance. This indicates that fourth grade students achieve equally in either a Montessori classroom or a traditional classroom for all areas listed in Hypothesis 3.

Grade 5

Hypotheses 3, 4, and 5 were tested using the General Linear Model for the ANOVA statistical procedure. This statistical procedure was used because there were unbalanced cells at this grade level. However, according to Lund (1993), "GLMODEL and ANOVA provide nearly identical output and graphical display. Operation is similar. One may substitute GLMODEL for procedure ANOVA to analyze data sets failing to meet its requirements for balance" (p. 4-70).

Hypothesis 3 states that no statistically significant differences exist between the academic achievement scores of students taught by the Montessori method of instruction and those students taught by traditional methods of instruction in grades 4 and 5 in vocabulary, reading comprehension, language mechanics, language expression, math concepts and application, math comprehension, spelling, study skills, social studies, and science.

Hypothesis 4 states that the method of instruction given to students and the gender of the students do not interact on academic achievement scores.

Hypothesis 5 states that the method of instruction and the aptitude of the student do not interact on achievement scores.

The results of the analysis for Hypotheses 3, 4, and 5 are listed in Tables 16 and 18. The means for these three hypotheses are listed in Tables 17 and 19.

Analysis of Grade 5 Data

An analysis of all subtests at grade 5 shows that there is a significant difference between the achievement of those students taught by the Montessori method of instruction and those students taught by traditional methods of instruction in language expression and social studies. On both of these subtests, those students taught by the Montessori method of instruction had a mean achievement score that was significantly higher than those taught by the traditional method of instruction. The mean score for those taught by the Montessori method of instruction in language expression was 44.04 and the mean score for the students taught by the traditional method was 37.25. In social studies, the mean score for those students taught by the Montessori method of instruction was

Table 16. Summary of analysis of variance comparing effect of method instruction and gender on academic achievement at grade 5.

Source	df	SS	MS	F-Ratio	P-Value
Reading Vocabulary					
Method of Instruction	1	15.408	15.408	.46	.5070
Method * Gender	1	10.208	10.208	.31	.5882
Reading Comprehension					
Method of Instruction	1	66.008	66.008	1.22	.2866
Method * Gender	1	5.208	5.208	.10	.7608
Language Mechanics					
Method of Instruction	1	27.075	27.075	.70	.4160
Method * Gender	1	.075	.075	.00	.9655
Language Expression					
Method of Instruction	**1**	**221.410**	**221.410**	**5.13**	**.0378***
Method * Gender	1	1.008	1.008	.02	.8805
Mathematics Computation					
Method of Instruction	1	46.875	46.875	1.65	.2177
Method * Gender	1	21.675	21.675	.76	.3958
Mathematics Concepts and Application					
Method of Instruction	1	112.130	112.130	2.90	.1077
Method * Gender	1	64.533	64.533	1.67	.2145
Spelling					
Method of Instruction	1	3.675	3.675	.18	.6767
Method * Gender	1	.675	.675	.03	.8578
Word Study Skills					
Method of Instruction	1	15.408	15.408	1.18	.2936
Method * Gender	1	1.008	1.008	.08	.7847
Science					
Method of Instruction	1	50.700	50.700	2.67	.1216
Method * Gender	**1**	**108.300**	**108.300**	**5.71**	**.0295***
Social Studies					
Method of Instruction	**1**	**143.010**	**143.010**	**4.52**	**.0495***
Method * Gender	1	25.208	25.208	.80	.3855

* Bold type indicates a statistical significance at alpha = .05.

Table 17. Mean achievement of method of instruction and gender and method of instruction by gender at grade 5.

Source	Means		Means
Reading Vocabulary			
Control	30.96	Montessori	32.75
Control * Male	30.75	Montessori * Male	34.00
Control * Female	30.75	Montessori * Female	31.50
Reading Comprehension			
Control	41.25	Montessori	44.96
Control * Male	41.50	Montessori * Male	46.25
Control * Female	41.00	Montessori * Female	43.67
Language Mechanics			
Control	29.00	Montessori	31.38
Control * Male	28.50	Montessori * Male	30.75
Control * Female	29.50	Montessori * Female	32.00
Language Expression			
Control	**37.25**	Montessori	**44.04***
Control * Male	38.00	Montessori * Male	45.25
Control * Female	36.50	Montessori * Female	42.83
Mathematics Computation			
Control	34.71	Montessori	37.83
Control * Male	35.25	Montessori * Male	40.50
Control * Female	34.17	Montessori * Female	35.17
Mathematics Concepts and Application			
Control	38.50	Montessori	43.33
Control * Male	38.50	Montessori * Male	47.00
Control * Female	38.50	Montessori * Female	39.67
Spelling			
Control	23.21	Montessori	24.08
Control * Male	24.25	Montessori * Male	25.50
Control * Female	22.17	Montessori * Female	22.67
Study Skills			
Control	24.58	Montessori	26.38
Control * Male	24.50	Montessori * Male	26.75
Control * Female	24.67	Montessori * Female	26.00
Science			
Control	27.25	Montessori	30.50
Control * Male	**27.00**	Montessori * Male	**35.00***
Control * Female	**27.50**	Montessori * Female	**26.00***
Social Studies			
Control	**31.17**	Montessori	**36.63***
Control * Male	30.50	Montessori * Male	38.25
Control * Female	31.83	Montessori * Female	35.00

* Bold type indicates a statistical significance at alpha = .05.

Table 18. Summary of analysis of variance comparing effect of method instruction and aptitude on academic achievement at grade 5.

Source	df	SS	MS	F-Ratio	P-Value
Reading Vocabulary					
Method of Instruction	1	11.250	11.250	.61	.4460
Method * Aptitude	1	31.250	31.250	1.70	.2112
Reading Comprehension					
Method of Instruction	1	61.250	61.250	1.64	.2189
Method * Aptitude	1	76.050	76.050	2.03	.1731
Language Mechanics					
Method of Instruction	1	28.800	28.800	1.40	.2543
Method * Aptitude	1	80.000	80.000	3.88	.0663
Language Expression					
Method of Instruction	**1**	**224.450**	**224.450**	**14.53**	**.0015***
Method * Aptitude	**1**	**151.250**	**151.250**	**9.79**	**.0065***
Mathematics Computation					
Method of Instruction	1	36.450	36.450	1.41	.2526
Method * Aptitude	1	11.250	11.250	.43	.5190
Mathematics Concepts and Application					
Method of Instruction	1	84.050	84.050	2.96	.1047
Method * Aptitude	1	11.250	11.250	.40	.5380
Spelling					
Method of Instruction	1	3.200	3.200	.19	.6695
Method * Aptitude	1	20.000	20.000	1.18	.2931
Study Skills					
Method of Instruction	1	14.450	14.450	2.13	.1635
Method * Aptitude	1	18.050	18.050	2.66	.1222
Science					
Method of Instruction	1	26.450	26.450	.92	.3528
Method * Aptitude	1	14.450	14.450	.50	.4895
Social Studies					
Method of Instruction	**1**	**125.000**	**125.000**	**6.44**	**.0219***
Method * Aptitude	1	80.000	80.000	4.12	.0592

* Bold type indicates a statistical significance at alpha = .05.

Table 19. Mean achievement of method of instruction and aptitude and method of instruction by aptitude at grade 5.

Source	Means		Means
Reading Vocabulary			
Control	31.00	Montessori	32.50
Control * High	35.60	Montessori * High	34.60
Control * Low	26.40	Montessori * Low	30.40
Reading Comprehension			
Control	41.20	Montessori	44.70
Control * High	46.40	Montessori * High	46.00
Control * Low	36.00	Montessori * Low	43.40
Language Mechanics			
Control	29.10	Montessori	31.50
Control * High	34.40	Montessori * High	32.80
Control * Low	23.80	Montessori * Low	30.20
Language Expression			
Control	**37.10**	Montessori	**43.80***
Control * High	**43.80**	Montessori * High	**45.00***
Control * Low	**30.40**	Montessori * Low	**42.60***
Mathematics Computation			
Control	34.60	Montessori	37.30
Control * High	37.60	Montessori * High	38.80
Control * Low	31.60	Montessori * Low	35.80
Mathematics Concepts and Application			
Control	38.50	Montessori	42.60
Control * High	43.00	Montessori * High	45.60
Control * Low	34.00	Montessori * Low	39.60
Spelling			
Control	23.00	Montessori	23.80
Control * High	25.80	Montessori * High	24.60
Control * Low	20.20	Montessori * Low	23.00
Study Skills			
Control	24.60	Montessori	26.30
Control * High	27.60	Montessori * High	27.40
Control * Low	21.60	Montessori * Low	25.20
Science			
Control	27.30	Montessori	29.60
Control * High	29.20	Montessori * High	29.80
Control * Low	25.40	Montessori * Low	29.40
Social Studies			
Control	**31.30**	Montessori	**36.30***
Control * High	36.00	Montessori * High	37.00
Control * Low	26.60	Montessori * Low	35.60

* Bold type indicates a statistical significance at alpha = .05.

36.63 and the mean score for those students taught by the traditional method was 31.17.

When the interaction between method and gender at the fifth grade level was analyzed for Hypothesis 4, one significant finding emerged: there was an interaction between the method of instruction and gender in the subtest science. The interaction was disordinal, with the Montessori male group having a mean of 35.00, the Montessori female group having a mean of 26.00, the control male group having a mean of 27.00, and the control female group having a mean of 27.50. An analysis of these numbers indicates that Montessori males may do better at fifth-grade level science than do students in traditional classrooms or Montessori females.

When the interaction between method and aptitude at the fifth grade level was analyzed for Hypothesis 5, one significant finding emerged. There was an interaction between the method of instruction and aptitude in the subtest for language expression. The interaction was ordinal, with the low aptitude Montessori group mean of 42.60, the high aptitude Montessori group mean of 45.00, the low aptitude control group mean of 30.40, and the high control aptitude group mean of 43.80. An analysis of these numbers indicates that Montessori low aptitude students may do better at the fifth grade level language expression than low aptitude traditional students.

Additional Investigation

The researcher conducted two additional investigations that added to this study. They include an examination of the simple effects of the significant interactions found in Hypotheses 3 and 4 and an examination of the composite scores of the total reading, total language, total mathematics, and total battery.

In the analyses where a significant interaction was found in Hypotheses 3 and 4, a simple effects test was performed (Table 20).

Table 20. Summary of the simple effects test when the interaction between method and aptitude was found to be significant at the second grade level in the subtest vocabulary.

Comparison of High Aptitude Control to High Aptitude Montessori					
Number	Error MS	df for MS	Mean Control	Mean Montessori	P-Value
14	15.96	36	29.43	29.71	.8964

Comparison of Medium Aptitude Control to Medium Aptitude Montessori					
Number	Error MS	df for MS	Mean Control	Mean Montessori	P-Value
14	15.96	36	26.14	24.43	.4285

Comparison of Low Aptitude Control to Low Aptitude Montessori					
Number	Error MS	df for MS	Mean Control	Mean Montessori	P-Value
14	15.96	36	19.00	24.86	.0094

The results of Table 20 indicate that there is a significant difference between the achievement of low aptitude Montessori students and that of low aptitude students in traditional classrooms.

Table 21. Summary of the simple effects test when interaction between method and gender was found to be significant at the fifth grade level in the subtest science.

Comparison of Science Control Males to Science Montessori Males

Number	Error MS	df for MS	Mean Control	Mean Montessori	P-Value
10	18.97	16	27.00	35.00	.0104

Comparison of Science Control Females to Science Montessori Females

Number	Error MS	df for MS	Mean Control	Mean Montessori	P-Value
10	18.97	16	27.50	26.00	.5936

Comparison of Science Control Males to Science Control Females

Number	Error MS	df for MS	Mean Male	Mean Female	P-Value
8	18.97	16	27.00	27.50	.8731

Comparison of Science Montessori Males to Science Montessori Females

Number	Error MS	df for MS	Mean Male	Mean Female	P-Value
12	18.97	16	35.00	26.00	.0025

The results of Table 21 indicate that there is a significant difference between the achievement of male Montessori students and all other groups in fifth grade science.

Table 22. Summary of the simple effects test when interaction between method and aptitude was found to be significant at the fifth grade level in the subtest language expression.

Comparison of Language Expression of Control High Aptitude to Montessori High Aptitude

Number	Error MS	df for MS	Mean Control	Mean Montessori	P-Value
10	15.45	16	43.80	45.00	.6358

Comparison of Language Expression of Control Low Aptitude to Montessori Low Aptitude

Number	Error MS	df for MS	Mean Control	Mean Montessori	P-Value
10	15.45	16	30.40	42.60	.0000

Comparison of Language Expression of Control High Aptitude to Control Low Aptitude

Number	Error MS	df for MS	Mean High Control	Mean Low Control	P-Value
8	15.45	16	43.80	30.40	.0000

Comparison of Language Expression of Montessori High Aptitude to Montessori Low Aptitude

Number	Error MS	df for MS	Mean High Montessori	Mean Low Montessori	P-Value
12	15.45	16	45.00	42.60	.3060

The results of Table 22 indicate that there was a significant difference between the achievement of high aptitude Montessori students and high aptitude students in traditional classrooms in fifth grade science. A significant difference in the high and low groups of both Montessori and the control group was expected. However, the results show that there was no significant difference in the high and low Montessori groups.

At the conclusion of the analysis of all hypotheses, the researcher determined that a more complete examination would include the analysis of composite scores of total reading, total language, total mathematics, and the total battery in grades 2 through 5. Sixty-four F-tests were conducted using the raw scores from the CTBS tests. Of the 64 tests conducted, 7 were found to be significant. Table 23 lists those tests that were significant.

The significant results at the second grade level were expected since both computation and concepts and application were significant in the tests conducted in Hypothesis 2. At the fifth grade in total language, the results were significant. Since the p-value for method of instruction was very low (.0015) in the test conducted for Hypothesis 3, the results for total language were also expected. There were significant results from the analyses run at the fifth grade level in total mathematics and the total battery.

Table 23. Summary of analysis of variance of the composite scores where a significance was found.

Grade 2, Mathematics Total, Two-Way Analysis of Method of Instruction and Gender

Number	MS	df for MS	Mean Control	Mean Montessori	P-Value
42	961.93	1	59.67	50.10	.0104

Grade 2, Mathematics Total, Two-Way Analysis of Method and Aptitude, Number

Number	MS	df for MS	Mean Control	Mean Montessori	P-Value
42	961.93	1	59.67	50.10	.0014

Grade 5, Language Total, Two-Way Analysis of Method with Aptitude

Number	MS	df for MS	Mean Control	Mean Montessori	P-Value
20	352.80	1	77.30	63.50	.0263

Grade 5, Language Total, Two-Way Analysis of Interaction of Method with Aptitude

Number	MS	df for MS	Mean Control	Mean Montessori	P-Value
20	520.20	1	H- 78.20 L- 54.20	H- 76.40 L- 72.80	.0090

Grade 5, Mathematics Total, Two-Way Analysis of Method with Aptitude

Number	MS	df for MS	Mean Control	Mean Montessori	P-Value
20	320.00	1	73.10	81.10	.0434

Grade 5, Total Battery, Two-Way Analysis of Method with Aptitude

Number	MS	df for MS	Mean Control	Mean Montessori	P-Value
20	2101.2	1	211.5	232.0	.0249

Grade 5, Total Battery, Two-Way Analysis of Interaction of Method with Aptitude

Number	MS	df for MS	Mean Control	Mean Montessori	P-Value
20	1862.40	1	H- 240.8 L- 182.2	H- 242.0 L- 222.0	.0332

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

The education of students in public schools has received a growing amount of attention since A Nation at Risk was published by the National Commission on Excellence in 1983. That report was the beginning of a continued focus on the academic achievement of public school students. This attention was heightened by the adoption of the national education goals in 1990. Today the American public's focus on education is stronger than ever. Measuring the success of the national goals has become a predominate focus in 45 states. Goals 3 and 5 concerning the demonstration of competency and academic achievement in the major subjects have become a priority of many state educational agencies and local districts. According to The National Education Goals Report: Executive Summary (National Education Goals Panel, 1996), "At least 32 states have developed state standards and an additional 14 report that standards development is underway. Forty-five states report that they have statewide assessment systems" (p. 7). Montana is one of the states that currently has an

assessment reporting system in the area of student achievement in place for all school districts.

Added to the increased emphasis on student achievement is the continued pressure by the public to add alternative education programs for parents to choose from when they are considering school placement for their children. Some of these programs include magnet schools, charter schools, voucher plans, open enrollment, and other alternatives for school placement. Montessori education is one of the alternatives that is growing in popularity across the nation. However, with the addition of any of these alternatives comes accountability by the local district for academic achievement.

The purpose of this study was to determine whether students in grades 2 through 5 in the Helena Public Schools who attend Montessori classes and are taught by the Montessori method of instruction achieve at significantly higher levels than those students taught in traditional classes using traditional methods. Sixty Montessori students were matched with 60 students from traditional classrooms in order to conduct this study. The study used TCS and CTBS test data from the 1996 spring system-wide testing conducted in the Helena Public Schools. Statistical comparisons as described in this study were conducted. The results of those comparisons are found in Chapter 4.

This chapter summarizes the results of this study, draws conclusions from the results, compares this study to other known studies on Montessori student achievement, and makes recommendations for future study.

Summary of Findings

Student achievement of Montessori students as compared to that of traditional students is analyzed in this study. There were 145 statistical analyses conducted to answer the general questions of this study. Of the 145 analyses, there were 36 main effects of method of instruction analyzed with the interaction of gender and the same main effects were analyzed with the interaction of aptitude. Twelve of the 145 tests were significant with 4 of the 12 being similar due to duplication of main effects.

Hypothesis 1 stated that no statistically significant differences exist between the aptitude scores of those children whose parents elect to have them placed in a Montessori classroom and all other children in traditional classrooms in grades 2, 3, 4, and 5 in the Helena Public Schools. This hypothesis was rejected, since it was found that the aptitude of Montessori students was significantly higher than that of traditional students. Because Montessori students in the Helena Public Schools have a higher aptitude than those in traditional classes, matching

of aptitude in Hypotheses 2, 3, 4, and 5 is important in this study.

Hypothesis 2 stated that no statistically significant differences exist between the academic achievement scores of students taught by the Montessori method of instruction and those taught by traditional methods of instruction in grades 2 and 3 in vocabulary, reading comprehension, language mechanics, language expression, math concepts and application, math computation, word analysis, and spelling. The study's results indicate that this null was retained in all but two of the subtests analyzed. A significant difference was found in the subtests for mathematics computation and for mathematics concepts and application at the second grade level. An examination of these significant findings indicates that students in traditional classrooms achieve at higher levels than do Montessori students in both mathematics computation and mathematics concepts and application.

Hypothesis 3 stated that no statistically significant differences exist between the academic achievement scores of students taught by the Montessori method of instruction and those students taught by traditional methods of instruction in grades 4 and 5 in vocabulary, reading comprehension, language mechanics, language expression, math concepts and application, math computation, spelling, science, social studies, and study skills. The results of

the study show that this null was retained in all but two of the subtests analyzed. A significant difference was found in the subtests for language expression and for social studies at the fifth grade level. Montessori students did significantly better than did traditional students on these two tests.

Hypothesis 4 stated that the method of instruction given to students and the gender of the students do not interact on academic achievement scores. This null was retained in 35 of the 36 subtests analyzed. There was a significant interaction between method of instruction and gender in science at the fifth grade level. Results indicate that Montessori males achieve at higher levels in fifth grade science than do Montessori females, traditional females, or traditional males.

Hypothesis 5 stated that the method of instruction and the aptitude of the student do not interact on achievement scores. This null was retained in 34 of the 36 subtests analyzed. At the second grade level in vocabulary, low aptitude Montessori students achieve at significantly higher levels than do low aptitude students in traditional classes. At the fifth grade level in social studies, high aptitude Montessori students' scores are significantly higher than those of high aptitude students from traditional classes.

Conclusions

The Montessori method of instruction provides school districts and parents with an alternative to the traditional method of instruction. However, the results of this study do not show that Montessori students achieve at significantly higher levels overall academically than do students in traditional classrooms with whom the Montessori students are matched in aptitude.

This study analyzed the aptitude of students who attend Montessori classes and those students who attend traditional classes. Since students are accepted into the Montessori program through a lottery system open to all students in the Helena School District, it could be assumed that a cross section of students would be found in the Montessori classrooms. However, the results of this study indicate that there is a significant difference between the aptitude of Montessori students and those students in traditional classrooms. If the tests in this study would have been conducted without matching Montessori students in aptitude with students from traditional classrooms, the results would have been much different. Since there is a significant difference in aptitude of Montessori students and students from traditional classrooms, the researcher has concluded that any future studies on student achievement that do not control for aptitude may be flawed.

Though the above conclusion does not directly affect assessment of achievement of students in Montessori classrooms as compared to those in traditional classrooms when students are matched by aptitude, it does indicate that a higher percentage of parents of higher aptitude children are more likely to elect the option of Montessori instruction. This study did not look at the reasons parents submit their child's name to the Montessori lottery. However, an analysis of these reasons may provide school districts with additional data that would enable them to make better decisions for their districts.

The results of this study do not show whether the Montessori method of instruction or the traditional method of instruction yields higher achievement scores. An analysis of these results indicates that no pattern can be established from the significant findings in any of the subtests conducted. The 145 tests yielded only three significant results at grade 2, no significant results at grades 3 and 4, and only four significant results at grade 5.

It would be reasonable to assume that out of 145 subtests, a researcher would find 5% of the subtests significant by chance alone. In this study, the researcher found 8.3% of the subtests significant.

Throughout this study there may have been the underlying assumption that students taught by the

Montessori method of instruction achieve at significantly higher levels than do students taught by traditional methods of instruction. The analysis of the results gathered from this study indicate that this is not true. However, it should be pointed out that the study does not indicate that the traditional method of instruction is better than the Montessori method of instruction. With only two of the 145 significant results favoring traditional methods, no such conclusions can be drawn from these results. The researcher believes that both methods of instruction provide opportunities for students to learn and that there is no indication that one is significantly better than the other.

The practical significance of this study is that both the Montessori method of instruction and the traditional method provide comparable opportunities for academic achievement. The two approaches provide different methodologies for teaching students the academic skills that have been tested in this study.

Regardless of the benefits that both teachers and parents believe students derive from Montessori method of instruction, it can be concluded from this study that students taught by traditional methods of instruction achieve as well academically as Montessori students. This conclusion is further analyzed in a comparison of this

study to those studies previously conducted on student achievement.

Comparison to Other Studies

There have been several studies conducted comparing achievement of students taught by the Montessori method of instruction to that of students taught by traditional methods of instruction, as was stated in Chapter 2. Many of the results of those studies coincide with the results of this one. The most recent study on student achievement was by Cisneros (1994). She found that there were no significant differences between the two groups of students at the third grade level in either mathematics or reading achievement. These results agreed with the findings of this study.

A study conducted by Curtis (1993) compared achievement scores of urban elementary students by ethnicity, gender, and instructional programs. Curtis found no significant differences at the fourth grade level in any subtest except writing, which was not examined in this study. His study did find differences in ethnic groups, which were not examined in this study. Though the research by Curtis differed somewhat in terms of the subtests examined, the results of instructional programs were similar to those indicated by the results of this study.

A more comprehensive study of student achievement of Montessori students was conducted by Claxton (1982). Her study, which examined overall student achievement in the first, second and third grades, was conducted in an urban area. Claxton's study was similar to this study in design, with the exception that she did not report subtests. She found a significant difference at the first grade level in academic achievement, with students taught by the traditional method of instruction scoring higher than those taught by the Montessori method. She found no significant differences in the achievement of Montessori students and students taught by traditional methods at the second or third grade levels. Claxton's results at the second and third grade levels were similar to the results of this study. The only reportable significant differences found in this study were in the interaction of method and aptitude in vocabulary and between the subtests of math computation and mathematics concepts and application at the second grade level.

Other studies including those by Gross, Green, and Clapp (1970) and Sciarra and Dorsey (1976) study found no significant difference between achievement of Montessori students and students in traditional classrooms.
One of the most comprehensive recent studies of public school achievement was conducted by Moore in 1991. His findings indicate that there was a significant difference

generated in second grade reading and third grade mathematics by different instructional methods differs somewhat from the results of this study. In Moore's study, Montessori students scored at significantly higher levels in both tests. This study found that there was no significant difference in reading comprehension scores at the second grade and no significant differences in mathematics scores at the third grade.

Recommendations

The results of this study appear to be conclusive in terms of the overall evaluation of academic achievement of Montessori students as compared to students in traditional classrooms. With only eight significant differences out of 145 tests analyzed, there appears to be no significant difference in achievement by students taught in Montessori classrooms as compared to achievement by those taught in traditional classrooms. The eight significant differences found could have occurred by chance alone.

The above statement does not indicate that either the Montessori method of instruction or traditional classroom instruction is a more effective method in terms of academic achievement. Since the Montessori method of instruction has continued to grow in popularity since the first class was started in the Helena Public Schools in 1990, it would be reasonable to assume that this type of instruction has

provided parents with an appropriate alternative to the traditional method of instruction. It is the opinion of this researcher that, since the initial startup costs have already been absorbed by the school district and since maintaining a Montessori classroom is no more expensive than maintaining a traditional classroom, Montessori classrooms should be continued as an alternative to traditional instruction. As long as there is a demand by the parents of the community, this alternative method of instruction should be continued.

It is also recommended that the Helena School District conduct a longitudinal study of students who have completed the elementary Montessori program. This recommendation is supported by the significant results obtained from the additional analysis run on the total scores of reading, language, mathematics, and total battery. Since the total battery produced an overall significance at the fifth grade, a longitudinal study would reveal if this is the result of Montessori instruction or if the results were by chance alone. Although it would be advantageous to continue to use the same control group throughout the students' years in school, the mobility of these students would make that nearly impossible. However, the school district could replicate this study using other students and the procedure outlined in Chapter 3 of this study. In addition, is also recommended that the students included in

a longitudinal study be those who have spent their entire educational career in the Helena Public Schools.

It is further recommended that an evaluation of the first grade Montessori program be conducted by the Helena Public Schools. This would allow a complete evaluation of all grades currently being served by this method.

Further research should be conducted on parental attitudes, student attitudes, and other outcomes that parents feel are important aspects of a Montessori program. These may include those outcomes examined in Neubert's (1992) study: independence, self-confidence, respect for others, joy of learning, self-respect, creativity, self-control, concentration, and development of the child's potential. Since the Montessori program in the public school will continue to be reviewed by the policy makers, it is this researcher's opinion that communities should continue to evaluate this program along with all other programs. This evaluation should include the attitudes of parents of children in traditional classrooms and parents of students in Montessori classrooms.

This study should be replicated in a larger public school setting in which Montessori is offered as an alternative to traditional methods of instruction. Using a larger number of students in the Montessori program would also be advantageous to any further studies.

Since the researcher found in this study that Montessori students have a significantly higher aptitude than students from traditional classes, it is strongly recommended that future studies on student achievement include aptitude in the statistical design. Any study that does not control for aptitude may be flawed.

Since implementation of Montessori programs in public schools tends to be controversial, any additional research would only strengthen the knowledge base needed to make good decisions for each community considering implementation of a new Montessori program or expansion of an existing one. To the knowledge of this researcher, there have been no studies completed that show that students in Montessori classrooms achieve at a rate lower than that of their peers in traditional classrooms. This statement corresponds to Katz's (1992) investigations and comes to the same conclusions. "I often pointed out to my respondents that even though the available relevant research has many problems, it generally gives Montessori methods good marks: I know of little in the way of negative findings about the effects of Montessori education" (pp. 185-186).

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APPENDICES

APPENDIX A

HELENA PUBLIC SCHOOLS
STUDENT POPULATION BY INSTRUCTIONAL METHOD

Table 24. Helena Public Schools student population by instructional method.

Grade Level	Number of Students Taught by Traditional Methods	Number of Students Taught by Montessori Methods
Pre-Kindergarten	80	
Kindergarten	491	
Pre-First Grade	38	
First Grade	458	24
Second Grade	484	24
Third Grade	518	23
Fourth Grade	522	23
Fifth Grade	595	13
Sixth Grade	609	
Seventh Grade	679	
Eighth Grade	728	
Ninth Grade	750	
Tenth Grade	761	
Eleventh Grade	707	
Twelfth Grade	669	
Alternative High School	53	
Alternative Middle School	7	

APPENDIX B

HELENA PUBLIC SCHOOLS ESSENTIAL SKILLS AND CONTENT LISTS--GRADES 2 THROUGH 5

Second Grade Essential Skills & Content

1995-96

Communication Arts

Reading: Word Identification
- reads high-frequency words
- identifies consonant variants, blends, digraphs
- identifies short and long vowel sounds
- identifies common endings
- identifies plurals (regular & irregular)
- identifies compound words, contractions, possessives
- combines sounds to make a word
- substitutes consonants to make new words
- uses sentence structure and meaning to identify words
- identifies synonyms, antonyms and homonyms
- identifies irregular vowels and dipthongs

Reading: Comprehension
- sets purpose for reading
- identifies main idea and supporting details
- identifies sequence of events
- identifies cause and effect
- makes inferences
- makes predictions
- compares and contrasts
- draws conclusions
- summarizes
- reads again for better understanding
- uses illustrations, photos, headings
- uses categories
- recognizes spatial relationships
- demonstrates steps in a process

Literature: Components
- identifies setting/plot
- identifies characters
- distinguishes fantasy and reality
- recognizes literary genre

Writing: Process
- selects topics
- locates a source of information in a library
- takes notes/records information using graphic organizers
- makes mental and/or written plans for drafting
- writes down ideas as they flow
- writes ideas in sequence
- conferences with teacher for feedback in order to revise draft
- produces finished written products

Writing: Spelling/Grammar & Usage
- recognizes declarative, interrogative, exclamatory, imperative sentences
- recognizes complete and incomplete sentences
- recognizes correct word and sentence order
- spells high frequency words
- spells words using consonant blends and diagraphs
- spells words using short/long vowel sounds
- spells short vowel/final e words with endings
- spells contractions
- spells words using irregular and dipthong vowels and consonant variants

Writing: Handwriting
- spaces letters, words, sentences
- uses punctuation

Speaking: Features and Delivery
- adjusts volume for the situation
- pronounces and enunciates words clearly
- regulates rate and tempo of speech
- maintains appropriate tone
- uses appropriate facial expressions
- maintains eye contact
- maintains appropriate posture
- uses correct language
- stays on topic

Speaking: Functions
- takes turns in a group situation
- demonstrates proper telephone etiquette
- interacts appropriately with speaker
- asks questions and suggests alternatives
- participates in group discussions
- relates or retells stories
- reads literature with expression

Listening: Strategies
- establishes own purposes for listening
- responds to speaker: asks questions, contributes ideas
- pays attention to speakers
- adapts behavior to presentation

Listening: Skills
- follows the sequence of ideas
- follows oral directions
- predicts outcomes in oral presentations

Thinking: Creative Thinking
- brainstorms in a group
- categorizes ideas in lists
- elaborates by adding on, expanding
- generates many and varied responses

Mathematics

Problem Solving
- develops and applies strategies to:
  - guess and check
  - tables and charts
  - patterns
- solves problems in real-life situations
- checks for reasonableness of answers
- uses calculators as a problem-solving tool

Second Grade Essential Skills & Content

Numeration
- reads whole number words to 999
- counts and writes whole numbers to 999
- understands one-to-one correspondence with whole numbers
- compares equivalent and non-equivalent sets with whole numbers
- compares two whole numbers using the words: less than/greater than, 1 more, 1 less, equal to, to 99
- identifies ordinal positions to 20th
- identifies place values to three places
- gives expanded number for any set to three places (23=2 tens, 3 ones)
- recognizes sequential patterns with whole numbers
- gives standard number for two-digit number (30+4=34)
- skip counts by 2's, 3's, and 5's to 100
- identifies even and odd whole numbers to 100
- recognizes equal parts
- identifies 1/2, 1/3, 1/4 for areas of a whole or for a set

Computation
- understands and uses the terms plus, minus, equal, sum, trading and difference
- knows addition and subtraction facts to 18
- adds and subtracts 3 one-digit numbers to 18 without regrouping
- adds and subtracts two 2-digit numbers with and without regrouping
- adds and subtracts two 3-digit numbers with and without regrouping

Communication
- relates manipulatives, pictures, and diagrams to mathematical concepts
- discusses mathematical ideas in other content areas
- reads and expresses mathematical ideas in writing

Reasoning
- describes, extends, and creates auditory, visual and written patterns
- describes relationships between quantities
- uses models, known facts, properties, relationships, and real-world experiences
- explains thinking and justifies solutions

Estimation
- explores estimation strategies
- recognizes when an estimation is appropriate
- determines reasonableness of results
- applies estimation in working with quantities, measurement, computation and problem-solving

Measurement
- understands and uses the terms quarter, half-dollar, dollar, time to the nearest 1/4 hour, inch, foot, yard, centimeter, meter, gram, kilogram, milliliter, liter, volume, area, perimeter, temperature, days, months, calendar, pints, quarts, and gallons
- understands non-standard units using objects as units of measure, ex., paper clips or unifix cubes
- compares liquid measurement using milliliters and liters
- reads time units to 15-minute interval
- gives cent value up to a dollar
- gives date, month, and year
- compares liquid measure using pints, quarts, and gallons
- finds the perimeter of a polygon with manipulatives
- measures to nearest inch and centimeter

Geometry
- identifies:
  - spheres, cubes, cylinders, cones, lines, points, triangles, circles, squares, and rectangles
  - symmetry
  - and explore congruent shapes
  - similar shapes (square, rectangle, triangle, circle, polygons, cubes, cylinder, cones)
- locates ordered pairs on graph (find letter and number position)
- plots points of ordered pairs on graph

Statistics and Probability
- collects, organizes, and displays data on graphs and tables

Library Media

- uses the picture dictionary
- records information onto an audio tape
- distinguishes between fiction and nonfiction
- discovers how a book is made
- recognizes:
  - Caldecott Award winning picture books
  - fables as a type of folktale
  - fairy tales and their unique characteristics
  - read-aloud stories and the art of storytelling
- chooses materials within their reading ability and interest
- demonstrates care and use of computer hardware and software

Science

Life Science
- demonstrates awareness for Science and related careers
- uses safe laboratory procedures
- classifies animals with respect to characteristics and habitat
- understands interrelationships between man,

Second Grade Essential Skills & Content

animals, and environments
- investigates plants for size, shape, structure, propagation, needs uses, and their physical changes during life cycles
- recognizes interrelationships of plants and animals in food chains
- recognizes deserts, grasslands, fresh water ponds, saltwater bodies, and arctic regions
- distinguishes between living and non-living matter
- distinguishes between personal health and safety habits

Earth Science
- recognizes positive and negative influences of air and water to living things
- compares various environments
- identifies various energy sources and develop ideas for conservation
- identifies weather conditions typical of various seasons
- understands relationships of the sun, moon, planets, and other celestial bodies

Physical Science
- understands:
  - states of matter: liquids, solids, gases
  - nature of sound, how it is made, how it travels, and the different types of sound
  - nature of light, how it travels, and light as an energy source
- compares magnetism and electricity as forms of energy
- compares linear distances in centimeters, temperature in Celsius scale, volume in liters, and weight in grams.
- relates metric measures to everyday life

Technology
- communicates scientific results

Computer *(To Be Revised)*

- activates computer hardware
- inserts a disk for operation
- exits from a program

Social Studies *(neighborhood)*

History—Time, Continuity, Change & Heritage
- differentiates between past, present and future
- demonstrates awareness of impact of past and present upon the future
- links present and past with holidays, historical figures and events
- reads and discusses current events

Geography—People, Places, Environment & Culture
- locates areas shown on a map or globe—U.S., Montana, Helena
- becomes aware of distances between points on a map or globe
- distinguishes cardinal directions
- recognizes climates, land forms, and bodies of water
- recognizes differences in work, travel, lifestyle, and use of resources
- recognizes United States as a country/50 states/many communities
- becomes aware of communities large and small
- uses appropriate resources, data sources, and geographic tools such as atlases, data bases, grid systems, charts, graphs, and maps to generate, manipulate, and interpret information

Economics—Production, Distribution & Consumption
- recognizes needs and wants of families
- gains exposure to "Fire Prevention" unit
- becomes aware how technology affects the economy
- defines goods, services, supply and demand
- describes how community helpers are interdependent
- understands the need for and value of money to purchase goods and services
- distinguishes between goods and services

Citizenship—Civic Rights and Responsibilities;
Government—Power, Authority & Justice
- Understands:
  - purpose and value of laws
  - rights and responsibilities of citizens
  - neighbors work together
  - characteristics of the U.S. and the Montana flag
  - government processes and functions
- Understands that people share a government which provides services
- Identifies the President and Vice President

Sociology—Individuals, Groups & Institutions
- recognizes that each individual is unique
- notes differences in individuals and groups
- identifies his/her place in family, peer groups, neighborhood, and community
- recognizes leaders and followers in any social group
- recognizes diverse groups and their contributions
- recognizes reasons communities change
- identifies and describes the interactions of institutions
- works independently and cooperatively to

Second Grade Essential Skills & Content

accomplish goals

Physical Education

Demonstrates:
- basic skills of movement
- basic sport skills and team activities
- individual, dual, recreational and lifetime activities
- rhythms
- fitness/wellness
- safe play

Fine Arts

Music

Recognizes:
- rhythm
- pitch
- form
- texture/harmony
- time/tone color
- expressive qualities
- music enrichment units

Visual Arts

Recognozes:
- aesthetic perception
- visual heritage
- art production
- analysis, interpretation, and judgement

Theater
- demonstrates skills, attitudes and understanding

Health Education

Develops awareness of:
- personal health
- mental-emotional health
- use and misuse of alcohol and other drugs
- consumer health

Third Grade Essential Skills & Content

1995-96

Communication Arts

Reading: Word Identification (see handbook)

- reads high-frequency words
- identifies blends, digraphs
- identifies consonant variants
- identifies short/long vowel sounds and rules
- identifies irregular vowels and dipthongs
- identifies plurals (regular & irregular)
- identifies compound words, contractions, possessives
- substitutes beginning and ending consonants to make new words (rhyming)
- uses sentence structure and meaning to identify words
- breaks long words into identifiable parts
- identifies synonyms, antonyms and homonyms
- identifies syllables and rules
- recognizes basewords, prefixes, suffixes

Reading: Literature/Comprehension

- uses illustrations, photos, headings
- sets purpose for reading (pre-reading strategies)
- identifies main idea and supporting details
- identifies sequence of events
- identifies cause and effect
- makes inferences
- makes predictions
- compares and contrasts
- draws conclusions
- distinguishes between important/unimportant information
- summarizes and paraphrases
- recognizes literary genre
- rereads for better understanding
- recalls factual information
- identifies setting/plot/characters
- identifies problem/solution
- distinguishes fantasy and reality
- recognizes mood of story/characters
- explores author/illustrator opinion and intent
- utilizes punctuation for oral reading expression
- adjusts reading rate
- understands figures of speech (idioms)
- visualizes
- evaluates for fact or opinion

Writing: Process (K-5th Grade)

- participates in the modeled writing process
- selects topics for writing
- communicates in written language (thank you, invitation, note, friendly letter, stories and journals)
- locates a source of information in a library
- takes notes/records information using graphic organizers (mapping, webbing)
- makes mental and/or written plans for drafting
- writes down ideas as they flow
- writes ideas in sequence
- conferences with teacher for feedback in order to revise draft
- revises/edits written draft
- produces finished written products

Writing: Spelling/Grammar & Usage

- spells high frequency words
- spells plurals (regular and irregular)
- spells prefixes, suffixes
- spells words using consonant blends and diagraphs
- spells words using short/long vowels sounds
- spells common endings
- spells contractions, compound words, possessives
- spells words using irregular and dipthong vowels and consonant variants
- recognizes declarative, interrogative, exclamatory, imperative sentences
- uses correct punctuation (. ? ! date , " " ( ) ')
- uses capital letters (sentences, initials, and proper nouns)
- uses correct capital letters and punctuation for friendly letters and addresses
- recognizes nouns, verbs, pronouns, and adjectives
- recognizes complete and incomplete sentences
- recognizes correct word and sentence order
- develops a paragraph
- utilizes noun/verb agreement

Writing: Handwriting

- positions paper correctly
- displays proper posture
- writes numerals, manuscript, and cursive letters **legibly**
- spaces letters, words, sentences
- adapts handwriting to situation
- utilizes uniform sizes and formations

Speaking: Organization and Delivery (observable) K-5

- stays on topic and sequences ideas
- adjusts volume for the situation
- pronounces and enunciates words clearly
- regulates rate, tempo, and fluency of speech
- maintains appropriate tone
- uses appropriate facial expressions
- maintains eye contact
- maintains appropriate posture
- uses correct language
- uses complete sentences
- uses descriptive attributes

Third Grade Essential Skills & Content

Speaking/Listening: Strategies (observable) K-5

- follows oral directions
- takes turns in a group situation
- participates in group discussions
- reads literature with expression
- listens for a specific purpose
- responds to speaker: asks questions, contributes ideas appropriately
- adapts behavior to presentation
- displays appropriate listening position

Thinking: Creative Thinking Skills (observable) K-5

- brainstorms in a group
- categorizes ideas in lists
- elaborates on ideas
- generates many and varied responses
- contributes to class discussions

Mathematics

Problem Solving (see handbook)

- develops and applies stategies to explore:
  - guess and check
  - tables and charts
  - patterns
- solves problems in real-life situations
- checks reasonableness of answers
- uses calculators as a problem-solving tool
- uses strategies for computation (see handbook)
- simplifies, (eliminates irrelevant information)

Numeration

- counts, reads, and writes whole number words through four places
- compares equivalent and non-equivalent sets with whole numbers (> <)
- compares two whole numbers using the words: less than/greater than, 1 more, 1 less, equal to, to four places
- identifies ordinal positions to 20th
- identifies place values to four places
- gives expanded number for any set to four places
- gives standard number for four-digit number
- recognizes sequential patterns
- skip counts by 3's, 4's, and 5's
- identifies even and odd whole numbers to 100
- identifies 1/4, 1/3, 1/6, 1/8 for areas of a whole or for a set
- identifies fractions with numerators other than 1 (i.e., 2/3, 5/6)
- identifies models for 1/4, 1/3, 1/6, 1/8
- identifies and models to demonstrate fractions

Computation

- understands and uses the terms addition, subtraction, sum, difference, multiplication, product, division, quotient, divisor, dividend, and factors
- knows basic addition and subtraction facts through 18—vertical and horizontal
- adds and subtracts 4-digit numbers with and without trading
- knows multiplication facts through 9 x 9
- multiplies and divides 2-digit numbers by a 1-digit number without trading
- knows division facts through 5's
- divides a 2-digit number by a 1-digit number with no remainder
- rounds numbers to the nearest 10, 100
- understands the communicative property (1 + 2 = 2 + 1)
- understands the associative property (1 + 2) + 3 = 1 + (2 + 3)

Communication

- relates manipulatives, pictures, and diagrams to mathematical concepts
- discusses mathematical ideas in literature and all other content areas
- reads and expresses mathematics with understanding and expresses mathematical ideas in writing

Reasoning

- recognizes relationships between quantities
- justifies solutions using models, known facts, properties, relationships, and real-world experiences

Estimation

- explores estimation strategies
- determines reasonableness of results
- applies estimation in working with quantities, measurement, computation and problem-solving

Measurement

- understands and uses the terms penny, nickel, dime quarter, dollar, 1/4 and 1/2 hour, minutes, pound, ounce, temperature, degree, perimeter, area, linear, inch, foot, yard, and mile
- identifies meter, centimeter, liter, milliliter, kilogram, gram, Celsius, volume, mass
- counts and identifies square units (area)
- gives dollar value for bill/coin set
- gives change from $1.00
- compares coin values to dollar values
- reads calendar
- reads a thermometer
- identifies linear, volume, and mass units
- compares weight units—oz., lb.
- finds the perimeter of 3- and 4-sided figures

Geometry

- identifies 2- and 3-dimensional shapes, including spheres, cubes, cylinders, cones, lines, points, triangles, circles, squares, and rectangles

Third Grade Essential Skills & Content

- sorts and classifies everyday objects and physical materials
- identifies:
  - and explore symmetry (use manipulatives)
  - and explore congruency
  - open and closed figures
  - positional relationships (above, below, beside, horizontal, vertical, perpendicular)
  - lines, points, and segments (used to form squares, rectangles, and triangles)
  - and explores angles (right)
- locates ordered pairs on map or graph
- plots points for ordered pairs on graph

Statistics and Probability

- recognizes concepts and processes of statistics and probability

Library Media

- recognizes information from different viewpoints
- locates fiction and nonfiction books
- alphabetizes to the third letter
- uses a general dictionary
- organizes information
- recognizes tall tales and legends and their unique characteristics
- reads books about other cultures
- retreives information from video tapes/ video disks
- understands the concept of propaganda
- recognizes types of catalogue entries (author, title, etc.)
- compares information from various formats
- demonstrates care and operation of filmstrip projector
- demonstrates care and operation of TV and VCR

Science

Life Science

- continues to develop science and related careers
- observes life cycle of animals
- uses safe laboratory procedures
- observes life cycle of plants
- compares living and non-living things
- observes interaction between living things and their environment
- describes how man has affected the environment
- demonstrates personal health and safety

Earth Science

- observes and records data about weather conditions
- explores effects of weather
- investigates water cycle
- investigates natural forces on the earth's surface
- investigates the relationships of sun, moon and planets

Physical Science

- observes shadow changes by light source location
- classifies differences among liquids, solids, and gases
- applies the use of metric system
- constructs simple student-constructed machine
- analyzes effects of force on an object
- classifies and predicts sound vibrations and pitch
- discovers properties of magnets

Technology

- uses computer-based technologies

Computer *(To Be Revised)*

- activates computer hardware
- inserts a disk for operation
- exits from a program
- uses a mouse

Social Studies *(communities)*

History—Time, Continuity, Change & Heritage

- understands communities differ in size, place and origin and change over time
- develops awareness of Helena's historical leaders, places, and events
- reads and discusses current events

Geography—People, Places, Environment & Culture

- understands the way the physical environment affects life and work
- understands and locates city, county, state, region, nation, continent
- identifies land and water forms on a map
- distinguishes between towns, cities, states, countries and continents using maps
- uses major compass directions to locate points on a map and globe
- uses appropriate resources, data sources, and geographic tools such as atlases, data bases grid systems, charts, graphs, and maps to generate, manipulate, and interpret information

Third Grade Essential Skills & Content

Economics—Production, Distribution & Consumption
- recognizes the importance of barter and trade in the exchange of goods and services
- recognizes that technology changes careers
- understands values and limits of natural resources
- begins to understand taxation and its impact on community economy
- identifies the relationship between supply and demand and its effect on price of a product
- identifies the advantage of division of labor

Citizenship—Civic Rights and Responsibilities; Government—Power, Authority & Justice
- names main leadership positions (i.e. president, governor, mayor)
- explains the need for government in a society
- discusses responsibilities that individuals have in making a community better
- identifies how laws are established and how they relate to individuals, families and communities

Sociology—Individuals, Groups & Institutions
- recognizes that people are similar
- understands how people adapt to their environment
- understands that each individual has an effect and is affected by the rest of the world
- works independently and cooperatively to accomplish goals

Physical Education

Demonstrates:
- basic skills of movement
- basic sport skills and team activities
- individual, dual, recreational and lifetime activities
- rhythms
- fitness/wellness
- safe play

Fine Arts

Music
Demonstrates:
- rhythm
- pitch
- form
- texture/harmony
- timbre/tone color
- expressive qualities
- music enrichment units

Visual Arts
Demonstrates an awareness of:
- aesthetic perception
- visual heritage
- art production
- analysis, interpretation, and judgement

Theater
- Demonstrates skills, attitudes, and understanding

Health Education

Demonstrates awareness of:
- personal health
- mental-emotional health
- use and misuse of alcohol and other drugs
- consumer health

Fourth Grade Essential Skills & Content

1995-96

Communication Arts

Reading: Word Identification (see handbook)

- identifies plurals (regular & irregular)
- identifies possessives
- uses sentence structure and meaning to identify words
- breaks long words into identifiable parts
- identifies synonyms, antonyms and homonyms
- identifies syllables and rules
- recognizes base words, prefixes, suffixes, word clues

Reading: Literature/Comprehension

- uses illustrations, photos, headings
- sets purpose for reading (pre-reading strategies)
- identifies main idea and supporting details
- identifies sequence of events
- identifies cause and effect
- makes inferences
- makes predictions
- compares and contrasts
- draws conclusions
- distinguishes between important/unimportant information
- summarizes and paraphrases
- recognizes literary genre
- rereads for better understanding
- recalls factual information
- identifies setting/plot/characters
- identifies problem/solution
- distinguishes between fantasy and reality
- recognizes mood of story/characters
- explores author/illustrator opinion and intent
- utilizes punctuation for oral reading expression
- adjusts reading rate
- understands figures of speech (idioms)
- visualizes
- evaluates for fact or opinion

Writing: Process (K-5th Grade)

- selects purpose and audience
- participates in the modeled writing process
- selects topics for writing
- communicates in written language (stories, how-to, description, compare/contrast, report, persuasive, etc.)
- locates a source of information
- takes notes/records information using graphic organizers (mapping, webbing)
- makes mental and/or written plans (pre-write)
- composes sentences for paragraph unity (topic sentence/supporting details)
- writes down ideas as they flow
- writes ideas in sequence
- conferences with peers/teacher for feedback in order to revise draft
- revises/edits written draft
- produces finished written products

Writing: Spelling/Grammar & Usage

- spells high frequency and commonly misspelled words
- spells long and variant vowel words
- spells plural forms of regular/irregular nouns
- spells compound words
- spells frequently used homonyms
- applies spelling skills to written work
- recognizes declarative, interrogative, exclamatory, imperative sentences
- uses correct punctuation (. ? ! date , " ( ) ')
- uses capital letters
- recognizes nouns, verbs, pronouns, adjectives, and adverbs
- recognizes complete and incomplete sentences
- uses noun/verb agreement
- identifies topic sentence and supportive details
- writes clear, concise sentences

Writing: Handwriting

- positions paper correctly and displays proper posture
- writes numerals, manuscript, and cursive letters legibly
- spaces letters, words, sentences
- uses uniform sizes and formations

Speaking: Organization and Delivery (observable) K-5

- selects and stays on topic
- pronounces and enunciates words clearly
- regulates rate, tempo, volume, tone and fluency of speech
- maintains appropriate posture, gestures and eye contact
- uses complete sentences and correct language

Speaking/Listening: Strategies (observable) K-5

- follows oral directions
- takes turns and participates in a group situation
- reads literature with expression
- listens for a specific purpose
- responds to speaker: asks questions, contributes ideas
- adapts behavior to presentation
- displays appropriate listening position

Mathematics

Problem Solving (see handbook)

- develops and applies strategies to explore:
  - makes and uses tables, charts, and graphs
  - makes a list
  - uses guess and check
  - finds a pattern
  - draws and uses pictures or diagrams
  - makes and uses models
  - chooses the operation
  - writes a number sentence/equation
  - uses estimation
  - acts out the problem
  - works backward
- recognizes, formulates, and solves problems in mathematical and real-life situations
- checks reasonableness of answers
- uses calculators as a problem-solving tool

Numeration

- counts, reads, and writes whole number words through nine places

Fourth Grade Essential Skills & Content

- compares equivalent and non-equivalent sets with whole numbers (> <)
- compares two whole numbers using the > < symbols up to six-digit numbers
- identifies place value of whole numbers through nine places
- gives expanded number for any number to five digits
- recognizes sequential patterns
- recognizes equal parts
- identifies 1/2, 1/3, 1/4
- develops awareness of concepts of fractions, mixed numbers, and decimals using models
- develops number sense for fractions and decimals using models
- applies fractions and decimals to real-world situations

Computation

- understands and uses the terms addition, subtraction, multiplication, division, equal, sum, difference, product, quotient, divisor, dividend, multiplier, multiplicant, and factors
- internalizes whole number addition, subtraction, multiplication, and division facts to ten
- adds and subtracts two 6-digit whole numbers with and without grouping
- multiplies 4-digits by 1 and 2 digits with and without grouping (models these problems)
- models division of 1-digit problems with and without a remainder
- uses written symbols to compute the division algorithm
- models division with a 2-digit divisor
- uses models to explore operations on fractions and decimals
- applies fractions and decimals to problem situations
- rounds to the nearest ten, hundred, and thousand
- uses commutative property (a + b = b + a)
- uses associative property (a + b) + c = a + (b + c)

Communication

- shows how manipulatives, pictures, and diagrams relate to mathematical concepts
- applies mathematical ideas in all other content areas
- reads, expresses and writes mathematics with understanding

Reasoning

- understands relationships between quantities
- justifies thinking with manipulatives

Estimation

- determines reasonableness of results
- applies estimation in working with quantities, measurement, computation and problem-solving

Measurement

- uses non-standard units of measure (i.e. paper clips or unifix cubes)
- uses metric units
  - measures to the nearest millimeter
  - estimates length (millimeter to meter)
  - estimates volume units (milliliter to liter)
  - estimates mass units (grams to kilogram)
  - models the area of a square and a rectangle
  - models volume
  - uses a written formula to solve perimeter
- uses non-metric units
  - reads time to the nearest 1/4 hour
  - gives change from $5.00
  - gives date, month, and year in a mathematical expression
  - finds the area/perimeter of a square and a rectangle
  - reads temperature

Geometry

- describes, models, draws, and classifies 2- and 3-dimentional shapes
- investigates and predicts results of combining, subdividing, and changing shapes
- sorts and classifies everyday objects and physical materials
- explores:
  - symmetry (use manipulatives)
  - congruent shapes
  - similar shapes—polygons, cubes, spheres, cylinders, circles, cones, triangles
  - open and closed figures
  - positional relationships (above, below, beside, horizontal, vertical)
  - lines, points, and segments (rays)
  - angles (acute, right, and obtuse)
- draws points and ordered pairs on a graph

Statistics and Probability

- interprets graphs and tables
- collects, organizes, and displays data by researching and constructing graphs and tables
- uses data to make and check predictions

Library Media

- examines the accuracy of print and non-print materials
- recognizes prejudice and stereotype in print and non-print materials
- determines the usefulness of print and non-print materials by assessing the relevancy and considering the copyright date
- identifies key words as indicators for locating information in an encyclopedia
- practices using guide words for efficient information retrieval
- distinguishes between headings and subheadings while locating information in a general encyclopedia
- uses an index in a general encyclopedia as a source of information
- demonstrates ability to locate information in a telephone directory
- becomes aware of the services of Lewis and Clark Library
- identifies information on catalogue record
- identifies and utilizes parts of a bok to locate information
- paraphrases information from a single source
- demonstrates appropriate online etiquette
- determines appropriate media format for presentation of information, recognizing the advantages of video or camera production, an overhead transparency, a graphic display, and a multimedia presentation

Fourth Grade Essential Skills & Content

- retrieves information from CD-ROM format
- retrieves information through telecommunications (online services)
- retrieves information from multimedia format
- demonstrates proper use and care of an overhead projector and a projection panel
- demonstrates proper use and care of camcorder

Science

Life Science

- continues to develop awareness of science and related careers
- recognizes the life cycles of animals
- develops respect for classroom equipment and uses safe laboratory procedures
- classifies conditions necessary for plant growth
- investigates the interaction between living things and their environments
- classifies the structure and function of various systems of living organisms
- examines how man has affected the environment in which he lives
- demonstrates effective personal health and safety habits

Earth Science

- observes and interprets weather conditions
- builds student-constructed weather instruments
- explores factors that affect weather conditions
- investigates the components of the water cycle
- reports the effects of natural forces on the earth's surface
- investigates predictable patterns in the universe
- discovers the relationships between the sun, moon and planets
- manipulates rocks and minerals and their properties
- classifies features of oceans

Physical Science

- interprets and gathers data about liquids, solids and gases
- measures and records data using the metric system and applies it to daily life
- experiments with the construction and use of simple machines
- observes the effects of forces on an object and records experimental data
- classifies, experiments and analyzes sound, vibrations and pitch
- analyzes and predicts the properties of magnets, and records the results
- predicts and measures electrical current; observes, then interprets, the results
- investigates and observes static electricity phenomena; records the observations
- experiments with mixtures and compounds; records and analyzes solutions
- discusses aerodynamics

Technology

- uses computer-based technologies

Computer *(To Be Revised)*

- knows the proper care, handling and usage of equipment
- uses proper finger placement
- demonstrates proper posture during keyboarding
- knows how to keyboard at a rate of 15 words per minute
- demonstrates the ability to use software and hardware appropriately
- composes, edits, and prints an assignment, meeting standards set by the classroom teacher
- saves and retrieves data

Social Studies *(Montana/US Regions)*

History—Time, Continuity, Change & Heritage

- is aware of prehistory development of Montana including the dinosaurs and the American Indian immigration to the North American Continent
- identifies lifestyles of differing Indian tribes in Montana (including shelter and means of survival)
- recognizes and identifies the state symbols (flag, seal, bird, tree, animal, and flower)
- identifies famous Montanans by indicating their historical place in Montana History including geographical location and personal contribution
- understands general historical perspective of the regions of the United States

Geography—People, Places, Environment & Culture

- uses maps and globes to differentiate between physical and geographical regions
- names the regions and identifies their natural resources, various land forms and major rivers
- recognizes and locates cities of Montana
- begins to use and understand map scales
- locates self in relation to familiar places, using position words and/or cardinal directions
- understands a map or globe as a representation of part or all of Earth (including continents, oceans, etc.)
- identifies state, national, and other boundary lines
- identifies the equator on globes and maps (tropics, artic regions)
- identifies a globe as a model of the Earth
- uses latitude and longitude to locate places on map or globe

Sociology—Individuals, Groups & Institutions

- compares ethnic groups in the state
- compares how groups of people use their technology to adapt to a variety of different environments

Economics—Production, Distribution & Consumption

- relates concept of supply and demand to Montana mining period
- researches various careers through community resources
- identifies major industries and explains the effects of natural resources on major industries in Montana
- recognizes that as technology changes so do the ways that people in a community or region earn a living

Fourth Grade Essential Skills & Content

Citizenship—Civic Ideals and Practices; Government—Power, Authority & Justice

- Compares the three branches of Montanta state government
- identifies competitive situations
- recognizes the contributions of different individuals and groups in the United States
- identifies, uses, and supports voting and majority rule as a method of making group decisions

Skill Development

- uses materials such as newspapers, magazines, atlases, and encyclopedias related to subject matter
- continues development of social studies vocabulary
- uses various forms of media and books for research
- identifies map symbols used for various physical features
- reads and interprets graphs and diagrams
- locates state on a U.S. map
- is aware of current issues
- summarizes data presented
- compares and contrasts information on a chart or graph with that learned from other sources
- writes summaries or reports

Physical Education

Demonstrates:

- basic skills of movement
- basic sport skills and team activities
- individual, dual, recreational and lifetime activities
- rhythms
- fitness/wellness
- safe play

Fine Arts

Music

Demonstrates:

- rhythm
- pitch
- form units
- texture/harmony
- timbre/tone color
- expressive qualities
- music enrichment

Visual Arts

- perception
- visual heritage
- art production
- analysis, interpretation, and judgement

Theater

- Demonstrates skills, attitudes, and understanding

Health Education

Demonstrates awareness of:

- personal health/wellness
- mental-emotional health
- use and misuse of alcohol and other drugs
- consumer health
- nutrition

Fifth Grade Essential Skills & Content

1995-96

Communication Arts

Reading: Word Identification (see handbook)

- reads high-frequency words
- uses short/long vowel sounds and rules
- uses irregular vowels and dipthongs
- uses plurals (regular & irregular)
- uses compound words, contractions, possessives
- uses sentence structure and meaning to identify words
- breaks long words into identifiable parts
- identifies synonyms, antonyms, homonyms and homophones
- uses syllables and rules
- uses basewords, prefixes, suffixes

Reading: Literature/Comprehension

- uses illustrations, photos, headings
- sets purpose for reading (pre-reading strategies)
- identifies main idea and supporting details
- identifies sequence of events
- identifies cause and effect
- makes inferences
- makes predictions
- compares and contrasts
- draws conclusions
- distinguishes between important/unimportant information
- summarizes and paraphrases
- recognizes literary genre
- rereads for better understanding
- recalls factual information
- identifies setting/plot/characters
- identifies problem/solution
- distinguishes fantasy and reality
- recognizes mood of story/characters
- explores author/illustrator opinion and intent
- utilizes punctuation for oral reading expression
- adjusts reading rate
- understands figures of speech (idioms)
- visualizes
- evaluates for fact or opinion

Writing: Process (K-5th Grade)

- participates in the modeled writing process
- selects topics for writing
- communicates in written language (interviews, advertisements, letter writing, journals, stories, steps in a process, scripts, poetry, completes forms)
- locates a source of information in a library/multi-media
- takes notes/records information using graphic organizers (mapping, webbing)
- makes mental and/or written plans for drafting
- writes down ideas as they flow
- writes ideas in sequence
- conferences with teacher/peers for feedback in order to revise draft
- revises/edits written draft
- produces finished written products

Writing: Spelling/Grammar & Usage

- spells in written context:
  - high frequency words and frequently misspelled words
  - plurals (regular and irregular)
  - prefixes, suffixes
  - common endings
  - contractions, compound words, possessives
  - words using irregular and variant vowels - consonant variants
- uses and recognizes declarative, interrogative, exclamatory, imperative sentences
- uses correct punctuation (. ? ! date , " " ( ) ' : -)
- uses capital letters (sentences, initials, proper nouns and titles)
- uses nouns, verbs, pronouns, and adjectives
- recognizes complete and incomplete sentences
- uses correct form for letters
- uses correct word and sentence order
- develops a paragraph
- uses correct noun/verb agreement

Writing: Handwriting

- writes numerals, manuscript, and cursive letters legibly
- spaces letters, words, sentences
- uses uniform sizes and formations

Speaking: Organization and Delivery

- stays on topic and sequences ideas
- adjusts volume for the situation
- pronounces and enunciates words clearly
- regulates rate, tempo, and fluency of speech
- maintains appropriate tone
- uses appropriate facial expressions and appropriate gestures
- maintains eye contact
- maintains appropriate posture
- uses complete sentences and descriptive attributes
- uses visual aids and props

Speaking/Listening: Strategies

- follows sequence of ideas and information
- takes turns in a group situation
- participates in group discussions
- listens for a specific purpose
- responds to speaker: asks questions, contributes ideas appropriately
- adapts behavior to presentation
- listens for:
  - propaganda
  - fact or opinion
  - emotional appeals
  - speaker bias
  - topic or main idea
- predicts:
  - outcomes in speeches in oral presentations
  - possible test questions

Mathematics

Problem Solving

- estimates for reasonableness of answer (use estimation strategies)
- chooses the appropriate operation
- develops and applies strategies to explore:
  - guess and check
  - tables and charts
  - patterns

Fifth Grade Essential Skills & Content

- models
- writes an equation (number sentence)
- eliminate & simplify
- working backwards

- applies strategies to explore a wide variety of mathematical situations
- checks reasonableness of answers
- uses calculators as a problem-solving tool

Numeration

- determines place value through 10 places
- compares greater than and less than (> <) to 9 places
- writes numbers in expanded notation form to the millions place value
- recognizes sequential patterns
- recognizes equal parts
- identifies 1/2, 1/3, 1/4, 1/6, 1/8
- experiences concepts of fractions, mixed numbers, and decimals using models
- experiences number sense for fractions and decimals using models
- applies and compares equivalent numbers in various forms
- compares the decimal system with other number systems (hieroglyphics and Roman Numerals)
- uses concrete materials and representational models to help in the transition from whole numbers to other number sets

Computation

- represents values on one- and two-dimensional graphs (x and y axis)
- compares the equivalency for fractions, ratios, decimals, percents, and proportions
- applies fractions, ratios, and decimals
- arranges a set of numbers in numerical order
- demonstrates that addition and subtraction as well as multiplication and division are inverse operations
- demonstrates that multiplication is repeated addition and division is repeated subtraction
- multiplies 4 digits by 1 and 2 digits with and without regrouping
- demonstrates 1 digit division problems with and without remainder
- uses written symbols to compute the division algorithm
- recognizes division with a 2-digit divisor
- uses manipulatives to explore operations on fractions and decimals
- applies fractions and decimals in problem solving situations
- rounds to the nearest ten, hundred, thousand, tenths, hundredths, thousandths
- uses commutative property (a + b = b + a)
- uses associative property (a + b) + c = a + (b + c)
- demonstrates simple calculations
- investigates other interest topics (perfect numbers, square numbers, cubes, palindromes, and factorials)

Communication / Reasoning

- shows how manipulatives, pictures, and diagrams relate to mathematical concepts
- verbalizes and writes mathematical ideas
- uses appropriate mathematical notation and symbols
- connects mathematical concepts with other school subjects and real-life situations
- generalizes and hypothesizes in the appropriate situation
- responds to "why" and "what if" questions

Estimation

- estimates for reasonableness of computation by using estimation skills
- chooses appropriate estimation strategies:
  - rounding
  - truncating (front-end estimation)
  - compatible numbers
  - nice numbers
  - computes and estimates money transactions

Measurement

- makes and interprets scale drawings
- uses non-standard units of measure
- uses metric units
  - measures to the nearest millimeter
  - estimates length (millimeter to meter)
  - estimates volume units (milliliter to liter)
  - estimates mass units (grams to kilogram)
  - models the area of a square, rectangle and triangle
  - models volume
  - reads temperature
- uses non-metric units
  - gives date, month, and year in a mathematical expression
  - finds the area/perimeter of a square and a rectangle
  - reads temperature
  - measures foot, yard, mile

Geometry

- describes, models, draws, and classifies 2- and 3-dimensional shapes
- sorts and classifies everyday objects and physical materials
- explores:
  - symmetry (use manipulatives)
  - congruent shapes
  - similar shapes—polygons, cubes, spheres, cylinders, circles, cones
  - open and closed figures
  - positional relationships (slide, flip, turn)
  - lines, points, and segments (rays)
  - angles (acute, right, and obtuse)
- draws points and ordered pairs on a graph

Statistics and Probability

- interprets graphs and tables
- collects, organizes, and displays data by researching and constructing graphs and tables
- uses data to make and check predictions

Library Media

- narrows the topic to be researched
- develops a statement of purpose or thesis statement
- formulates questions which give guidance to research
- identifies appropriate sources of information
- follows a research process and a specified research plan
- understands the organization of the Dewey Decimal System

Fifth Grade Essential Skills & Content

- differentiates between key word and browsing strategies in electronic searches
- utilizes an established method of note-taking
- defines plagiarism and recognizes the legal implications
- recognizes the significance of the Newbery Award and Young Reader's Choice Award and uses these titles for possible reading selections
- determines and prioritizes information sources
- utilizes the thesaurus, atlas and almanac
- organizes information in an outline
- presents information in a written report
- determines appropriate media format for presentation of information, recognizing the advantages of computer graphics and word processing
- recognizes characteristics of historical fiction

Science

- continues to develop interest in science and related careers
- develops respect for classroom equipment and use safe laboratory procedures
- demonstrates the use of computer-based technologies as a tool that scientists use

Life Science

- investigates the life cycles of animals
- investigates photosynthesis
- compares the interaction between living things and their environments
- identifies the structure and function of various systems of living organisms
- analyzes how humans have affected the environment in which he lives
- demonstrates effective personal health and safety habits
- uses scientific classification or animals

Earth Science

- interprets collected data about weather conditions
- forecasts weather using student-constructed instruments
- compares factors that affect weather conditions
- experiments with components of the water cycle
- investigates the effects of natural forces on the earth's surface
- explores predictable patterns in the universe
- investigates the relationships between constellations and stars
- identifies rocks and minerals and their properties
- distinguishes features of oceans

Physical Science

- compares and analyzes liquids, solids and gases
- applies the use of the metric system
- observes and experiments with light and color
- compares and maximizes the application of a student-constructed simple machine
- applies the effects of forces on an object, analyzing and recording those effects
- experiments with sound, vibrations and pitch, measuring and recording
- applies the properties of magnets
- predicts and explores electrical current; analyzing the effects
- predicts and observes static electricity phenomena
- predicts and observes mixtures and compounds

Computer *(To Be Revised)*

- develops keyboarding techniques
- develops and expands upon word processing skills
- applies word processing skills for a variety of purposes
- demonstrates the ability to use computer graphics/ word processing in presenting information

Social Studies (United States explorers through Civil War)

History—Time, Continuity, Change & Heritage

- develops an overview of the main periods and trends in American history through the Westward Movement
- states reasons for and outcome of exploration of the nation
- traces the settlement and early development of the nation through the earlier Western Movement (to 1870s)
- understands that America has enlarged her boundaries through purchase, conflict, treaty and annexation
- outlines the major historical events, people and documents that played a significant role

Geography—People, Places, Environment & Culture

- recognizes map functions by utilizing map reading skills
- understands map scales and symbols
- compares and contrasts the state regions of the U.S.
- identifies and labels the fifty states and their capitals
- relates the influence of geography upon the growth and location of American cities
- reinforces and locates the seven continents and four major oceans using a globe and a world map
- develops an understanding of global differences by climate, landforms, and natural resources

Citizenship—Civic Rights and Responsibilities; Government—Power, Authority & Justice

- recognizes the privileges and responsibilities of citizens living in a democracy
- explains the development, organization, and function of our national government

Economics—Production, Distribution & Consumption

- recognizes that geography affects occupations of people
- understands the effects of regional economy to national economy and to world economy

Sociology—Individuals, Groups & Institutions

- demonstrates an awareness of the cultural similarities and differences that exist in the nation
- aquires an awareness for individual rights, privileges, and responsibilities
- demonstrates that American society is characterized by ethnic diversity
- identifies reasons for the movement and migration of people

Fifth Grade Essential Skills & Content

Skill Development

- places events in chronological order
- begins to determine points of view
- begins to take notes from reading materials
- compares and contrasts information from a variety of resources
- extends skills in locating and compiling information
- continues to build social studies vocabulary
- utilizes the functions and importance of a variety of maps and map-like diagrams, time lines, grids, graphs and compass
- continues to identify the major components of any map (longitude, latitude, scale and symbols on legends)
- expands the use of various resources for research
- understands and identifies cause and effect in an historical context

Physical Education

Demonstrates:

- basic skills of movement
- basic sport skills and team activities
- individual, dual, recreational and lifetime activities
- rhythms
- fitness/wellness
- safe play

Fine Arts

Music

Demonstrates:

- rhythm
- pitch
- form
- texture/harmony
- timbre/tone color
- expressive qualities
- music enrichment units

Visual Arts

Demonstrates an awareness of:

- perception
- visual heritage
- production
- analysis, interpretation, and judgement

Theater

- Demonstrates skills, attitudes, and understanding of theater

Health Education

Demonstrates awareness of:

- personal health
- mental-emotional health
- use and misuse of alcohol and other drugs
- consumer health
- nutrition

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