A STUDY OF THE RELATION BETWEEN TWO METHODS OF ELEMENTARY SCHOOL MATHEMATICS INSTRUCTION AND CHILDREN'S ATTITUDES TOWARD MATHEMATICS

A thesis submitted in partial satisfaction of the requirements for the degree of Master of Arts in Education by

Brenda Iris Rudín

June, 1977
The Thesis of Brenda Iris Rudín is approved:

California State University, Northridge
To Adam and Brian,
in fond recollection of countless things
as feeding ducks together in the park.
ACKNOWLEDGEMENTS

I appreciate the guidance and assistance given to me by Ed Labinowich, Linda Jones and VanDyk Buchanan.

I thank Bob for his encouragement and patience.

I thank myself for getting it done.
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ABSTRACT

A STUDY OF THE RELATION BETWEEN TWO METHODS OF ELEMENTARY SCHOOL MATHEMATICS INSTRUCTION AND CHILDREN'S ATTITUDES TOWARD MATHEMATICS

By

Brenda Iris Rudin

Master of Arts in Education

The major problem of this study was to investigate the relation between two methods of teaching mathematics (a manipulative materials approach and a traditional approach) and attitudes of elementary school children toward mathematics. The relation between sex, grade level and mathematics attitudes of the children were also investigated.

The subjects were third and sixth graders from two schools matched for socioeconomic level and ethic make-up. A revised version of Dutton's mathematics attitude scale was administered to the children by the researcher. An attitude index between zero and twenty was given to each of the randomly selected questionnaires.
T-tests between two independent groups revealed evidence of
differences in mathematics attitudes between the students exposed
to two different methods. Significant differences in mathematics
attitudes between the third-grade students and the sixth-grade
students from both schools were also found. This study did not
reveal sufficient evidence for the rejection of the null hypotheses
relating to sex differences in mathematics attitude. Chi square
tests were performed to determine if differences between groups in
the distribution of responses on the attitude questionnaire differed
from chance (p<0.05). Only four statements revealed significant
chi square scores.

The researcher recommends an experimental study be conducted,
matching schools for achievement as well as socioeconomic status
and ethnic make-up, and controlling for method of instruction.
CHAPTER I

INTRODUCTION

Statement of the Problem

There have been many changes in the past twenty-five years in the teaching of mathematics. A major development in this period has been the advent of methods which recognize children's developmental needs for experience with physical materials in developing mathematical concepts. Despite these changes, the scores on mathematics achievement tests have dropped (Glennon, 1976). Since a child's attitude can affect his achievement (Neale, 1969), there is a concern to determine children's current attitudes toward mathematics and how more favorable attitudes can be developed.

The major problem of this study is to investigate the relation between two methods of teaching mathematics (a manipulative materials approach and a traditional approach) and attitudes of elementary school children towards mathematics. The relation between sex and grade level of the children will also be investigated.
Background and Significance of the Study

Educators are concerned with attitudes of children toward mathematics because of findings which have established a relationship between mathematics attitude and achievements. Daniel Neale (1969) pointed out that not only do attitudes affect achievement but the reverse is true - achievement affects attitudes.

Students' attitudes toward mathematics appear to be related to the attitudes and abilities of their parents and teachers (Poffenberger & Norton, 1959; Dutton, 1954). Marshall Stone (1959) says that today's "mathematically ill-prepared" and "ill-disposed" teachers are infecting their students with fear and dislike of mathematics that can rarely be overcome. If children see mathematics as a subject that adults find distasteful and frustrating, it is inevitable that such attitudes will be transmitted to children (Wirtz, 1976).

Bassham, Murphy and Murphy, (1964) have found that a person with a favorable attitude toward mathematics will learn more readily than will a person with an unfavorable attitude. Since studies show that attitude affects achievement, different teaching techniques for improving attitudes toward mathematics should be sought. The use of manipulative materials in the teaching of mathematics demonstrates potential in creating more favorable attitudes toward mathematics.

It would be of value to educators to know whether there is a relation-
ship between the use of manipulative materials and children's attitudes toward mathematics.

A revised version of Dutton's attitude scale (Dutton, 1954) which was used by Stright (1960) was employed in this study to measure attitudes toward mathematics of third- and sixth-grade students from a school which readily uses manipulative materials in the teaching of mathematics and third- and sixth-graders from a school that employs a traditional approach in the teaching of mathematics. The third-graders were chosen to take part in this study because Virginia Stright (1960) found that definite attitudes toward mathematics have developed by the third-grade. Sixth-graders were chosen because at each grade level mathematics gets progressively more demanding, and the researcher is interested in determining whether changes in attitudes toward mathematics are reflected in this increasing complexity.

Hypotheses

1. There is no significant difference in mathematics attitudes between students in a school that uses manipulative materials and those in a school that does not.

2. There is no significant difference in mathematics attitudes between third-grade students and sixth-grade students in a school that uses manipulative materials.
3. There is no significant difference in mathematics attitudes between third-grade students and sixth-grade students in a school that does not use manipulative materials.

4. There is no significant difference in mathematics attitudes between third-grade boys and third-grade girls in a school that uses manipulative materials.

5. There is no significant difference in mathematics attitudes between third-grade boys and third-grade girls in a school that does not use manipulative materials.

6. There is no significant difference in mathematics attitudes between sixth-grade boys and sixth-grade girls in a school that uses manipulative materials.

7. There is no significant difference in mathematics attitudes between sixth-grade boys and sixth-grade girls in a school that does not use manipulative materials.

Definition of Terms

An attitude is an expressed liking or disliking of a particular subject.

Manipulative materials are objects or things that the pupils are able to feel, handle and move; materials that appeal to several senses and are characterized by a physical involvement of the pupil in active learning situation (Reys, 1971).
A manipulative materials approach to teaching mathematics is a method which uses manipulative materials.

The traditional approach to teaching mathematics consists of mathematical concepts presented to the whole class by the teacher. The students memorize the information presented by the teacher and participate in periods of repetitive practice to master basic skills (Schminke, Maetens & Arnold, 1973).
CHAPTER II

REVIEW OF THE LITERATURE

During the past twenty-five years, there has been a plethora of studies concerned with attitudes toward mathematics. The major topics of those studies include: the methods of measuring attitudes toward mathematics, the distribution and stability of mathematics attitudes, the sex differences in attitude toward mathematics, the effects of attitudes on achievement in mathematics, and the relationships of mathematics attitudes to parental attitudes and expectations, and teacher attitudes and characteristics. In addition to reviewing studies in the above areas, a discussion of the use of manipulative materials in teaching mathematics and studies dealing with the relation of the use of these materials and mathematics attitudes will also be reviewed.

Methods of Measuring Attitudes Toward Mathematics

There are a number of techniques for measuring attitudes toward mathematics: 1) observational methods, 2) interviews, and 3) self-reports (questionnaires, attitude scales, etc). This literature review will only include studies using attitude scales and questionnaires.
A popular measure of attitudes is the Likert attitude scale (Aiken, 1972). In Likert's method of summed ratings, the respondent indicates whether he strongly disagrees, disagrees, is undecided, agrees, or strongly agrees with each statement expressing a positive or negative attitude toward something. The score on the scale is the sum of the weights (successive integers, usually 1, 2, 3, 4 and 5) which have been assigned to the particular responses made by the respondent. A high score usually indicates a more positive attitude toward the particular topic of the scale.

The scale of attitudes toward mathematics which has probably been used more than any other is Dutton's scale (Dutton, 1954). It consists of a number of statements expressing positive and negative attitudes toward mathematics. Originally constructed to measure the attitudes of prospective elementary teachers, it has been administered to junior high school students (Dutton, 1968). The reliability of Dutton's scale was found to be 0.94 (Dutton, 1954). After a careful study of many scales, and after many trials with small groups of children, a revised version of Dutton's Attitude Scale was used successfully with third graders in Stright's study (Stright, 1960).

Grade Distribution and Stability of Attitudes

Stright (1960) found evidence that very definite attitudes toward mathematics seem to be formed by the third grade. These attitudes were mostly positive. In the attitude survey by Capps
and Cox (1969) of school subjects most preferred by fourth and fifth graders, it was found that mathematics was given a median rank when the subjects were ranked from the least to the most liked. There was a decline from the third to the sixth grade in the number of students expressing negative mathematics attitudes in Stright's study (1960).

Very little information is available concerning the grade level at which a lasting attitude toward mathematics develops. In a retrospective study by Dutton (1954), prospective teachers were asked to estimate when they developed their feelings (good or bad) toward mathematics. Student responses indicated that the third through the sixth grades were the main years when their feelings toward mathematics had developed.

Attonen (1969) did examine the stability of mathematics attitudes in his longitudinal study. In the spring of 1960, a mathematics attitude inventory was administered to fifth and sixth graders in St. Paul, Minnesota. Six years later, the attitude inventory was readministered to a portion of the same group of students when they were in the eleventh and twelfth grades. The correlation between mathematics attitudes in the elementary school and high school was found to be 0.305, a low positive correlation.

Although it is possible to measure attitudes toward mathematics as early as the third grade, such attitudes are reported to be rather unstable (Stright, 1960). The reason for this may be that the
degree of self-insight and consciousness with which students can express their attitudes increases with age (Aiken, 1972).

Sex Differences in Attitudes Toward Mathematics

Boys have traditionally been viewed as better achievers in mathematics than girls (Stright, 1960). The results of Stright's questionnaire showed that elementary school girls liked mathematics more than elementary school boys. On the other hand, Dutton (1968) found that junior high school boys and girls who studied the "new math" were about equal in their liking for mathematics. More recently however, Hilton and Berglund (1974) found at grade five no significant differences in achievement between boys and girls in mathematics. After grade five, however, boys pulled ahead of the girls in achievement as well as interest towards mathematics.

Relationship of Attitude to Achievement in Mathematics

There is a great concern about a student's attitude toward mathematics probably because it is thought to affect his performance in mathematics in some way. According to Neale (1969), not only do attitudes affect achievement, but achievement also affects attitudes. Although some findings have not been in agreement (Travers, 1973) there seems to be a low positive correlation between pupil attitudes toward mathematics and pupil achievement in mathematics (Bassham et al., 1964). This general trend between mathematics achievement and mathematics attitude was observed in twelve countries at all grade levels.
(Hušen, 1967). More recently, Aiken (1972) found the correlation between attitudes and achievement seemed to be higher for mathematics than for other school subjects with more verbal content.

**Relationship of Mathematics Attitude to Parental Attitude and Expectation**

Parental attitudes toward mathematics are of key importance in shaping their children's attitudes (Wirtz, 1976). For the most part, children do not see adults engage in mathematics as a pleasurable activity. "Recreational mathematics" is not an everyday part of life as is reading. If children see mathematics as something their parents dislike and find frustrating, it is very likely that these negative attitudes will be transmitted to the children (Wirtz, 1976).

Poffenberger and Norton (1959) found that parents affected their child's attitude and performance in mathematics by 1) parental expectations of their child's achievement, 2) parental encouragement, and 3) the parents' own attitudes. Almost four hundred University of California freshmen filled out a questionnaire concerning their own attitudes toward mathematics and their perceptions of the attitudes and expectations their parents had toward mathematics. It was found that the students' attitudes toward mathematics was related to how they rated their fathers' attitudes toward mathematics. Sixty percent of the fathers who were reported as liking mathematics had children who liked mathematics; whereas seventy-eight percent of the fathers who were reported as having disliked mathematics had
children who disliked mathematics. Poffenberger and Norton chose not to run this data on the mothers of the students because it seemed that only a small number of the mothers were reported by their children as having liked mathematics.

In Jon Hill's study (1967), the fathers and mothers of thirty-five upper-middle class boys were interviewed. A questionnaire concerned with mathematics attitudes was administered to the sons. Hill found the ratings of maternal attitudes toward mathematics to be significantly related to the sons' \( r = 0.39, p<0.05 \). It was also found that the correlation between maternal expectations and sons' attitudes were nonsignificant, but paternal expectations and sons' attitudes were significantly related \( r = 0.37, p<0.05 \).

Relationship of Mathematics Attitude to Teacher Attitudes and Characteristics

Teachers' attitudes and effectiveness in mathematics are very important determinants of student attitudes and performance in mathematics. The teacher who feels insecure and dislikes mathematics "cannot avoid transmitting her feelings to the children." (Banks, 1959 p.17).

Dutton's study (1954) supports the statement by Banks about teachers' effectiveness. In his study of attitudes of prospective teachers, Dutton provided space on the questionnaire for the students...
to write their reasons for liking or disliking mathematics. One of the main reasons for these college students disliking mathematics was "poor teachers who punished or used inadequate methods" (p.28).

**Manipulative Materials in Learning Mathematics**

Teachers in the past quarter century concerned with the mathematical achievement of their students have directed their attention to helping them develop an understanding of the structure of mathematics. Some of these teachers have begun to use mathematical instruction based on the personal investigations and discoveries of their students. It is believed that investigations of the environment will be more beneficial than didactic teaching methods in building interest for and confidence in mathematics (Kidd, Meyers, and Cilley, 1970).

This approach to teaching mathematics is not new. Educators have been advised since 1855 to use manipulative materials in teaching mathematics but only recently has it become a reality (Brousseau, 1973). Psychologists have studied the effects of the manipulative approach on achievement, retention, attitude and transfer of mathematical concept.

The results of psychological studies by Jean Piaget about the way in which children learn are affecting the way in which children are being taught. Piaget advocates the use of manipulative materials (Reys & Post, 1973).
Jean Piaget believes that a child must experiment for himself, try things out to see what results, manipulate objects and symbols, ask questions, find his own answers and compare his finding with those of other children (Duckworth, 1964). He emphasizes that you cannot further a child's understanding simply by talking to him (Copeland, 1974). Symbolic or verbal instruction is meaningless unless the symbolism is related to something real or concrete (Biggs, 1963). Knowledge to the child is primarily what he can construct internally from actions he performs on concrete materials (Copeland, 1974). Lack of experience with concrete objects, Piaget feels, leads to inadequate mental operations and inadequate development of the abstractions required for more advanced mathematics (Pulaski, 1971).

Over the years a great deal of research in mathematics education has focused on practical questions such as whether a manipulative approach to instruction results in greater achievement and more positive attitudes than a teacher-centered, expository, traditional approach. A review of the literature apparently indicates nothing conclusive at the present time.

J. Biggs compared three manipulative methods with traditional methods of teaching mathematics in the elementary school. It was found that boys with high I. Q.'s fared better on understanding, motivation and attitude under the manipulative materials approach than under the traditional method (Kieren, 1969).
Similar results were obtained by Jonathan Knaupp (1971) when he measured the achievement and attitudes of second graders toward specific activities used during arithmetic instruction. Children were assigned to either a manipulative or teacher-centered mode of instruction. Knaupp found that the students with the higher I. Q. scores preferred the manipulative mode of mathematics instruction.

When small groups of low-ability ninth graders using concrete materials took part in Wasylyk's study, the results indicated that the achievement of these students was significantly higher than those in a control group taught the same topics in a traditional, teacher-directed setting. In addition, it was found that the students in the materials group exhibited significantly more positive attitudes toward mathematics than did the control group (Vance and Kieren, 1971).

In Vance's study (Vance & Kieren, 1971), seventh and eighth graders in six classes were rotated on a once-a-week basis through ten activity lessons. Each lesson was based on some type of concrete material and led to the discovery of a new concept or relationship. Tests of achievement, retention and transfer revealed that the students did learn new mathematical ideas, although they learned slightly less than a control group taught the same lessons without the use of manipulatives. More favorable attitudes toward mathematics were exhibited, however, by the students who used the concrete materials.
The positive results cited in the above studies conflict with those of Martin Cohen. In a comparison study of the use of a manipulative materials approach with didactic instructional techniques, Cohen tested the achievement and attitudes of seventh and eighth graders. While the results show a significant increase in achievement for the didactic treatment, there was no significant difference between the two methods in students' attitudes toward mathematics (Brousseau, 1973).

Conclusion

There seems to be a general agreement that a child's attitude toward mathematics is important, but no causal relationship between attitudes and mathematics achievement has been established. The review of the literature revealed that attitudes toward mathematics involves a complex interaction of factors: parental attitudes and expectations, teacher characteristics, attitudes and behavior, and methods of mathematics instruction.

The need for further investigations to determine any causal relationships of attitudes of mathematics and mathematics achievement, and factors influencing students' attitudes has been indicated by the literature review.
CHAPTER III

METHOD AND PROCEDURES

Subjects

All the students in the third-grade and sixth-grade from two public schools in Area 1 in the San Fernando Valley of Southern California were administered a revised version of Dutton's attitude scale (See APPENDIX B).

One of the schools readily uses manipulative materials in the teaching of mathematics. The other school which was matched for socioeconomic status and ethnic make-up (see APPENDIX A), uses a traditional approach in the teaching of mathematics.

Procedures for Collecting Data

A questionnaire (see APPENDIX B) was administered by the researcher in the spring of 1977 to all the third-graders and sixth-graders in each of the two schools. The questionnaire was administered in each of the classrooms with each classroom teacher present to assure optimal testing conditions.

Prior to the survey, it was explained to the students that no one but the researcher would see the completed questionnaires. The students were instructed not to put their names on the questionnaire but to indicate their school, grade and sex. After the students were instructed how to show whether they agreed or disagreed with
each statement on the questionnaire, they were asked to respond to all the statements on the questionnaire to the best of their ability. Because the questionnaires did not ask for names, there was no pressure for approval on responses to certain statements on the questionnaire.

**Treatment of Data**

The questionnaires from each of the schools were tabulated separately. In each of the schools, the questionnaires were sorted according to grade, then sex within grade. From each school, thirty questionnaires were randomly selected from each grade—fifteen from male students and fifteen from female students.

According to the number of positive responses, an attitude index between zero and twenty was given to each of the randomly selected questionnaires. T-tests between two independent groups were performed to test the statistical significance of all the hypotheses. Chi square tests were conducted to determine if any differences between each pair of groups in the distribution of responses on the attitude questionnaire differed from chance. Significance was set at the 0.05 level of probability for both the t-tests and chi square tests.

**Limitations of the Study**

1) No attempt was made to control such factors as reading level, achievement or I.Q. These factors are assumed to be normally distributed.
2) No attempt was made to compare achievement with attitude.

3) As with any self-rating device, the attitude scale used in this study is only accurate to the degree that the self-perceptions are accurate, and to the degree that the students are willing to express them honestly.

4) There will be no follow-up to detect any changes in attitude from year-to-year.

5) The findings of this study can only be generalized to the third- and sixth-grade students in the school surveyed.

6) This study is limited by its ex post facto design. The groups are pre-existing and no careful control of method of instruction was possible.

7) The schools in this study were selected on the recommendation of the area mathematics supervisor and no specific criteria were identified for either method of instruction (e.g., kinds and quality of materials; if materials were readily available; if materials were stored in the classroom or central location; if the students were encouraged to use the materials).
CHAPTER IX

FINDINGS OF THE STUDY

T-tests between independent groups were applied to the data to test the statistical significance of the hypotheses.

Presentation of Data for Hypothesis One

Hypothesis One predicted that there would be no significant differences between attitudes toward mathematics for students from a school which uses manipulative materials and those from a school that does not. Table 1 shows the results of the t-test, and Hypothesis One is rejected at the 0.05 level.

Table 1

COMPARISON OF MEAN ATTITUDE INDICES FOR STUDENTS FROM THE TRADITIONAL AND MANIPULATIVE SCHOOLS

<table>
<thead>
<tr>
<th>Group</th>
<th>Number in Sample</th>
<th>Mean Attitude Index</th>
<th>Variance</th>
<th>Degrees of Freedom</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>60</td>
<td>15.1500</td>
<td>.6806</td>
<td>118</td>
<td>2.425</td>
</tr>
<tr>
<td>Materials</td>
<td>60</td>
<td>14.8000</td>
<td>.5689</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Needed for significance at 0.05: 1.98
Presentation of Data for Hypothesis Two

Hypothesis Two predicted that there would be no significant difference in mathematics attitudes between third-grade students and sixth-grade students in a school that uses manipulative materials. Table 2 shows the results of the $t$-test and Hypothesis Two is rejected at the 0.05 level of probability.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Number in Sample</th>
<th>Mean Attitude Index</th>
<th>Variance</th>
<th>Degrees of Freedom</th>
<th>$t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>30</td>
<td>15.5333</td>
<td>2.2756</td>
<td>29</td>
<td>3.843</td>
</tr>
<tr>
<td>6</td>
<td>30</td>
<td>14.2667</td>
<td>0.0356</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Needed for significance at 0.05: 2.045
Presentation of Data for Hypothesis Three

Hypothesis Three predicted that there would be no significant difference in mathematics attitudes between third-grade students and sixth-grade students in a school that does not use manipulative materials. Table 3 shows the results of the t-test and Hypothesis Three was rejected at p < 0.05.

Table 3

<table>
<thead>
<tr>
<th>Grade</th>
<th>Number in Sample</th>
<th>Mean Attitude Index</th>
<th>Variance</th>
<th>Degrees of Freedom</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>30</td>
<td>15.7333</td>
<td>1.0756</td>
<td>29</td>
<td>5.872</td>
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<tr>
<td>6</td>
<td>30</td>
<td>14.5667</td>
<td>1.089</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Needed for significance at 0.05: 2.045
Presentation of Data for Hypothesis Four

Hypothesis Four predicted that there would be no significant difference in mathematics attitudes between third-grade boys and third-grade girls in a school that uses manipulative materials. Table 4 shows the result of the t-test and Hypothesis Four was retained.

Table 4

<table>
<thead>
<tr>
<th>Group</th>
<th>Number in Sample</th>
<th>Mean Attitude Index</th>
<th>Variance</th>
<th>Degrees of Freedom</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>15</td>
<td>16.4000</td>
<td>9.4000</td>
<td>14</td>
<td>1.5447</td>
</tr>
<tr>
<td>Boys</td>
<td>15</td>
<td>14.2667</td>
<td>19.2095</td>
<td></td>
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</tr>
</tbody>
</table>

Needed for significance at 0.05: 2.145
Presentation of Data for Hypothesis Five

Hypothesis Five predicted that there would be no significant difference in mathematics attitudes between third-grade boys and third-grade girls in a school that does not use manipulative materials. Table 5 shows the results of the t-test and Hypothesis Five was retained.

<table>
<thead>
<tr>
<th>Group</th>
<th>Number in Sample</th>
<th>Mean Attitude Index</th>
<th>Variance</th>
<th>Degrees of Freedom</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>15</td>
<td>16.4667</td>
<td>6.9810</td>
<td>14</td>
<td>1.4147</td>
</tr>
<tr>
<td>Boys</td>
<td>15</td>
<td>15.0000</td>
<td>9.1429</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Needed for significance at 0.05 level: 2.145
Presentation of Data for Hypothesis Six

Hypothesis Six predicted that there would be no significant difference in mathematics attitudes between sixth-grade boys and sixth-grade girls in a school that uses manipulative materials. Table 6 shows the results of the t-test and Hypothesis Six was retained.

<table>
<thead>
<tr>
<th>Group</th>
<th>Number in Sample</th>
<th>Mean Attitude Index</th>
<th>Variance</th>
<th>Degrees of Freedom</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>15</td>
<td>14.1333</td>
<td>14.2667</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>15</td>
<td>14.4000</td>
<td>20.1143</td>
<td>14</td>
<td>0.1762</td>
</tr>
</tbody>
</table>

Needed for significance at 0.05 level: 2.145
Presentation of Data for Hypothesis Seven

Hypothesis Seven predicted that there would be no significant difference in mathematics attitudes between sixth - grade boys and sixth - grade girls in a school that does not use manipulative materials. Table 7 shows the results of the t-test and Hypothesis Seven was retained.

Table 7

<table>
<thead>
<tr>
<th></th>
<th>Number in Sample</th>
<th>Mean Attitude Index</th>
<th>Variance</th>
<th>Degrees of Freedom</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>15</td>
<td>14.3333</td>
<td>10.3810</td>
<td>14</td>
<td>0.3262</td>
</tr>
<tr>
<td>Boys</td>
<td>15</td>
<td>14.8000</td>
<td>20.3143</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Needed for significance at 0.05: 2.145
Presentation of the Data on the Chi Square Tests

The results of the chi square tests revealed that the difference between the expected and observed frequencies in the distribution of responses to four statements on the questionnaire are beyond what would be expected by chance.

Table 8 shows the distribution of responses of the third-grade students and sixth-grade students to the first statement of the questionnaire. The chi square score was significant.

Table 8

<table>
<thead>
<tr>
<th>Grade</th>
<th>Number who Agreed</th>
<th>Number who Disagreed</th>
<th>Chi Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>54</td>
<td>6</td>
<td>10.753*</td>
</tr>
<tr>
<td>6</td>
<td>39</td>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at p<0.05
Table 9 shows the results of the chi square test with regard to the second statement on the questionnaire.

**Table 9**

RESPONSES OF THIRD AND SIXTH GRADERS TO STATEMENT TWO: "MATH IS USEFUL"

<table>
<thead>
<tr>
<th>Grade</th>
<th>Number who Agreed</th>
<th>Number who Disagreed</th>
<th>Chi Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>55</td>
<td>5</td>
<td>4.183*</td>
</tr>
<tr>
<td>6</td>
<td>47</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

Significant at $p<0.05$.

Table 10 shows the distribution of responses of third-grade students and sixth-grade students to the eleventh statement of the questionnaire. Chi square score was significant at the 0.05 level of probability.

**Table 10**

RESPONSES OF THIRD AND SIXTH GRADERS TO STATEMENT ELEVEN: "I REALLY ENJOY MATH"

<table>
<thead>
<tr>
<th>Grade</th>
<th>Number who Agreed</th>
<th>Number who Disagreed</th>
<th>Chi Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>50</td>
<td>10</td>
<td>5.263*</td>
</tr>
<tr>
<td>6</td>
<td>39</td>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at $p<0.05$
Table 11 shows the distribution of responses of all the boys and all the girls to the sixteenth statement on the questionnaire. Chi square was again significant at \( p<0.05 \).

<table>
<thead>
<tr>
<th>Group</th>
<th>Number who Agreed</th>
<th>Number who Disagreed</th>
<th>Chi Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>11</td>
<td>49</td>
<td>5.175*</td>
</tr>
<tr>
<td>Girls</td>
<td>3</td>
<td>57</td>
<td></td>
</tr>
</tbody>
</table>

Significant at \( p<0.05 \).

Chi Square tests were conducted for all the groups and subgroups on the data of all the remaining statements on the questionnaire. The results of these additional chi square tests were not significant.
CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The major problem of this study was to investigate the relation between two methods of teaching mathematics (a manipulative materials approach and a traditional approach) and attitudes of elementary school children toward mathematics. The relationship between sex, grade level and mathematics attitudes of the children were also investigated.

The subjects were third - grade and sixth - grade students from two schools matched for socioeconomic level and ethnic make-up. A revised version of Dutton's mathematics attitude scale was administered by the researcher. An attitude index between zero and twenty was given to each of the randomly selected questionnaires depending upon the number of positive responses.

T-tests between two independent groups were conducted and the results allowed the rejection of three hypotheses and the retention of the other four. Chi square tests were also performed to determine if any differences between groups in the distribution of responses on the attitude questionnaire differed from chance (p< 0.05). Only four statements revealed significant chi square scores.
Conclusions

In this study, the data revealed evidence of differences in mathematics attitudes between the students from the manipulative materials school and those from the traditional school. The students from the school using a traditional approach in teaching mathematics appear to have significantly more positive attitudes toward mathematics than those students in the school using the manipulative materials approach (Hypothesis One). Despite the randomization within schools and the matching of the schools for socioeconomic and ethnic make-up, mathematics achievement was not controlled for and could have influenced the results of this study, especially since mathematics achievement seems to have an effect on mathematics attitudes (Neal, 1959; Bassham et al., 1964). Similarly, the lack of control of the method of instruction in this ex post facto design could account for the unexpected outcome.

The differences in mathematics attitudes between the third-grade students and the sixth-grade students from both schools (Hypotheses Two and Three) are probably not due to chance \( (p<0.05) \). The third-graders had significantly more positive attitudes toward mathematics than the sixth-graders. Specific statements in the questionnaire suggest explanation for these significant differences. More than half of the sixth-grade students from both schools agreed that the difficulty in the content of mathematics is
disproportionate to that of the other subjects (statement 13 on the attitude questionnaire), and almost half of the sixth - graders agreed that they liked mathematics better when they were younger (statement 20).

This study did not reveal sufficient evidence for the rejection of the null hypotheses relating to sex differences in mathematics attitudes (Hypotheses Four, Five, Six and Seven). Contrary to current belief, this study found no evidence to assume that the boys surveyed had more favorable attitudes toward mathematics than the girls surveyed.

The results of the chi square tests revealed that the differences between the expected and the observed frequencies in the distribution of responses to Statements One, Two, Eleven and Sixteen are beyond what would have been expected by chance (p 0.05). There is evidence of a relationship between grade level and the agreement (or disagreement) of three statements ("Everybody should study mathematics"; "Mathematics is useful"; "I really enjoy mathematics"). A relationship appears to exist between the sex variable and the agreement (or disagreement) of the statement "Mathematics is just a waste of time".

Contrary to popular opinion, a large percentage of both boys and girls in this study do like mathematics (75%) and feel that it is a very useful subject (85%). The overall mathematics attitudes of the students surveyed are quite favorable. The total mean attitude index of all the groups combined is 14.97. Although the range of
attitude indices is twenty, very few indices were found to be less than ten; in fact, only eight percent of all the students surveyed fell into this category.

As stated in the limitations, the findings and conclusions of this study can only be generalized to the students in the schools surveyed. Sampling other student populations may quite possibly produce findings different from those found here.

Recommendations

Based upon the findings, observations, and subsequent conclusions of this study, the researcher recommends the following: an experimental study, controlling for method of instruction, should be undertaken which matches schools for achievement as well as socio-economic level and ethnic make-up.
Aiken, L. R. Research on attitudes toward mathematics. The Arithmetic Teacher, 1972, 19, 229-334.


Bassham, H., Murphy, M. and Murphy, K. Attitude and achievement in arithmetic. The Arithmetic Teacher, 1964, 11, 66-72.


Capps, L. R. and Cox, L. S. Attitude toward arithmetic at the fourth and fifth grade levels. The Arithmetic Teacher 1969, 16, 215-220.


APPENDIX A

Breakdown of the Groups Surveyed

<table>
<thead>
<tr>
<th></th>
<th>Manipulative Materials School</th>
<th>Traditional School</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of third graders</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>boys</td>
<td>58</td>
<td>74</td>
</tr>
<tr>
<td>girls</td>
<td>27</td>
<td>41</td>
</tr>
<tr>
<td><strong>Number of sixth graders</strong></td>
<td>31</td>
<td>33</td>
</tr>
<tr>
<td>boys</td>
<td>86</td>
<td>92</td>
</tr>
<tr>
<td>girls</td>
<td>46</td>
<td>39</td>
</tr>
<tr>
<td><strong>Average family income</strong>*</td>
<td>$11,143</td>
<td>$11,130</td>
</tr>
<tr>
<td>Ethnic make-up of school**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>55%</td>
<td>46.8%</td>
</tr>
<tr>
<td>Black</td>
<td>3%</td>
<td>2.3%</td>
</tr>
<tr>
<td>Oriental</td>
<td>1%</td>
<td>3.6%</td>
</tr>
<tr>
<td>American Indian</td>
<td>0%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Anglo</td>
<td>41%</td>
<td>46.3%</td>
</tr>
</tbody>
</table>

*as shown on 1970 census
**as of October 1976
APPENDIX B

Mathematics Attitude Questionnaire
MY FEELINGS ABOUT MATHEMATICS

School ________________________________
Grade ____________________ Sex _____________________________

Directions: Put an X in the box marked AGREE if you agree with the statement. OR
Put an X in the box marked DISAGREE if you disagree with the statement.
Do not put an X in both boxes.

1. If I had my way, everybody would study mathematics.
   AGREE ☐
   DISAGREE ☐

2. Mathematics is one of the most useful subjects I know.
   AGREE ☐
   DISAGREE ☐

3. Each year mathematics seems more difficult to understand than my other subjects.
   AGREE ☐
   DISAGREE ☐

4. All people should know mathematics.
   AGREE ☐
   DISAGREE ☐

5. I wouldn't take mathematics if I didn't have to.
   AGREE ☐
   DISAGREE ☐
6. Mathematics might be worthwhile if it were taught right.
   AGREE ☐
   DISAGREE ☐

7. Mathematics is dull and boring.
   AGREE ☐
   DISAGREE ☐

8. I can't see how mathematics will be very useful to me out of school.
   AGREE ☐
   DISAGREE ☐

   AGREE ☐
   DISAGREE ☐

10. Mathematics is very interesting.
    AGREE ☐
    DISAGREE ☐

11. I really enjoy mathematics.
    AGREE ☐
    DISAGREE ☐

12. I wish we'd miss mathematics more often.
    AGREE ☐
    DISAGREE ☐

13. I found mathematics is useful at home.
    AGREE ☐
    DISAGREE ☐
14. Mathematics is just too hard for me to understand.
   AGREE ✅
   DISAGREE ✅

15. Mathematics is the best subject in school.
   AGREE ✅
   DISAGREE ✅

16. Mathematics is a waste of time.
   AGREE ✅
   DISAGREE ✅

17. Mathematics will help us in our daily lives.
   AGREE ✅
   DISAGREE ✅

18. I don't even try to do my best in mathematics.
   AGREE ✅
   DISAGREE ✅

19. Mathematics teaches me to be accurate.
   AGREE ✅
   DISAGREE ✅

20. I liked mathematics better when I was younger.
   AGREE ✅
   DISAGREE ✅