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Attitudinal Effects of Unified Mathematics at Hillcrest High School

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ATTITUDINAL EFFECTS OF UNIFIED MATHEMATICS AT HILLCREST HIGH SCHOOL

by

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ABSTRACT

Attitudinal Effects of Unified Mathematics

at Hillcrest High School

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The purpose of this study was to investigate the relationship between (1) attitude as expressed on Aiken's Mathematics Attitude Scale between students who had been taught Unified Mathematics and similar students who had not been taught Unified Mathematics. The sample consisted of 37 students in the treatment group and 46 students in the control group.

The students were given a copy of Aiken's Mathematics Attitude Scale. The responses were scored by the researcher. Seven null hypotheses were examined by calculating the means and standard deviations of each group. Comparison of the posttest means was performed by using the z test for each of the relationships stated in seven hypotheses.

It was concluded from this study that:

1. The Unified Mathematics program had a less positive effect on the attitudes of the students in the treatment than students in the control group.

2. The Unified Mathematics program had a negative effect on females in the treatment but not on the males in the same group.

3. The non-Unified Mathematics program did not produce negative attitudes on students as did the Unified Mathematics program.

4. The Unified Mathematics program had no negative effect on the attitudes of male students.

(66 pages)

CHAPTER I

INTRODUCTION

General nature of the problem

The late 1960s through the early 1970s have witnessed a change in mathematics education that may well be remembered in history as the era of, "The Great Circle." During this period of time an attempt was made to eliminate the traditional approach to mathematics education in favor of a newer mathematics approach. "There was general agreement in the early 1950s and even before that date that the teaching of mathematics was far lower than in other subjects. Student dislike, and even dread, of mathematics was widespread" (Kline, 1973).

It was felt that a change in the secondary mathematics curriculum was needed. What is now called the "new math" is the result of these changes.

Several research studies have been conducted to establish student attitudes toward mathematics. Recently, a study was published which indicated that student attitude toward mathematics was highest in the 4th through the 7th grades and then seemed to decline in the higher grades (Dutton, 1968).

It became apparent from the many studies that were conducted that there are perhaps some non-cognitive or nonintellective variables

such as motivation, personality and attitude which may have a profound influence on learning and achievement. Of these variables Abrego (1966) contends that attitude is perhaps the most important. She states ". . . without the right attitude, the child's full potential of growth in knowledge cannot be realized" (p. 206).

Only recently have research programs been designed to study the influences of attitudes on the learning processes and achievement of students. Men such as Dreger and Aiken (1957, 1970), Dutton (1954), and Poffenburger and Norton (1956), directed their efforts to study attitudes and the influence upon performance in mathematics. Their research suggests that there is a marked decrease in the number of students enrolling in mathematics classes at the high school levels, and that one of the reasons for this decrease may be a general negative attitude toward mathematics.

Some possible contributing factors toward student attitude are teacher attitudes, teaching methods, text books and curriculum, and lack of relevancy of material.

Since the adaptation of the new mathematics, enrollment in college and high school mathematics courses has dropped far below the figures of the 1950s and early 1960s (Dutton, 1968; Educational Testing Services of Princeton, 1956; and Gough, 1954).

In order to implement the new mathematics in the high schools, and to prove that new mathematics was better than the traditional

mathematics, the achievement tests were changed from favoring the traditional mathematics students to favoring the new mathematics student (Kline, 1973). Therefore, the traditional mathematics teacher was forced into changing to the new mathematics approach in order for his students to stay competitive on the achievement tests. Morris Kline, in numerous articles as far back as early 1950s has been an unrelenting opponent to the changes taken by the new mathematics creators. The basic change taken by new mathematics creators was to move away from traditional mathematics emphasis on computation and manipulation of mathematics expressions to a rigorous, formal and deductive approach into the reasoning behind the manipulations. They felt that if a student knew the reasons behind the manipulations they could figure out how to do the manipulations.

Kline, in his vigorous opposition against the new mathematics, has had much to say against new mathematics. He predicts a deterioration in the enrollment of mathematics courses in high schools and colleges.

> If mathematical education of the traditional type has suffered from the martinets who imposed rote learning, the newer education will suffer more horribly from the rigormongers. . . Mathematics proper does not and perhaps should not appeal to ninty-eight percent of the students. . . By neglecting motivation and application, the pedagogues have caused mathematics education to suffer. These men have presented the stem but not the flower and so have failed to present the true worth of what they are teaching. (Kline, 1974, p. 19)

Edward G. Begle has been active in bringing the new mathematics into being. Begle in answer to Kline, comments in a recent article.

> No substantiation is provided for this (Kline's) statement, and, in fact, Kline is again quite remote from reality. In the National Longitudinal Study, student attitudes toward mathematics and other school subjects were assessed at the beginning of the first, third, and fifth years of the study. . . these students gave mathematics a good rating, but also that their attitudes towards mathematics improved when a substantial number of them were exposed to modern programs. (Begle, 1974, pp. 27-28)

One of the most radical moves away from traditional mathematics in the junior and senior high school mathematics curriculum was the approach taken by the Secondary School Mathematics Curriculum Improvement Study organized by Howard Fehr of Columbia University. This organization attempted to unify three branches of mathematics; arithmetic, algebra, and geometry by basing them on the ideas of sets, axioms, and mappings (Fehr, 1972). The resulting Unified Mathematics program was offered in many junior and senior high schools. The Unified Mathematics program was designed to be taught only to the top ten or fifteen percent of the mathematics students. These top mathematics students were selected from the sixth grade graduating classes and enrolled into the Unified Mathematics course starting in the seventh grade and continuing through each grade to the twelvth grade. The Unified Mathematics course was authored by Howard Fehr; James Fey, University of Maryland; and Thomas Hill, University of

Oklahoma. Unified Mathematics in the seventh grade book covers advanced subjects such as probability, analysis, geometries, number systems, vector spaces, fields, rings, groups, relations, mappings, operations, sets, absolute values, translations of lines, lattice-point graphs, translations and dilation in lattices, sets, subsets, operations on sets, binary relations, line reflections, translational symmetry, rotational symmetry, symmetry in a point, dilations, groups of isometries, dilations in a plane and similarity, and translations and groups (Fehr, Fey, Hill, 1972). After the seventh grade course, topics taught included theory of numbers, abstract algebra, linear algebra, n-dimensional geometry, projective geometry, tensors, topology, differential equations, and the calculus.

The forementioned seventh grade subjects were taught in an introductory manner rather than in great depth. However, the topics are treated again in more detail as the student advances through the program. Understanding of the seventh grade material is essential in these more advanced classes. Many of the subjects treated in the seventh grade book are subjects which are normally taken only by college mathematics majors and graduate mathematics majors.

What affect does this Unified Mathematics Program have on the attitudes of the students? Do these students who were in the seventh grade have a favorable attitude towards mathematics? How do their attitudes toward mathematics compare with the attitudes of

other students who are the top ten or fifteen percent of their mathematics class but who were not exposed to the Unified Mathematics Program?

Because attitude is a most important factor in the learning process (Abrego, 1966), the purpose of this research is to determine what affect, if any, the Unified Mathematics Program has on the attitudes of students in the program compared with similar students who are not in the program.

Importance of the study

Typically, a modern program in mathematics was begun in the Jordan School District in 1971. The top ten percent of the mathematics students entering the seventh grade at Union Junior High School in the Jordan School District, Salt Lake City, Utah from the elementary schools in the district were handpicked by the Union Junior High School mathematics department. Letters were sent to the parents of these students stating that their child had been selected to participate in an advanced mathematics program and that the child should be allowed to participate in the program.

The program is a modern mathematics program which utilizes a rigorous treatment of the real number system. The text used in the six year program was Unified Mathematics by Fehr, Fey, and Hill. The seventh grade began with Course 1. Follow-on courses were offered those students in the eighth, ninth, and tenth grades.

What is the cause of the drop in mathematics enrollment? Is new mathematics turning students against mathematics as Kline predicted it would? Are authors such as Fehr, Fey, and Hill "rigor mongers?" (Kline, 1973).

This study attempted to assess the efforts of the curriculum purposed in 1971 by the Union Junior High School mathematics department, and give implication for further study.

If the students who had taken Unified Mathematics had poorer attitudes, then it might be concluded that the cause for the drop in mathematics enrollment was a result of adaptation of the new cirriculum. The new mathematics curriculum might also be the cause of the lowering enrollment in the other mathematics related sciences such as physics and engineering.

On the other hand, if it were found that student attitudes were unchanged or were better after having taken the new mathematics (Begle, 1974), then researchers must look elsewhere for the cause of lower mathematics enrollments. Researchers might then look to the Begle philosophy of mathematics for future mathematics curriculum changes.

Hypotheses of the study

Generally, the research was aimed at accomplishing three objectives: first, to determine what effect, if any, the Unified Mathematics program had on the students in the program as compared to

similar students who were not in the program as expressed on the Aiken Mathematics Attitude Scale; second, to determine if the Unified Mathematics program had a different effect on boys than girls; and third, to compare the attitudes of the girls in the Unified program with that of the girls in the non-Unified program, and to compare the attitudes of the boys in the Unified program with that of the boys in the non-Unified program.

The answers to these objectives were obtained by the investigation and testing of the following specific hypotheses:

1. There is no significant difference between the means on Aiken's Mathematics Attitude Scale scores of students in the treatment group and students in the control group at Hillcrest High School.
2. There is no significant difference between the means on Aiken's Mathematics Attitude Scale scores of male students in treatment group and female students in treatment group at Hillcrest High School.
3. There is no significant difference between the means on Aiken's Mathematics Attitude Scale scores of male students in treatment group and female students in control group at Hillcrest High School.
4. There is no significant difference between the means on Aiken's Mathematics Attitude Scale scores of male students

in treatment group and male students in control group at Hillcrest High School.

5. There is no significant difference between the means on Aiken's Mathematics Attitude Scale scores of female students in treatment group and female students in control group at Hillcrest High School.
6. There is no significant differences between the means on Aiken's Mathematics Attitude Scale scores of female students in treatment group and male students in control group at Hillcrest High School.
7. There is no significant difference between the means on Aiken's Mathematics Attitude Scale scores of female students in control group and male students in control group at Hillcrest High School.

Definition of terms

Attitude. Thurstone as early as 1928 pointed out that attitudes could be measured. In this study he defined attitude as: ". . . the sum total of a man's inclinations and feelings, prejudices or bias, preconceived notions, ideas, fears, threats, and convictions about any specified topic" (Thurstone, 1928, p. 531). One of the most complete and precise statements pertaining to the definition of attitudes is given by Osgood, Suci, and Tannenbaum (1957, pp. 189-190):

Most authorities are agreed that attitudes are learned and implicit--they are inferred states of the organism that are presumably acquired in much the same manner that other such internal learned activity is acquired. Further, they are predispositions to respond, but are distinguished from other such states of readiness in that they predispose toward an evaluative response. Thus, attitudes are referred to as "tendencies of approach or avoidance," or as "favorable or unfavorable" and so on. This notion is related to another shared view--that attitudes can be ascribed to some basic bipolar continuum with a neutral or zero reference point, implying that they have both direction and intensity and providing a basis for the quantitative indexing of attitudes.

Control Group. Control Group as used in the hypotheses and sections of this paper refer to students in the top ten percent of their seventh grade mathematics classes but who have not been exposed to Unified Mathematics.

New Mathematics. New Mathematics as used in the context of this paper shall have the same meaning as Unified Mathematics.

Traditional Mathematics. The study of each of these branches of mathematics; arithmetic, algebra, and geometry, each separated from the other and without a common basis. Also, a model of teaching which requires a large portion of memorizing of operational manipulations rather than a rigorous development of reasoning.

Treatment Group. Treatment Group as used in the hypotheses and sections of this paper refer to students who had been given Unified Mathematics in their seventh grade mathematics class and who were currently in the tenth grade.

Unified Mathematics. Generally, the approach toward mathematics which has attempted to unify three branches of mathematics; arithmetic, algebra, and geometry by basing them on the ideas of sets, axioms, and mappings. Specifically, the mathematics curriculum organized by the Secondary School Mathematics Curriculum Improvement Study group and presented in curriculum form as Unified Mathematics, which is authored by Howard F. Fehr, James T. Fey, and Thomas J. Hill.

CHAPTER II

REVIEW OF LITERATURE

The review of literature consists of: (1) effects and implications of curriculum development in mathematics, and (2) the attitudinal effects of curriculum developments in mathematics.

Curriculum development effects in mathematics

As far back as the year 1912 some mathematics educators (Whitehead, 1912) advocated a relaxation of rigor and structure in the teaching of mathematics in the elementary and secondary levels. He charged that mathematics on these levels should have been purged of every element which could only be justified by reference to a more prolonged course of study. He maintained that, "there could be nothing more destructive on true education than to spend long hours in the acquirement of ideas and methods which lead nowhere" (p. 16). He advocated, for example, "that the secondary level geometry curriculum be rigidly purged of all propositions which might appear to the student to be merely curiosities without important bearings" (p. 16).

In the fall of 1957 Russia launched their first Sputnik. Soon after the Sputnik launching, many groups decided to go into the business of producing a new mathematics curriculum to close the gap in

mathematics and science which was believed to exist between the United States of America and the Soviet Union.

In 1958, The American Mathematical Society, an organization concerned with mathematics research, organized a new group called The School Mathematics Study Group, headed by Professor Edward G. Begle. The group was to write a new mathematics curriculum for high schools and then extend its program to include the elementary school arithmetic curriculum. (College Entrance Examination Board, 1958, Report, Program for College Preparatory Mathematics)

The National Council of Teachers of Mathematics set up its own curriculum committee called The Secondary School Curriculum Committee which printed its recommendations of curriculum changes in the May 1959 issue of The Mathematics Teacher.

In the summer of 1963 a group of mathematicians assembled for The Cambridge Conference on School Mathematics (Goals for School Mathematics, Report, 1963). This group recommended the inclusion of many additional and advanced topics drawn from the theory of numbers, abstract algebra, linear algebra, n-dimensional geometry, projective geometry, tensors, topology, differential equations, and calculus. The report (p. 7) asserts that the subject matter which they were proposing could be roughly described by saying that a student who had worked through the full thirteen years of mathematics in grades K

through 12 should have a level of training comparable to 3 years of a top-level college training today.

Other groups such as the Ball State Project, The University of Maryland Mathematics Project, The Minnesota School Science and Mathematics Center, and the Greater Cleveland Mathematics Program all were formed to up-grade the mathematics curriculum in elementary and secondary levels (Kline, 1973, p. 17). The Secondary School Mathematics Curriculum Improvement Study was organized in 1965 and proposed to unify several branches of mathematics in the secondary curriculum (The objectives of this group have been covered in Chapter I of this research). Professers Fehr and Fey (co-authors of Unified Mathematics) contend that their organization of the subject matter would permit the introduction into the high school curriculum of much that has been considered collegiate mathematics.

In an article published by the Council for Basic Education that author (Moise, 1965) and co-creater of the new mathematics asserted that one thing was obvious as soon as the Unified Mathematics Course was written, which was, ". . .the improvement in intellectual content was so great that it would surely produce an educational improvement or a collapse of classroom morale" (p. 461).

Many opinions have been made for and against this new, abstract and deductive approach to mathematics which is founded on a high level of structure. Mathematics educators in favor of the new mathematics

(Brunner, Brown, 1961) took the position that modern mathematics was well within the grasps of high school students. Brunner went so far as to say that, "Any subject can be taught in some intellectually honest form to any child at any stage of development" (Brunner, 1961, p. 45). Brown (1961) stressed that an area of emphasis common to all improved mathematics programs is structure and that structure is reflected in the careful development of mathematics as a deductive system.

The new mathematics brought about a division in mathematics education circles. One side was opposed to the abstract and deductive approach to mathematics education, the other side was in favor of the approach. It was said by some opponents (Glennon, 1973, and Newsom, 1972) that, "In retrospect, mathematicians influence was too great." They contended that the imposition of the standard new mathematics textbook program on all children is an unsound approach. Also, the large majority of elementary children need a modern approach to mathematics that is flexible and more socially relevant than the present abstract approach. "Only by the students being successful most of the time can the teacher contribute to their positive mental health, mathematical competence and literacy" (Glennon, 1973, p. 66). These two mathematics education scholars could not understand the reason for making learning so difficult that only a small proportion of the students can persevere to mastery.

Instead of pretending concern for utility of their work, one mathematician (Stone, 1961) emphasized that the trend toward abstraction in elementary and secondary mathematics education must inevitably continue rather than the emphasis on mastery of manipulative skills. Stone further asserts that the triumph of modern mathematics is credited to one fundamental principle, abstraction and conscious detachment of mathematics from physical and other substances. Thus, he maintains that the mathematical mind, freed from ballast, may soar to heights from which reality on the ground can be perfectly observed and mastered. ". . .the necessity for presenting mathematics as the abstract subject it has become and reconciling its antithetical aspects greatly increase the difficulties involved in bringing mathematical instruction up to the level demanded by our times. . ." (Stone, 1961, p. 716)

However, this view did not go unchallenged (Courant, 1961, Neumann, 1961, Stoker, 1962, and Birkhoff, 1943). These well published mathematicians attacked this pro-abstract, anti-applied mathematics position of Stone. Stoker (1961, p. 245) states:

> I observe that the abstract point of view and the neglect, even the contempt, for that kind of mathematics which concerns itself with the world of reality, still represents the prevailing tone in American mathematics. . .there are strong forces at work which have the tendency to perpetuate this situation by propogating the notion that the strongly abstract approach to mathematics is the suitable way to introduce it to children in the elementary and secondary schools. It would seem to me that this attitude ignores human psychology and turns reason upside down. It ignores the historical fact that the mode of

> progress in mathematics has always consisted in formulating the appropriate and truly valuable abstractions on the basis of prolonged experience of a very concrete character, and the accompanying highly plausible inference that that is also the way most people's minds work.

Birkhoff (1943, p. 291) of Harvard University said as far back as 1943, that it will probably be the new mathematics discoveries which are suggested through physics that will always be the most important, for, from the beginning Nature has led the way and established the pattern which mathematics, the language of Nature, must follow.

One possible cause for the new mathematics trend is suggested by Kline (1973, p. 128) wherein he states:

> About eighty-five percent of the Ph. D.'s in mathematics are not only narrow specialists but are concentrated in corners of mathematical logic, algebra, and topology, fields which are remote from science. . . These men do not know even freshmen physics. . . Most present-day professors pursue abstractions, generalizations, structure, rigor, and axiomatrics. Since this is what most mathematicians do it is not surprising that this is what they think mathematics education should train young people to do.

Kline also states that the consequences of having university professors lead curriculum reform are very harmful. He takes the position that, generally, college professors are chosen largely for their knowledge of subject matter and research strength and not for their pedagogical skill. "Trained only to do research, they are not prepared for teaching even on the college level" (Kline, 1973, p. 129).

Weinberg (1965) criticizes the narrow professional point of view of mathematicians by pointing out that they impose upon the elementary

and secondary curricula their narrowly disciplinary point of view and they try to put across what seems important to them, not what is important when viewed in a larger perspective. He explains that puristic research-oriented mathematicians have got hold of the curriculum reform and have created puristic monsters. However, he states that education at the elementary level of a field is too important to be left entirely to the professionals in that field, especially if the professionals are themselves too narrowly specialized in outlook.

An early experimenter in the mathematics education field (Beberman, 1964) stated that his only job was to find out what things can be taught and what things can not be taught to children. He takes the position that when he gives his best efforts to his job and he still can not get a mathematical concept across to children, then maybe the concept can not be taught. One other very pertinent point that he observes from his research is that mathematicians do not know just what is appropriate mathematics for students. "They do not know what the really important things are in mathematics as far as general education is concerned."

At the November 16, 1962 University Symposium at Ohio State University, Beberman made the following comment in one of his lectures:

> I think in some cases we have tried to answer questions that children never raise and to resolve doubts they never had, but in effect we have answered our own questions and resolved our own doubts as adults and teachers, but these were not the doubts and questions of the children.

Concerning mathematics programs at elementary and secondary levels, a more recent researcher (Newsom, 1972) found that as a whole the new mathematics programs were well designed to produce good mathematicians. However, he says that it had come to light that mathematicians had too free a hand in the development of these programs.

In summary, two basic schools of thought have recently emerged in the mathematics education field. The one school is advocating that only applied mathematics be taught in elementary and secondary schools. The other school is advocating the more structured and abstract approach.

Both sides have logical arguments as to why their approach is better. The new mathematics people are saying that the new mathematics programs are having a good effect on the students, while others are saying, and attempting to prove, that the new programs are tearing at the basic purpose of education which is to provide a more general rather than specialized curriculum.

Attitudinal effects of curriculum developments in mathematics

The research on attitudes has generally shown that attitudes toward mathematics and the learning of mathematics (mathematics laws, operations, etc.) are positively correlated. In other words, the more positive one's attitude toward mathematics, the greater is

his ease of learning the fundamentals of mathematics. The more negative one's attitude toward mathematics, the greater is his difficulty in learning the fundamentals of mathematics.

Because of the positive relationship between attitudes and learning, mathematics educators have been concerned with factors that are related to attitudes toward mathematics.

In a study financed by the Carnegie Corporation of New York and conducted by the Educational Testing Services of Princeton, New Jersey (1956, p. 74) it was found that students, "just don't like the stuff; they are afraid of it; they don't see any point to it. . . Several other studies suggest that mathematics has the dubious honor of being the least popular subject in the curriculum."

Several research studies include Aiken (1963), Aiken & Dreger (1951), Tulock (1957), Poffenberger & Norton (1959, 1956), and Dutton (1956, 1954). These studies have centered on finding how prevalent negative attitudes are and what makes students fear, dislike, and avoid mathematics even when a majority of these students make satisfactory grades in other subjects. Although each researcher used a different research design, they all concluded generally the same as the findings of Poffenberger & Norton (1959, p. 75) that "students do not care as much for mathematics as they do for other school subjects."

Findings on research conducted at the secondary level by the researchers is typical of the following quote from Poffenberger & Norton (1959, pp. 171-172):

> Fifty-two percent reported their liking for school in general as "very much" while 25% reported liking arithmetic and mathematics "very much." Only 2% reported dislike for school in general, which would be expected among entering freshmen, but 24% reported an active dislike for mathematics.

Further support for the existence of negative attitudes towards mathematics is found in Robert's (1969) study of mathematics attitudes at the collegiate level.

Although the studies previously cited indicate that negative attitudes are common, there are studies which have shown that attitudes toward mathematics are not as low as some tend to believe (Mosher 1952; Rowland & Inskeep 1963; Sister Josephone 1959; and Chase 1949).

In a rating of best liked subjects, Rowland & Inskeep (1963) and Mosher (1952) found that intermediate grade students ranked arithmetic first. Further support for belief in the prevalence of positive attitudes comes from the reports of Sister Josephine (1959) and Chase (1949) that students at the elementary level rated arithmetic as the second best liked subject.

Although there appears to be disagreement between grade levels regarding general attitudes toward mathematics, the majority of the studies indicate a dislike for the subject in grades seven through twelve.

Another trend that is evident in the studies is that mathematics starts to lose popularity in the junior high school and becomes

progressively more unpopular at the higher grade levels. Some think this may be a result of the students being introduced to algebra and other abstract mathematics which are part of the curriculum at junior high schools.

Aiken (1970) stated that "the relationship between attitudes and performance is certainly the consequence of a reciprocal influence, in that attitudes affect achievement and achievement in turn affects attitudes" (p. 560). The outcome of this relationship is seen in Aiken's (1970) account of Shapiro's (1962) findings that perseverance in solving arithmetic problems was greater for students who liked mathematics than for those who disliked it. This study also indicated that girls as a group were more persevering than boys at the elementary level.

Degnan (1967) studied the attitudes of twenty-two eighth grade students classified (for analysis purposes) as low achievers in mathematics with twenty-two eighth grade students designated as high achievers in mathematics. His group designated as high achievers included students whose reading and arithmetic grade levels were above average. The underachievement groups consisted of students whose reading grade levels were above average but whose arithmetic grade levels were below average. Degnan used the children's form of the Taylor Manifest Anxiety Scale and Dutton's Mathematics Attitude Scale (1954) to obtain measures of general anxiety and mathematics attitudes for each group.

The high achievers had a much more positive attitude towards mathematics than the underachievers. Also, underachievers ranked mathematics significantly lower than did achievers by order of preference. The findings of his study supported the contention of other researchers that poor mathematical performance among otherwise high achieving students is related to poor attitude toward the subject. Stephens (1960) in studying attitude towards mathematics of high and low achiever obtained similar results.

The foregoing studies have indicated that achievement is related to attitude and is, therefore, an important variable in attitude research.

Summary

The first section of this chapter discussed the dichotomy existing between two major factions in mathematics education. The separation between the two groups is of vital interest to mathematics education since the Unified Mathematics Program is such a radical departure from past trends in mathematics education. Charges leveled by the opponents of the Unified Mathematics Program are making very strong allegations and predictions as to the future harm to mathematics education which will be caused by such programs. This section further brought out the major arguments presented by each side. This information is imperative in order to gain a full understanding and background into the purpose and goal of this research.

In the second section of this chapter, attention was focused on attitudes of students toward new mathematics. Since both new and old mathematics groups are claiming that their approach has the better outcome on attitudes toward mathematics, it was necessary to include past research findings relating to attitudes. As was brought out in this section, attitudes affect achievement, and attitudes determine the level of dislike, fear, and anxiety that students have towards mathematics.

Mathematics education can be of service to students by motivating them and by providing them with skills required in their future stations in life. Or, mathematics education can turn students against mathematics and all mathematics related subjects.

Studies done in all areas related to attitudes towards mathematics are few in number. Continued research is needed to replicate existing results and to seek additional answers to questions in this important area of research. Indeed, it is necessary to continue to contemplate the question of where mathematics education is heading and what factors determine its direction.

CHAPTER III

METHOD

The methods and procedures of this study are divided into seven separate sections: population and description of subjects, description of measure employed, procedure for collecting data, the mathematics attitude scale, assumptions, limitations, and research design to be used.

Population and description of subjects

The target population of interest in this study was all tenth grade students who had Unified Mathematics in the seventh grade, and all other tenth grade students who were the top fifteen percent of their class in mathematics and who had not had Unified Mathematics. However, due to economic and physical limitations, the accessible population for this study was all tenth grade students at Hillcrest High School who had Unified Mathematics in the seventh grade, and all tenth grade students at Hillcrest High School who were allowed to take algebra in the eighth grade but who had not had Unified Mathematics. This last group was selected from Adams Junior High School where Unified Mathematics is not taught. Unified Mathematics is taught at Union Junior High School. Both junior high schools feed their students to Hillcrest High School upon their graduation from the ninth grade.

The treatment group in this research refers to the group which was taught Unified Mathematics in the seventh grade. The control group in this research refers to the group which was not taught Unified Mathematics. The treatment group consists of 37 subjects--10 male students and 27 female subjects. The control group consists of 46 subjects--24 male subjects and 22 female subjects.

Hillcrest High School is in the Jordan School District, Midvale, Utah. Midvale is located in Salt Lake Valley which is the southern rural portion of Greater Salt Lake City. According to the Utah Department of Employment Security (1973), a large portion of the working population of the district were employed in the areas of mining, manufacturing, trade, services, government, or were self employed. The largest portion were employed in mining and construction.

A list of all seventh grade students enrolled in Unified Mathematics in Union Junior High School in 1973-1974 school year was obtained from the junior high school. Then, an exhaustive search of the entire tenth grade personal folders was made to find any other students who were not on the list, and to locate all tenth grade students from Adams Junior High School who had algebra in the eighth grade. The subjects in this research are a result of this search. It is also worth noting that most of the treatment group subjects had taken Unified Mathematics in the eighth, ninth, and tenth grades.

Description of measure employed

The instrument used in the collection of the data for this investigation was the standard Mathematics Attitude Scale (Aiken, 1972). This attitude scale was used to provide a general description of "enjoyment of mathematics". . . which encompasses not only a liking for mathematics problems, but for mathematics terms, symbols, and routine computations. The test consists of 20 questions of which the correlation coefficient of reliability is 0.95 and the predictive validity is listed as 0.40. This instrument was used after treatment to assess attitudes. The time required to administer the Mathematics Attitude Scale is approximately 10 minutes.

Procedure for collecting data

In order to test the set of hypotheses, the Statis-Group Comparison Design was used.

The following procedures were used to facilitate the use of this design.

1. Requests for permission to do research in the Hillcrest High School were sent to the Jordan School District.
2. Contact was made with the Head Counselor at Hillcrest High School to establish a procedure for procuring the required information from student files.
3. Contact was made with the Union Junior High School Principal to obtain names of treatment group.

4. A search of school records was made in order to obtain a list of control and treatment group subjects.
5. A list of each group, by name, was assembled.
6. A cover letter was written explaining to the students that the responses to the questions would be confidential (Appendix C).
7. The students were called out of class and given the attitude scale in the counseling office. The students were instructed to write either a "T" or a "C" in place of their name. Those students in the treatment group were instructed to write a "T", and those in the control group were instructed to write a "C".
8. Each student was then instructed to designate "Male" or "Female" on the top of the answer sheet.
9. All students were given the attitude scale within a four day period.
10. The results were hand scored by the researcher.
11. Test scores were calculated and analyzed by the researcher using the z-test.

The mathematics attitude scale

The mathematics attitude scale used in securing data for this research was the Aiken Attitude Scale (Appendix A). As can be seen from the test, a Likert type scale was used for student responses.

The following values are assigned to student responses: SA = 100, A = 80, U = 60, D = 40, and SD = 20. A score was obtained for each of the twenty questions, and then all twenty scores were added. This total score was then divided by 20 to obtain the average for each student. If a student chose to answer U (60) for each response, his mean score would be 60. Therefore, any mean score above 60 is a positive response, and any mean score below 60 is a negative response.

All test scores were graded and placed in the control group or the treatment group depending upon letter designation on the sheet. The two groups were further divided into male and female sub-groupings. The scores and statistical data for each group and sub-group are found in Table 1, Table 2, and Appendix B.

Assumptions

The assumptions upon which the study is based are:

1. Student responses to the mathematics attitude scales are made honestly and sincerely.
2. The measuring device used to obtain desired data is valid and reliable.
3. The samples of students from the control and treatment groups are representative of the accessible population.
4. Mortality of the control group between the seventh and tenth grades was the same as for the treatment group. This

Table 1. Summary of test results

Group	Size of Group	$\bar{X}$	S. D.
A (Male Treatment)	10	71.1	10.7
B (Female Treatment)	27	58.8	14.5
C (Female Control)	22	71.1	16.6
D (Male Control)	24	72.5	14.3
E (Treatment Group)	37	65.45	14.7
F (Control Group)	46	71.79	15.35

Table 2. Comparison of groups

Groups compared	Level of significance (.05)	z-Value
E and F	−1.95	−4.7*
A and B	1.95	3.0*
A and C	1.96	.20
A and D	−1.96	.23
B and D	−1.96	−3.39*
B and C	−1.96	−2.72*
C and D	−1.96	− .30

* Significant at .05 level

assumption offsets the possible experimental mortality of the design.

Limitations

The study was limited by:

1. The availability of funds to finance the necessary programs of testing and data processing.
2. The number of students in the treatment group who moved from the district between their seventh and tenth grades.
3. The representativeness of the samples for the target population.

Research design

The research design used in this research was the Static-Group Comparison design. This is a design in which a group which has experienced X is compared with one which has not, for the purpose of establishing the effect of X (Campbell and Stanley, 1963). What follows is a schematic representatiion of the design to facilitate an understand ing of the analysis employed.

Variables: X refers to the treatment

0 refers to the measurement

Group		
Treatment A, B, and E	X	0_1
Control C, D, and F		0_2

The dahed line between treatment and control groups indicates that the samples were not randomly selected.

One common source of internal invalidity affecting this design is that post-test differences between groups can be attributed to characteristics of the groups as well as to the experimental treatment (Borg and Gall, 1971). However, this weakness was offset by a preliminary matching to equalize the treatment and control groups. The preliminary matching was accomplished by choosing the control group to be in the top fifteen percent of the mathematics class. Thus, the two groups were similarly matched as much as possible. Also, it was assumed that there would be approximately the same subject mortality in each group which would offset the variable of experimental mortality.

The treatment group was divided into two sub-groups. Sub-group A was males in the treatment group, and sub-group B was the females in the treatment group. Group E was the combination of sub-groups A and B.

The control group was divided into two sub-groups. Sub-group C was females in the control group, and sub-group D was the males in the control group. Group F was the combination of sub-groups C and D.

Anonymity of all subjects was implimented to avoid the possibility that a fear reaction by students would adversely affect the results. Therefore, students were told not to put their names on the answer

sheet. The students were told to write a "T" or a "C" in place of their names according to instructions from the examiner.

The data yielded by this experimental design was analyzed by doing a z-test comparison of the posttest mean scores (Newmark, 1975, and Campbell and Stanley, 1963).

CHAPTER IV

FINDINGS

As previously mentioned in chapters one and three, the purpose of this study was to investigate the relationship between (1) attitude as expressed on Aiken's Mathematics Attitude Scale between students who had been taught Unified Mathematics and similar students who had not been taught Unified Mathematics; and, (2) to determine if Unified Mathematics had a different attitudinal effect on boys than on girls, compared with the control group. The relationships were investigated by testing the seven hypotheses stated in chapter one. Aiken's Mathematics Attitude Scale was used to give a measure of attitude for each of the various groups in this study.

There are many instances in which one must decide whether the observed differences between two sample means is due purely to chance or whether the population means from which these samples were selected are really different.

The z test was used to test all of the hypotheses. The z test is a standard statistical test for comparing the difference between two sample means.

All groups and sub-groups in this research are larger than 24 except sub-groups A and C. Sub-group A has n = 10, and sub-group C

has n = 22. Some authors recommend measures other than the z test for samples less than 24, while others do not.

Hypothesis testing is the process by which a decision is made to either reject or accept a null hypothesis about one of the parameters of the distribution. The decision to accept or reject a null hypothesis is based upon information obtained from the sample data and upon the test statistic z, where

$$z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2^2}}}$$

We let $\bar{X}_1$, S_1, and N_1 be the mean, standard deviation, and sample size, respectively, of one of the samples, and $\bar{X}_2$, S_2, and N_2 the mean, standard deviation, and sample size, respectively, of the second sample. The null hypotheses were tested using the Mathematics Attitude Scale. This chapter will outline the findings of each of the seven hypotheses.

Hypothesis I

The z test analysis between the attitudes expressed by the treatment group and the control group showed a z value of -4.7. This z value for the analysis is greater than the critical z value of -1.96.

Hence, hypothesis I, according to the data in this study was rejected at the .05 level. This means that this study indicates a statistically significant difference in attitudes towards mathematics expressed between the treatment group and the control group, or that the control group had significantly more positive attitudes than the treatment group.

Hypothesis II

The z test analysis between the attitudes expressed by the males in the treatment group and the females in the treatment group showed a z value of 3.0. This z value for the analysis is greater than the critical z value of 1.96. Hence, hypothesis II, according to the data in this study, was rejected at the .05 level. This means that this study indicates a statistically significant difference in attitudes towards mathematics expressed between the males in the treatment group and the females in the treatment group, with the males having a more positive attitude.

Hypotheis III

The z test analysis between the attitudes expressed by the male students in the treatment group and the females in the control group showed a z value of .20. This z value for the analysis is less than the critical z value of 1.96. Hence, hypothesis III, according to the data in this study, was not rejected. This means that this study indicates that there was no statistically significant differences in

attitudes towards mathematics expressed between the males in the treatment group and the females in the control group.

Hypothesis IV

The z test analysis between the attitudes expressed by the male students in the treatment group and the male students in the control group showed a z value of −.23. This z value for the analysis is less than the critical z value of −1.96. Hence, hypothesis IV, according to the data in this study, was not rejected. This means that this study indicates that there was no statistically significant difference in attitudes towards mathematics expressed between the males in the treatment group and males in the control group.

Hypothesis V

The z test analysis between the attitudes expressed by the females in the treatment group and females in the control group showed a z value of −2.72. This z value for the analysis is greater than the critical z value of −1.96. Hence, hypothesis IV, according to the data in this study, was rejected at the .05 level. This means that this study indicates a statistically significant difference in attitudes towards mathematics expressed between the females in the control group and females in the treatment group with the females in the control group having a significantly more positive attitude.

Hypothesis VI

The z test analysis between the attitudes expressed by the female students in the treatment group and male students in the control group showed a z value of -3.39. This z value for the analysis is greater than the critical z value of -1.96. Hence, hypothesis VI, according to the data in this study, was rejected at the .05 level. This means that this study indicates a statistically significant difference in attitudes towards mathematics expressed between the females in the treatment group and males in the control group, with the males having a more positive attitude.

Hypothesis VII

The z test analysis between the attitudes expressed by the female students in the control group and male students in the control group showed a z value of $-.30$. This z value for the analysis is less than the critical z value of -1.96. Hence, hypothesis VII, according to the data in this study, was not rejected. This means that this study indicates that there was no statistically significant difference in attitudes towards mathematics expressed between the females in the control group and males in the control group.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary of Hypotheses, method and findings

The purpose of this study was to investigate the relationship between (1) attitude as expressed on Aiken's Mathematics Attitude Scale between students who had been taught Unified Mathematics and similar students who had not been taught Unified Mathematics; and (2) to determine if Unified Mathematics had a different attitudinal effect on boys than on girls as compared to the control group.

The null hypotheses that were tested are as follows:

1. There is no significant difference between the means on Aiken's Mathematics Attitude Scale scores of students in the treatment group and students in the control group.

2. There is no significant difference between the means on Aiken's Mathematics Attitude Scale scores of male students in the treatment group and female students in the treatment group.

3. There is no significant difference between the means on Aiken's Mathematics Attitude Scale scores of male students in the treatment group and female students in control group.

4. There is no significant difference between the means on Aiken's Mathematics Attitude Scale scores of male students in the treatment group and male students in the control group.

5. There is no significant difference between the means on Aiken's Mathematics Attitude Scale scores of female students in the treatment group and female students in the control group.

6. There is no significant difference between the means on Aiken's Mathematics Attitude Scale scores of female students in the treatment group and male students in the control group.

7. There is no significant difference between the means on Aiken's Mathematics Attitude Scale scores of female students in the control group and male students in the control group.

Conducting the study and testing of the null hypotheses were made possible through the cooperation of the Jordan School District, Hillcrest High School administration, and counseling staff. The sample consisted of 37 students in the treatment group and 46 students in the control group.

Permission was received from Jordan School District in April, 1976 to conduct the research study in the district. Contact was made with the Head Counselor at Hillcrest High School to establish a procedure for procuring the required information from student files.

After the foregoing procedures were established, a list was obtained from the Union Junior High School principal which contained

the names of all tenth grade students who were enrolled in Unified Mathematics in the seventh grade. Then, a search of all tenth grade files was conducted in order to form a list of all tenth grade students who were enrolled in algebra in the eighth grade at Adams Junior High School. The students who had Unified Mathematics were placed in the treatment group, and the students who were enrolled in eighth grade algebra were placed in the control group. Students were then called out of class and given the attitude scale in the counseling office. Those students in the treatment group were instructed to write a "T" on their answer sheet, and those students in the control group were instructed to write a "C" on their answer sheet. Each student was also asked to put either "Male" or "Female" on the sheet. The Aiken Mathematics Attitude Scale had a reliability coefficient of .95 and validity of .40.

The tests were collected and hand-scored by the researcher. A z test was used to analyze the findings relative to each of the seven hypotheses.

Based on the findings of this study, the following conclusions were reached.

1. The null hypothesis comparing the attitudes expressed between the treatment group and the control group was rejected. Therefore, it was concluded that Unified Mathematics has a less positive effect on the attitudes of students.

2. The null hypothesis comparing the attitudes expressed between the males in the treatment group and the females in the treatment group was rejected. Therefore, it was concluded the Unified Mathematics had a negative effect on the females but not on the males. The mean score for the girls in the treatment group was 58.8 (negative), and the mean score for the males in the treatment group was 72.1 (positive).

3. The null hypothesis comparing the attitudes expressed between the males in the control group and the females in the control group was not rejected. The mean score for the girls in the control group was 71.1 (positive), and the mean score for the boys in the control group was 72.5 (positive). Therefore, it was concluded that the non-Unified Mathematics mathematics programs did not produce negative attitudes in the students as did Unified Mathematics.

4. The null hypothesis comparing the attitudes expressed between the males in the control group and males in the treatment group was not rejected. The mean score for the males in the control group was 72.5, and the mean score for the males in the treatment group was 72.1. Therefore, it was concluded that the Unified Mathematics has no negative effect on the attitudes of male students.

Since the null hypothesis comparing the attitudes expressed between the treatment group and the control group was rejected, it appears that Kline's view of Unified Mathematics is valid. His view

was that student attitudes would be effected negatively by the new mathematics. When taken as a whole, his view appeared to be valid. However, this study showed that his view was correct for only females. The male students expressed attitudes toward mathematics not unlike the males and females in the control group. An interesting point is that most of the students that were enrolled in Unified Mathematics were female.

Recommendations

To the extent that the findings presented in this study are of sufficient worth to warrant further investigation, the following recommendations would seem to be in order:

1. It is suggested that this study be repeated using samples from a variety of schools and a variety of locations.

2. Because of the complex nature of mathematical attitudes, it is possible that the present scales and devices employed to measure these attitudes are not sensitive enough. Therefore, further research and study into the revision and development of mathematical attitude scales is needed.

3. Since the attitude scale used in this study was an adaptation of Aiken's Mathematics Attitude Scale, it is suggested that this study is repeated using another mathematics attitude scale such as the one developed by Dutton.

4. It is recommended that the mathematics curriculum in the elementary and junior high schools move away from the abstract approach used in Unified Mathematics and all other such programs to a more applied and useful approach.

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APPENDIXES

Appendix A

Mathematics Attitude Scale

MALE___ FEMALE___ NAME:_____
Junior High School Attended_____

MATHEMATICS ATTITUDE SCALE

Directions: Please write your name in the upper right-hand corner. Each of the statements on this opinionnaire expresses a feeling or attitude toward mathematics. You are to indicate, on a five-point scale, the extent of agreement between the attitude expressed in each statement and your own personal attitude. The five points are: Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), Strongly Agree (SA). Draw a circle around the letter or letters giving the best indication of how closely you agree or disagree with the attitude expressed in each statement.

1.	I am always under a terrible strain in a mathematics class.	SD	D	U	A	SA
2.	I do not like mathematics, and it scares me to have to take it.	SD	D	U	A	SA
3.	Mathematics is very interesting to me, and I enjoy arithmetic and mathematics courses.	SD	D	U	A	SA
4.	Mathematics is fascinating and fun.	SD	D	U	A	SA
5.	Mathematics makes me feel secure, and at the same time it is stimulating.	SD	D	U	A	SA
6.	My mind goes blank and I am unable to think clearly when working mathematics.	SD	D	U	A	SA
7.	I feel a sense of insecurity when attempting mathematics.	SD	D	U	A	SA
8.	Mathematics makes me feel uncomfortable, restless, irritable, and impatient.	SD	D	U	A	SA
9.	The feeling that I have toward mathematics is a good feeling.	SD	D	U	A	SA
10.	Mathematics makes me feel as though I'm lost in a jungle of numbers and can't find my way out.	SD	D	U	A	SA
11.	Mathematics is something that I enjoy a great deal.	SD	D	U	A	SA
12.	When I hear the word mathematics, I have a feeling of dislike.	SD	D	U	A	SA
13.	I approach mathematics with a feeling of hesitation, resulting from a fear of not being able to do mathematics.	SD	D	U	A	SA

(continued on next page)

14.	I really like mathematics.	SD	D	U	A	SA
15.	Mathematics is a course in school that I have always enjoyed studying.	SD	D	U	A	SA
16.	It makes me nervous to even think about having to do a mathematics problem.	SD	D	U	A	SA
17.	I have never liked mathematics, and it is my most dreaded subject.	SD	D	U	A	SA
18.	I am happier in a mathematics class than in any other class.	SD	D	U	A	SA
19.	I feel at ease in mathematics, and I like it very much.	SD	D	U	A	SA
20.	I feel a definite positive reaction to mathematics; it's enjoyable.	SD	D	U	A	SA

Appendix B

Table 3. Test Results by Group

Table 3. Test results by group

Group Scores and Means	Group Scores and Means	Group Scores and Means
Group A, n = 10	Group C, n = 22 $\bar{X}$ = 71.1	Group E = Group A + Group B
61	56 50	n = 37 $\bar{X}$ = 65.45
88 $\bar{X}$ = 72.1	47 79	
68	85 75	
62	75 81	
69	77 94	
73	65 56	Group F = Group C + Group D
89	78 56	n = 46 $\bar{X}$ = 71.79
61	75 84	
82	92 60	
68	91 49	
	97 42	
Group B, n = 27 $\bar{X}$ = 58.8		
32 70	Group D, n = 24 $\bar{X}$ = 72.5	
64 54	50 69	
79 76	89 75	
71 54	88 72	
80 60	68 98	
76 52	58 67	
60 61	86 75	
26 43	75 45	
68 57	80 49	
57 48	78 54	
41 47	82 83	
37 64	78 90	
69 76	56 69	
65		

Appendix C

Attitudes Toward Mathematics Letter

DEAR STUDENT:

THE SECONDARY EDUCATION DEPARTMENT AT UTAH STATE UNIVERSITY REQUEST YOUR ASSISTANCE IN OBTAINING RESEARCH DATA. THE INFORMATION SOUGHT HAS TO DO WITH ATTITUDES TOWARD MATHEMATICS. IT IS BELIEVED THAT SUCH INFORMATION MAY SERVE TO IMPROVE FUTURE MATHEMATICS TEACHING. YOUR COOPERATION WILL GREATLY HELP IN BROADENING OUR FIELD OF KNOWLEDGE IN THIS AREA. BECAUSE IT IS IMPORTANT THAT YOU ANSWER TRUTHFULLY YOU ARE ASKED NOT TO PUT YOUR NAME ON THE ANSWER SHEET. YOUR RESPONSE TO ALL QUESTIONS WILL BE KEPT CONFIDENTIAL AND WILL IN NO WAY AFFECT YOUR STANDING IN THIS CLASS OR USU.

YOUR PARTICIPATION IS GREATLY APPRECIATED.

RESPECTFULLY YOURS,

W. Dean Samuels

W. DEAN SAMUELS,
RESEARCH CHAIRMAN

VITA

Willis Dean Samuels

Candidate for the Degree of

Master of Science

Thesis: Attitudinal Effects of Unified Mathematics at Hillcrest High School

Major Field: Mathematics Education

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Personal Data: Born in Des Moines, Iowa, March 4, 1936, son of Walter and Sylva Samuels; married Shayla Reid, February 18, 1956; five children, Dean, David, Douglas, Daniel, and Aaron.

Education: Attended elementary school in Long Beach, California; graduated from Long Beach Polytechnic High School in 1954; attended Pacific States University 1956-57, East Los Angeles Junior College 1957-58, California Polytechnic College 1958-59, graduated from National Radio Institute, Washington, D. C. 1973, received Bachelor of Science degree from Utah State University in June 1975 with a major in mathematics education and a minor in physics, completed requirements for the Master of Science degree, specializing in mathematics education and education administration with emphasis in curriculum development in 1976.

Professional Experience: Currently, engineering consultant at Pepperidge Farms Inc., Logan, Utah: taught electronics Logan High School and owned TV service business 1974-76; Vocational Coordinator for Snow College, Ephraim, Utah 1973-74; electronics instructor for Hillcrest High School, Midvale, Utah 1972-73; owned chain of six stores in California and Utah 1964-72; Hughes Aircraft Co. member of 14-man launch team at Cape Kennedy for

Surveyor (First soft moon landing by U.S.A.); President of Phone Consultants of Southern California Inc., manufacturer of electronics equipment 1964; Northrup Nortronics Corp., Field Service Engineer and Company representative. Trained Navy missile technicians on how to launch Polaris missiles from submarines. Developed testing on special air-launched radar jamming device at White Sands, New Mexico, 1962-64; Engineering consultant for various firms. Wrote count-down manuals for Titan, Hawk, Minuteman missiles. Taught missile technicians how to launch and troubleshoot missiles at Cape Kennedy, 1959-62. Engineering technical writer for Douglas Aircraft, Missile Division. Wrote count-down manuals for Thor missile system. Taught technicians how to launch and troubleshoot missiles, 1959. United States Navy dental technician 1954-56.

Additional Information: Hold a current FCC First Class Radiotelephone license; Certified Electronics Technician, Advanced Radio Amateur License, and Private Pilot License.