THE EFFECT OF ATTITUDE IN MATHEMATICAL ACHIEVEMENT

A Research Paper

Presented to

The Graduate Council of

Austin Peay State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

in Education

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by

Carolyn Reese Reed

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To the Graduate Council:

I am submitting herewith a Research Paper written by Carolyn Reese Reed entitled "The Effect of Attitude in Mathematical Achievement." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts in Education with a major in Mathematics.

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Major Professor

Accepted for the Council:

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Dean of the Graduate School

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CHAPTER I

INTRODUCTION

I. THE PROBLEM

The mathematics teacher has long been disturbed by the large number of students who voice a dislike for mathematics and who avoid mathematics courses whenever possible. Gough, a teacher of mathematics from the sixth grade through junior college over a period of twenty-five years, stated that many of these students are actually victims of "mathemaphobia".[1] Tutlock termed these fears "emotional blocks" and charged that they were responsible for a "shrinking per cent of students studying mathematics."[2] Such concerns brought about investigations into the attitudes which produced this dislike and fear of mathematics.

It has long been believed by most educators that a student's attitude toward a course affects his achievement. As early as 1937, Allen postulated that, "Favorable emotional attitude toward both teacher and topic is probably the greatest contributing factor to student success and the mental annoyance of unfavorable emotional attitude contributes most to failure."[3] Perhaps the feelings of educators about this subject can best be summarized by Kinney and Purdy:

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[1] M. F. Gough, "Mathemaphobia: Causes and Treatments," Clearing House, XXVIII (January, 1954), p. 290.

[2] Mary K. Tutlock, "Emotional Blocks in Mathematics," Mathematics Teacher, L (December, 1957), pp. 572-573.

[3] J. Eli Allen, "Some Psychological Phases of Student Success in High School Mathematics," Mathematics Teacher, XXX (November, 1937), p. 323.

> Because learning is colored by emotions, considerations of feelings toward the subject is particularly important in establishing a desirable learning situation. Favorable attitudes are of course a necessary but not a sufficient condition for learning. Although desirable attitudes do not guarantee successful experience, learning takes place only if the pupils develop favorable attitudes toward the subject.[4]

For this reason, the development of favorable attitudes is usually one of the objectives of mathematics instruction. Johnson and Rising state as one of the goals of mathematics education that, "The student develops attitudes and appreciations which lead to curiosity, initiative, confidence and interest."[5]

Although it is generally accepted that attitudes play a major role in achievement, this belief has been questioned. According to Wofford and Willoughby:

> A number of educators have held that student attitudes are critical in determining scholastic achievement. Others have stated that personal achievement motives provide such a consistent academic performance level that course related attitudes are relatively unimportant.[6]

Few research studies have investigated the relationship between attitudes and achievement. A review of these studies leads Neidt and Hedlund to the conclusion that such studies have "usually found significant, although small, relationships."[7] In a paper presented to the

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[4]L. B. Kinney and R. C. Purdy, Teaching Mathematics in the Secondary School (New York: Rinehart and Company, Inc., 1952), p. 285.

[5]Donovan A. Johnson and Gerald R. Rising, Guidelines for Teaching Mathematics (Belmont, California: Wadsworth Publishing Company, Inc., 1967), p. 14.

[6]J. C. Wofford and T. R. Willoughby, "Attitudes and Scholastic Behavior," Journal of Educational Research, LXI (April, 1968), p. 360.

[7]C. O. Neidt and D. E. Hedlund, "The Relationship Between Changes in Attitudes Toward a Course and Final Achievement," Journal of Educational Research, LXI (October, 1967), p. 56.

National Council of Teachers of Mathematics recently, Neale states that the role of attitudes toward mathematics in mathematics achievement, if any, is modest and suggests the possibility that favorable attitudes are caused by learning rather than that learning is caused by favorable attitudes.[8] He suggests also that a student learns not so much because he "enjoys discovering the orderliness of mathematical relationships, but rather that he wants to be an obedient person and do his duty."[9]

Statement of the problem. The purposes of this study were: (1) to investigate the change, if any, in the students' attitudes toward mathematics following a course of instruction in mathematics; (2) to investigate the relationship between the attitude of students toward mathematics at the beginning of a course in mathematics and their achievement as measured by their grade in the course; and (3) to investigate the relationship between the attitudes of students toward mathematics following a course in mathematics and their achievement in the course.

Limitations. This study was limited to sixty-one students enrolled in Mathematics 200, Fundamental Concepts of Mathematics, at Austin Peay State University in Clarksville, Tennessee, during the spring of 1969. These 61 students were selected from 167 students enrolled in the Fundamental Concepts of Mathematics course. The others were eliminated because of unavailability of ACT scores or because of previous enrollment in college mathematics courses.

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[8]Daniel C. Neale, "The Role of Attitudes in Learning Mathematics" (paper presented at the National Council of Teachers of Mathematics Annual Meeting, April 24, 1969).

[9]Ibid., p. 12.

The conclusions of this study are based upon the assumption that attitudes can be accurately measured. This assumption has been questioned, but this author agrees with Malone and Freel that:

> While some authors declare that one's verbal attitudes may not actually measure what one will do when he encounters a certain object or situation, and, as such, attitude questionnaires merely measure verbal attitudes toward symbolic objects or situations, it would seem plausible that they do represent the current, conscious attitude of the person in the absence of some concrete explanation why they do not. It is of course possible that they do not represent an unconscious attitude and other techniques would appear necessary to explore that area.[10]

However, this study, like all attitude studies, is subject to certain limitations--namely the weakness in the instrument in measuring attitude and also in possible lack of truthfulness in the answers.

The validity of the conclusions of this study is also limited by the extent to which course grades are a measure of achievement. Douglass says that marks as a criterion of achievement may not be fully valid since they are often measures of "docility, promptness, personality, attendance, diplomacy, etc."[11] However, since the course grade is the criterion used most often in schools and universities to measure students' achievement, it was chosen for this study.

Significance of the study. It has long been suspected by many educators that there is a significant relationship between a positive attitude

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[10] W. H. Malone and E. L. Freel, "A Preliminary Study of the Group Attitudes of Junior and Senior High School Students Toward Mathematics," Journal of Educational Research, XLVII (April, 1954), p. 599.

[11] Harl R. Douglass, "The Prediction of Pupil Success in High School Mathematics," Mathematics Teacher, XXVII (December, 1935), pp. 489-490.

toward mathematics and high achievement in mathematics, but others charge that research studies have failed to establish positively the existence of such a relationship. This research is significant in that it is a continuation of research attempting to establish the existence of a significant relationship between attitude and achievement.

The study is also significant in that it attempts to determine what change takes place in students' attitudes toward mathematics after having completed the course, Fundamental Concepts of Mathematics. Such a study has not been done at Austin Peay State University.

II. THE HYPOTHESES

The following null hypotheses were made:

1. There is no change in the attitude of students toward mathematics for general education during a period of instruction in mathematics.

2. There is no difference in achievement in mathematics for general education between students with a poor attitude toward mathematics and students with a good attitude toward mathematics as measured at the beginning of the course.

3. There is no difference in achievement in mathematics for general education between students with a poor attitude toward mathematics and students with a good attitude toward mathematics as measured near the end of the course.

III. ORGANIZATION OF THE STUDY

This first chapter has defined, stated, and given the limitations of the problem under study. It also includes the hypotheses and the significance of the study. Chapter II is devoted to the review of the literature which is related to this study. Chapter III outlines the methods of procedure used in conducting this study, and Chapter IV presents the statistical analysis of the data. Chapter V presents the conclusions of the study and the recommendations based on these conclusions.

CHAPTER II

REVIEW OF RELATED LITERATURE

I. DEVELOPMENT OF THE STUDY OF ATTITUDES

As early as 1862, the psychologist Herbert Spencer employed the term, "attitude".[1] In the last fifty years, the study of attitudes has occupied a central place in social psychology.[2] With this emphasis has come many definitions of the terms.[3] The definition of attitude that seems most widely accepted is that by Allport:

> An attitude is a mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related.[4]

Thus it is the definition accepted for this study.

By 1954, the study of attitudes had become a vital concern in education.[5] Mathematics educators became concerned about attitudes toward

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[1] Gordon W. Allport, "Attitudes," Readings in Attitude Theory and Measurement (New York: John Wiley and Sons, Inc., 1967), p. 4.

[2] Marvin E. Shaw and Jack M. Wright, Scales for the Measurement of Attitudes (New York: McGraw-Hill Book Company, 1967), p. 1.

[3] For a review of some traditional definitions, see Shaw and Wright, p. 3.

[4] Allport, op. cit., p. 8.

[5] H. H. Remmers, Introduction to Opinion and Attitude Measurement (New York: Harper and Brothers, 1954), p. 393.

mathematics specifically. It was in 1954 that Gough stated her concern about "mathemaphobia"[6] and in 1957 that Tutlock wrote of "emotional blocks"[7] toward mathematics.

The first elaborate research studies of the attitudes associated with learning mathematics were conducted by Dutton. In 1951, he surveyed the attitudes of prospective teachers of arithmetic. He compiled a list of favorable and unfavorable attitudes (seventy-four per cent were unfavorable) from students' responses to the questions: (1) What are the most important favorable attitudes that you have toward arithmetic as we begin our study of the teaching of this subject in the elementary school?; (2) What are your most unfavorable attitudes toward arithmetic?[8] For his study, attitudes were defined simply as "the emotionalized feelings of students for or against something."[9] Dutton continued his study of attitudes in 1954 by devising a scale for measuring attitudes toward mathematics based on the responses given by prospective teachers. This study was a very significant one in the study of

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[6]M. F. Gough, "Mathemaphobia: Causes and Treatments," Clearing House, XXVIII (January, 1954), p. 290.

[7]Mary K. Tutlock, "Emotional Blocks in Mathematics," Mathematics Teacher, L (December, 1957), p. 573.

[8]Wilbur H. Dutton, "Attitudes of Prospective Teachers Toward Arithmetic," Elementary School Journal, LII (October, 1951), p. 84.

[9]Ibid.

mathematics attitudes since it concluded that a scale could be devised that would give significant information about students' attitudes toward mathematics.[10]

Several succeeding studies concerning attitudes about mathematics have employed the Dutton attitude scale. Among other instruments for the measurement of mathematics attitudes is the scale, Attitudes Toward Mathematics, developed in 1960 by Gladstone, Deal and Drevdahl[11] and the Revised Math Attitude Scale, devised in 1961 by Aiken and Dreger.[12]

In research reports and other writings concerning mathematics attitudes, each author has his own definition or description of mathematics attitudes. The definition by Corcoran and Gibbs seems to be inclusive of the others and is the accepted definition for this study. A student's attitude toward mathematics is, "A composite of intellectual appreciation of the subject and emotional reactions to it."[13] To clarify, it includes likes, dislikes, appreciations, prejudices, and interests.

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[10] Wilbur H. Dutton, "Measuring Attitudes Toward Arithmetic," Elementary School Journal, LV (September, 1954), pp. 24-31.

[11] Shaw and Wright, op. cit., pp. 237-242.

[12] Ibid., pp. 242-243.

[13] Mary Concoran and E. Glenadine Gibb, "Appraising Attitudes in the Learning of Mathematics," Evaluation in Mathematics, Twenty-Sixty Yearbook of the National Council of Teachers of Mathematics (Washington, D. C.: The National Council of Teachers of Mathematics, Inc., 1961), pp. 105-106.

II. RELATED RESEARCH

Among the studies of the relationship between attitudes and achievement is one by Aiken and Dreger. Their 1961 study involved entering college freshmen. They devised a mathematics attitude scale by the use of paragraphs describing attitudes toward mathematics, which were written by 310 college students, for use in their study. The subjects were entering college freshmen enrolled in general mathematics, intermediate algebra, and college algebra classes. Multiple regression analyses of the predictive value of the mathematics attitude scale were made with sixty males and sixty-seven females. It was found that mathematics attitudes made a significant contribution to the prediction of course grades for girls, but not for boys. Studying fifty-two males and sixty-three females, they found also that mathematics attitude scores could be used to predict gains in scores from initial to final administration of mathematics achievement tests when training had been interjected.[14]

In 1963 Lyda and Morse experimented with fourth grade students to see if students' attitudes toward arithmetic could be changed in a positive direction as a result of effective teaching methods and also to see what effect this change had on arithmetic achievement. The Dutton Arithmetic Attitude Scale and the Stanford Arithmetic Achievement Test were

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[14] L. J. Aiken and R. M. Dreger, "The Effects of Attitudes on Performance in Mathematics," Journal of Educational Psychology, LII (February, 1961), pp. 19-24.

administered to the subjects. They were then taught for twenty-one instructional periods of forty minutes each. Emphasis was placed on such topics as: concept of numbers, understanding of numeration systems, place value, and the use of fundamental operations. Following this instruction, the attitude scale and achievement test were again administered. The researchers found that changes in attitude took place in the desired direction and that these changes produced significant gains in arithmetic achievement as measured by achievement tests.[15]

Bassham and Murphy made a study with 159 pupils in five sixth-grade classes in 1963. They employed the Dutton Attitude Scale to study the relationship between attitudes about mathematics and classification as over-or under-achieving according to intelligence scores and reading comprehension. They found that a significant relationship existed; almost three times as many students with high attitudes over-achieved as under-achieved.

To determine whether students' attitudes are critical in determining scholastic achievement, Wofford and Willoughby studied the attitudes of seventy-two general psychology students at a coeducational state university in 1968. A forty-item sentence completion type attitude test was used. It consisted of four scales of ten items each to obtain scores for attitudes toward the instructor, the course, college, and life, as well as

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[15] W. J. Lyda and E. C. Morse, "Attitudes, Teaching Methods, and Arithmetic Achievement," Arithmetic Teacher, X (March, 1963), pp. 136-138.

[16] Harrell Bassham, M. Murphy, and K. Murphy, "Attitude and Achievement in Arithmetic," Arithmetic Teacher, XI (February, 1964), pp. 66-72.

a composite score. Course grades were significantly correlated with attitudes toward the course as well as with the composite attitude score.[17]

Antonnen devised a Semantic Differential for measuring students' attitudes regarding mathematics. He applied the test in a longitudinal study in which students whose attitudes toward learning mathematics had been measured in the fifth or sixth grades were retested six years later when they were in the eleventh or twelfth grades. He found a positive, but low, correlation (0.305) between the secondary attitude scores and the elementary attitude scores. The students' attitude toward learning mathematics became less favorable as the students progressed in school. In studying the relationship between attitudes and achievement, Antonnen found low correlations between achievement test scores and elementary attitudes (0.218) and between achievement test scores and secondary attitudes (0.379). The correlation between mathematics grade point average and elementary attitudes was 0.311 while the correlation between grade point average and secondary attitudes was 0.432. In summary, it was found that low correlations existed between mathematics attitude scores and both elementary and secondary mathematics achievement. A somewhat higher correlation existed between secondary mathematics attitude and secondary mathematics achievement.[18]

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[17] J. C. Wofford and T. L. Willoughby, "Attitudes and Scholastic Behavior," Journal of Educational Research, LXI (April, 1968), pp. 360-362.

[18] R. H. Antonnen, "An Examination into the Stability of Mathematics Attitude and Its Relationship to Mathematics Achievement from Elementary to Secondary School Level" (doctoral dissertation, University of Minnesota, Minneapolis, 1967).

The International Study of Achievement in Mathematics, which was begun in 1961, considered the relationship between attitudes and achievement. Five attitude scales were constructed for the study entitled: (1) Interest; (2) Desires More Mathematics; (3) Mathematics as a Process; (4) Difficulty of Mathematics; and (5) Importance of Mathematics. Correlations between these scores and Total Mathematics Scores were obtained for four populations: (1) thirteen-year-olds; (2) students in the grade level containing most thirteen-year-olds; (3) mathematics students in final secondary school year; (4) nonmathematics students in final secondary school year. The coefficients of correlation between the mathematics scores and interest were in the 0.27-0.34 range, between mathematics scores and the desire for more mathematics in the 0.19-0.25 range, between mathematics scores and "mathematics as process" in the negative 0.24-0.08 range, between mathematics scores and "difficulty of mathematics" in the negative 0.07-0.00 range, and between mathematics scores and "importance of mathematics" in the 0.04-0.13 range. Interest in mathematics and the desire to take more mathematics were positively related to achievement, and achievement was positively, but weakly, correlated with student belief about the importance of mathematics. On the other hand, achievement scores correlated negatively with the attitudes toward mathematics as a process and toward the difficulty of learning mathematics. The study concluded that, "The coefficients of correlation between achievement and attitudes are small in general."[19]

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[19] Torsten Husén (ed.), International Study of Achievement in Mathematics (New York: John Wiley and Sons, 1967), pp. 153-154.

Ryan conducted a study from 1964 to 1966 to determine the effects of certain modern mathematics programs (Ball State, UICSM, and SMSG) on the attitudes of students toward mathematics. The experiment involved 126 pairs of mathematics classes composed mostly of ninth graders. Each teacher taught a pair of classes--one experimental, the other conventional. The major conclusion of the study was that the experimental programs had little effect, in comparison to conventional programs, on the attitude of students toward mathematics. In this study, Ryan also studied the relationships among various indices of mathematics attitude (interest, perceived utility, ease of learning, etc.) and indices of achievement (course grades and achievement test scores). The highest correlation (0.31) existed between scores on the Aiken Mathematics Interest Scale and course grades, while the correlation between the interest scores and achievement test (STEP) scores was 0.23. Correlations between scores on the Dutton Mathematics Attitude Scale and mathematics achievement were in the 0.22-0.28 range. Ryan concluded from these scores that correlations between attitude indices and measures of achievement were relatively low.[20]

Neale, after reviewing the findings presented by Antonnen, Husén, and Ryan, admits that, at first glance, the above data gives support--

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[20] J. J. Ryan, "Effects of Modern and Conventional Mathematics Curricula on Pupil Attitudes, Interests, and Perception of Proficiency" (Washington, D. C.: United States Office of Education, Bureau of Research, 1968). (Mimeographed.)

though limited--to the belief that favorable attitude leads to learning. But he believed that, since in each of these cases attitudes and achievement were measured at the same time, these correlations could just as well mean that learning causes favorable attitudes. Therefore, he did a study with 105 sixth grade boys, administering a Semantic Differential at the beginning of the year to measure attitudes. An achievement test and an intelligence test were also administered at this time. At the end of the year, the boys were retested with an advanced form of the achievement test. A series of correlation and multiple regression analyses were made to predict achievement at the end of the year from the data received at the beginning of the year. He found a correlation between attitude and achievement of approximately 0.35. However, he states that almost ten per cent of the variation was a result of attitudes acting jointly with prior achievement. He concluded that it is still impossible to accept either hypothesis--that favorable attitudes cause learning or that learning causes favorable attitudes.[21]

In 1961, Bastrom and Vlandis studied 228 college students to determine the relationship between grades and attitude change. Students responded to an attitude scale and several weeks later were requested to write an essay on topics related to this attitude, adopting the opposite view from that measured by the attitude scale. Grades were randomly assigned to the essays, and the attitude scale was administered again.

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[21]Daniel C. Neale, "The Role of Attitudes in Learning Mathematics" (paper presented to the National Council of Teachers of Mathematics Annual Meeting, April 24, 1969).

They found that good grades serve as a reinforcing role whereas poor grades or no grade at all had no effect.[22]

Neidt and Hedlund inquired into the relationship between change in student attitudes toward a class and final achievement in that class. Five attitude scales were constructed to measure attitude toward a particular class. These scales were administered at two week intervals to 573 college students enrolled in three different courses--anatomy, English, and German. They found that attitudes become progressively less favorable. They found in two of the three classes that attitudes were significantly related to course grades early in the period of instruction, when variance due to ability was controlled, and became more closely related as the period of instruction progresses. However, all correlations were small.[23]

In 1968 Roberts employed the Rabinowitz Mathematics Attitude Scale to study the attitudes of 264 college freshmen toward mathematics. Among the conclusions of this study were these findings: (1) There was no significant difference in mathematics attitudes with respect to sex; and

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[22] R. M. Bastrom and J. W. Vlandis, "Grades as Reinforcing Contingencies and Attitude Change," Journal of Educational Psychology, LII (April, 1961), pp. 112-115.

[23] C. O. Neidt and D. E. Hedlund, "The Relationship Between Changes in Attitudes Toward a Course and Final Achievement," Journal of Educational Research, LXI (October, 1967), pp. 56-58.

(2) Students in the engineering track showed significantly more positive attitudes than did students in terminal mathematics courses.[24]

The preceding evidence is inconclusive regarding the relationship between attitudes and achievement. This author believes, therefore, that further investigation is warranted.

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[24]Fannie Roberts, "Attitudes of College Freshmen Towards Math," Mathematics Teacher, (January, 1969), pp. 25-27.

CHAPTER III

METHODS OF RESEARCH

The subjects for this study were chosen from the 167 students enrolled in five classes of Mathematics 200, Fundamental Concepts of Mathematics, at Austin Peay State University in Clarksville, Tennessee, during the spring quarter of 1969. Fundamental Concepts of Mathematics is a one quarter course designed for the general education program. The textbook used for the course is Introduction to Mathematics by Meserve and Sobel, published by Prentice-Hall, Inc. The authors hope that this text will "leave the reader with a better picture of the true meaning and beauty of mathematics as opposed to a traditional approach with a major emphasis on abstract manipulations."[1]

The Rabinowitz Mathematics Attitude Scale[2] was used to measure students' attitude toward mathematics. The scale is a Likert-type scale composed of fifty statements, twenty-five of which are positive and twenty-five negative. The student signifies either agreement or disagreement with the statements, and one point is given for each correct response. The attitude score then is the number of correct responses. The scale appears to have face validity in that a "yes" response to a

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[1] Bruce E. Meserve and Max A. Sobel, Introduction to Mathematics (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1964), p. v.

[2] Devised by Dr. William Rabinowitz, Chairman of the Department of Psychology of Pennsylvania State University.

positive statement denotes a favorable attitude and a "no" response to a negative statement denotes an unfavorable attitude. The scale was administered to twenty-eight students enrolled in a Mathematics 200 class during the winter quarter of 1969 to determine its reliability for this population. The split-half method was used to yield a reliability coefficient of 0.90. The scale and instructions are reproduced in Appendix A.

During the first session of the class in the spring quarter, March, 1969, the Rabinowitz Mathematics Attitude Scale was administered to obtain a Pre-Course Attitude Score. The scale was administered again during the last week of the course to obtain a Post-Course Attitude Score.

Only the sixty-one students who had previously taken no mathematics course in college and for whom American College Test (ACT) scores were available were chosen for this study. Final course grades were chosen as the criterion for achievement.

The Pre- and Post-Attitude Scores of all sixty-one students were used to determine what change, if any, occurred in students' attitude. Table VI of Appendix B contains a list of these scores. These scores are from students enrolled in five classes with three different teachers. The number of students per teacher and the distribution according to sex is shown in Table I.

TABLE I

NUMBER AND SEX OF SUBJECTS PER TEACHER

	Males	Females	Totals
Teacher I	16	14	30
Teacher II	13	10	23
Teacher III	2	6	8
Totals	31	30	61

To test hypothesis two, the Pre-Course Attitude Scores of the sixty-one students were ranked from high to low. Those students whose scores were in the upper 40 per cent were chosen to form the High Attitude Group, while those whose scores were in the lower 40 per cent formed the Low Attitude Group. Therefore, each group consisted of twenty-four students. Table II shows the number of students per teacher and the distribution according to sex for each group. ACT scores and course grades were tabulated for each group. Table VII of Appendix B contains these tabulations.

TABLE II

NUMBER AND SEX OF SUBJECTS PER TEACHER ACCORDING TO PRE-COURSE ATTITUDE SCORES

	High Attitude Group			Low Attitude Group		
	Males	Females	Totals	Males	Females	Totals
Teacher I	8	5	13	5	6	11
Teacher II	4	2	6	5	6	11
Teacher III	1	4	5	1	1	2
Totals	13	11	24	11	13	24

To test hypothesis three, Post-Course Attitude Scores of the same sixty-one students were ranked from high to low. The High Group and the Low Group were formed by the method outlined in the preceding paragraph and, as before, each group consisted of twenty-four students. Table VIII of Appendix B shows the tabulations of ACT scores and course grades for these groups. Table III shows the number of students per teacher and the distribution of students according to sex for each group.

TABLE III

NUMBER AND SEX OF SUBJECTS PER TEACHER ACCORDING TO POST-COURSE ATTITUDE SCORES

	High Attitude Group			Low Attitude Group		
	Males	Females	Totals	Males	Females	Totals
Teacher I	10	5	15	5	6	11
Teacher II	6	1	7	5	4	9
Teacher III	0	2	2	1	3	4
Totals	16	8	24	11	13	24

CHAPTER IV

STATISTICAL ANALYSIS

Analysis of variance was used to test the change in students' attitudes toward mathematics from the beginning of the course, Fundamental Concepts of Mathematics, to the end of the course. The relevant data may be tabulated as follows:

Mean of Pre-Course Attitude Score	28.0
Mean of Post-Course Attitude Score	26.4
Standard Deviation	4.49
F-Value (for trials)	3.98

The value of F at the .05 level of significance is 4.00. Therefore, there was no significant change in attitude toward mathematics from the beginning of the course to the end of the course, although a change toward an unfavorable attitude approached significance.

The difference in the means of achievement of the High Attitude Group and the Low Attitude Group, according to Pre-Course Attitude Scores, was analyzed by analysis of covariance to allow for differences in ability. Final course grades were replaced by the following numerical values: 5 for A; 4 for B; 3 for C; 2 for D; and 1 for F. Significant data derived from this analysis are presented in Table IV.

TABLE IV

STATISTICAL DATA OBTAINED WHEN INVESTIGATING THE RELATIONSHIP BETWEEN PRE-COURSE ATTITUDE SCORES AND ACHIEVEMENT

	Mean of ACT	Mean Grade	Mean Grade (Adjusted)
High Attitude Group	17.25	3.54	3.46
Low Attitude Group	14.21	2.88	2.96
General Mean	15.73	3.21	3.21

The standard deviation after adjustment for differences in ACT scores was found to be 0.83. The F-value (after adjustment) was 12.57. The value of F at the .05 level of significance is 4.06, and at the .01 level is 7.23. Therefore, the difference in means for achievement between the High Attitude Group and the Low Attitude Group, as measured at the beginning of the course, was highly significant at the .01 level.

The difference in the means in achievement of the High Attitude Group and the Low Attitude Group, according to Post-Course Attitude Scores, was also analyzed by analysis of covariance. Significant data are presented in Table V.

TABLE V

STATISTICAL DATA OBTAINED WHEN INVESTIGATING THE RELATIONSHIP BETWEEN POST-COURSE ATTITUDE SCORES AND ACHIEVEMENT

	Mean of ACT	Mean Grade	Mean Grade (Adjusted)
High Attitude Group	17.92	3.54	3.45
Low Attitude Group	12.96	2.71	2.80
General Mean	15.44	3.12	3.12

The standard deviation after adjustment for differences in ACT scores was found to be 0.84. The F-value (after adjustment) was 14.09. Again the value of F at the .05 level of significance is 4.06, and at the .01 level is 7.23. Therefore, the difference in means in achievement between the High Attitude Group and the Low Attitude Group, as measured at the end of the course, was highly significant at the .01 level.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

It was the purpose of this study (1) to investigate the change in attitude and (2) to investigate the relationship between attitudes and achievement, in a college mathematics course designed for the general education program. The study seems justifiable in view of the need for any knowledge of any of the factors which contribute to learning. Related literature indicates that student attitude may be such a factor.

Students were given the Rabinowitz Mathematics Attitude Scale at the beginning of the spring quarter and again at the end of the quarter. Only those students who had previously taken no mathematics course in college and for whom ACT scores were available were chosen for the study.

On the basis of Pre- and Post-Course Attitude Scores, the ACT scores, and final course grades, the following conclusions were made:

1. Since there was no significant difference (at the .05 level) in Pre-Course Attitude Scores and Post-Course Attitude Scores, there is no change in students' attitude toward mathematics as a result of a general course in mathematics. However, there is some evidence that attitudes may have become less favorable as a result of the course. Perhaps more conclusive results could have been established if more students could have been available for the study.

2. Since students with a favorable attitude toward mathematics achieved significantly more than students with an unfavorable attitude, a student's attitude toward a course does have an effect on his achievement in the course.

Since this study suggests the possibility that students' attitudes become less favorable toward mathematics following instruction in the course, Fundamental Concepts of Mathematics, while offering substantial evidence that attitudes affect achievement, the following topics for further research are recommended:

1. A study of possible teaching methods, to be employed in the Mathematics 200 classes at Austin Peay State University, in an attempt to promote more favorable attitudes toward mathematics.

2. The change in attitudes produced by instruction in Mathematics 200 at Austin Peay State University--using more students and, perhaps, a different attitude scale.

3. The change in attitudes as a result of other mathematics courses, especially the course for elementary teachers.

4. The relationship between attitudes and achievement, utilizing more students and controlling more variables--such as teachers, course grades, and intelligence scores.

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APPENDIX A

HOW DO YOU FEEL ABOUT MATHEMATICS?

This is not a test.

It is a chance for you to show how you feel about mathematics.

On the next two pages you will find 50 statements about mathematics. You will probably agree with some of the statements. With other statements you will probably disagree. We are interested in your opinion about each of the statements.

You can tell us how you feel about each statement in the following way. First, read each statement carefully. Then, if you feel that the statement is true or if you agree with it, cross out the "A" on the separate answer sheet. If you feel that the statement is false or if you disagree with it, cross out the "D" on the separate answer sheet.

For example, suppose you were given this statement: I GET MY LOWEST MARKS IN MATHEMATICS. If you feel that this is true, that you get your lowest marks in mathematics, you should cross out the "A" on the answer sheet. But if you feel that the statement is false, that you do not get your lowest marks in mathematics, you should cross out the "D" on the answer sheet.

Be sure to mark a response for each statement even if you are not sure how you feel. Don't leave anything out.

There are 50 statements for you to read and respond to. Don't spend too much time on any particular one.

Be sure to make your response on the separate answer sheet. Just cross out the letter that shows how you feel.

Remember: This is not a test. There are no right or wrong answers. Give your personal opinion.

1. It takes me a long time to catch on to a new topic in mathematics.

2. Very often in mathematics courses I cannot see a clear relationship between one topic and another.

3. I get a great deal of satisfaction out of solving a problem in mathematics.

4. I can't see how most of the mathematics I have learned thus far will really help me very much in later life.

5. In mathematics you have to be able to remember an awful lot of rules that don't make too much sense.

6. I find mathematics clear.

7. To do well in mathematics it's much more important to think clearly than to have a good memory.

8. Mathematics is such a hard subject that one student usually can't get very much help from another.

9. When I get an answer to a mathematical problem, I usually can't tell whether it's right or wrong until the teacher gives the correct answer.

10. Unless a mathematics teacher gives many quizzes, most students will soon fall far behind.

11. In mathematics, ideas have a logical relationship to one another.

12. Mathematics is probably the most difficult subject in school.

13. Even before I begin a new topic in mathematics, I feel confident that I will be able to understand it.

14. Mathematics should be very appealing to a student with imagination.

15. I'm looking forward to studying some of the advanced mathematical topics I've heard about.

16. The trouble with mathematics is that it's too theoretical, and not practical enough.

17. I enjoy trying to solve mathematical problems and puzzles.

18. I think I have good mathematical ability.

19. The average student can't help being bored by mathematics.

20. I feel quite capable of going on to higher mathematics.

21. Mathematics helps us to find out more about the world we live in.

22. In mathematics you either know what you're doing or you don't, there's no in-between.

23. Unless a mathematics teacher gives a clear explanation of a topic, a student has difficulty.

24. I find mathematics useful in everyday life.

25. Mathematics is very interesting.

26. Mathematics courses are for the bright students, not those who are just average.

27. The only students who should be required to take mathematics are those who need it for a career like engineering or science.

28. Mathematics is an essential part of the background of a well-educated person.

29. Most of the students who get good marks in mathematics are "bookworms".

30. You don't have to have a special kind of abstract mind or an unusual mathematical talent to enjoy mathematics.

31. Mathematics frightens me.

32. In mathematics, more than in any other subject, what a student learns depends on how good the teacher is.

33. Mathematics is probably not the easiest school subject, but it isn't the hardest either.

34. Homework in mathematics is more difficult than homework in other subjects.

35. The most important thing in mathematics is a good memory.

36. Mathematicians are no more peculiar than doctors, lawyers, or people in other fields.

37. I would take mathematics even if I didn't have to.

38. Even when I understand a mathematical topic fairly well, I find it hard to explain it to someone else.

39. Mathematics is basically a very interesting subject, and there is no reason why a student has to find it boring or dull.

40. I get more nervous before a test in mathematics than a test in any other subject.

41. I find mathematics confusing.

42. Mathematics is highly practical as well as theoretical.

43. We always start a new topic in mathematics before I feel sure of the old one.

44. You don't need a special aptitude for mathematics to do well in the subject.

45. Students who are very good in mathematics are often not interested in other students.

46. An average student can understand mathematics.

47. In mathematics I have to memorize because I can't really understand.

48. In mathematics it isn't necessary for each student to study topics in the same order.

49. If you go about studying mathematics in a sensible way, you usually find it's not too difficult.

50. I like to study interesting applications of mathematics even if they are not part of the assigned course work.

APPENDIX B

TABLE VI

SCORES TO INVESTIGATE CHANGE IN ATTITUDE

Student Number	Pre-Course Attitude Score	Post-Course Attitude Score
1	44	43
2	43	42
3	43	44
4	42	44
5	41	34
6	41	44
7	40	40
8	39	42
9	38	42
10	38	36
11	37	36
12	37	35
13	36	42
14	36	43
15	35	40
16	35	38
17	34	33
18	34	24
19	34	27
20	33	32
21	33	17
22	32	20
23	31	28
24	31	20
25	31	26
26	30	28
27	29	22
28	28	18
29	28	17
30	27	32
31	26	31
32	26	20
33	26	23
34	25	26
35	25	16

TABLE VI (continued)

Student Number	Pre-Course Attitude Score	Post-Course Attitude Score
36	25	
37	24	10
38	24	22
39	24	26
40	23	15
41	23	25
42	23	32
43	22	17
44	22	15
45	22	21
46	21	18
47	21	29
48	21	22
49	20	19
50	20	19
51	20	15
52	20	17
53	20	21
54	19	12
55	19	5
56	18	22
57	18	21
58	18	22
59	13	18
60	12	26
61	9	16
		20

TABLE VII

ACT SCORES AND COURSE GRADES FOR STUDENTS IN THE HIGH AND LOW ATTITUDE GROUPS ACCORDING TO PRE-COURSE ATTITUDE SCORES

High Attitude Group			Low Attitude Group		
Student Number	ACT	Grade	Student Number	ACT	Grade
1	14	D	1	18	C
2	21	B	2	23	A
3	18	B	3	17	D
4	24	B	4	10	D
5	23	B	5	15	C
6	26	A	6	6	C
7	14	B	7	19	C
8	22	B	8	9	D
9	15	D	9	14	D
10	26	B	10	16	B
11	15	C	11	17	F
12	20	C	12	15	C
13	12	D	13	17	D
14	14	B	14	16	C
15	17	B	15	14	C
16	18	B	16	13	C
17	17	B	17	11	D
18	15	C	18	9	C
19	24	C	19	4	C
20	22	C	20	9	C
21	9	B	21	18	D
22	9	B	22	16	C
23	14	B	23	22	A
24	5	C	24	13	B

TABLE VIII

ACT SCORES AND COURSE GRADES FOR STUDENTS IN THE HIGH AND LOW ATTITUDE GROUPS ACCORDING TO POST-COURSE ATTITUDE SCORES

High Attitude Group			Low Attitude Group		
Student Number	ACT	Grade	Student Number	ACT	Grade
1	26	A	1	9	D
2	24	B	2	14	C
3	18	B	3	4	C
4	14	D	4	9	B
5	14	B	5	5	C
6	21	B	6	8	D
7	22	B	7	13	B
8	15	D	8	17	F
9	12	D	9	15	C
10	14	B	10	9	D
11	17	B	11	14	D
12	18	B	12	18	D
13	26	B	13	9	B
14	15	C	14	16	C
15	20	C	15	6	C
16	23	B	16	16	C
17	17	B	17	16	D
18	22	C	18	22	A
19	22	B	19	17	D
20	15	C	20	19	C
21	16	B	21	17	D
22	14	B	22	13	C
23	1	C	23	14	D
24	24	C	24	11	D