A CROSS SECTIONAL STUDY OF THE MODIFICATION OF ATTITUDES OF SELECTED PROSPECTIVE ELEMENTARY SCHOOL TEACHERS TOWARD MATHEMATICS

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PREFACE AND ACKNOWLEDGMENTS

The purpose of this study was to investigate the modification of attitudes toward mathematics of a group of prospective elementary school teachers. The investigator also gave some consideration to differences in types of modified attitudes toward mathematics.

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CHAPTER I

INTRODUCTION

An outstanding survey conducted relative to the ten most significant contributions of research to education includes both the mathematics curricula reform and educational attitudinal development (70). There has been much criticism about the way arithmetic has been taught in grade schools and until recently it had a meager intellectual content. Thus, the oft-noted reaction against the subject was not an unfortunate rebellion against a difficult subject, but a perfectly proper response to a preoccupation with triviality. The reformers have shown a concern for the development of wholesome attitudes toward mathematics and the improvement of content (10). Similarly, some of the departments and personnel of Oklahoma State University have been interested in improving both the attitudes and mathematics training of elementary school teachers. This has been evidenced through several publications and research studies which pertained to the education of teachers and their attitudes toward mathematics (20, 27, 46, 54).

Attitudes are important. What a person is or what he may become; whether he succeeds or fails, achieves satisfaction or not; whether he approaches his potential or allows his talents to remain underdeveloped does not rest alone upon the smile of fortune, intelligence, a healthy body, and the knock of opportunity. Instead these factors, perhaps, ultimately rest upon the attitudes one has acquired (35).

Reeve (53) has voiced the idea that the educational institutions of our society have shown concern over the knowledge, skills, emotional life and cultural values of students. Thus, researchers, school people, and especially teachers are interested in the nature of attitudes - how they are acquired, how they are developed or modified - and the degree to which they are related to anticipated pupil achievement as well as to the application of subject-matter.

Statement of the Problem

Instruction is an interrelationship between the teacher and students. This interrelationship consists of two parts; a verbal and a non-verbal part. The verbal part is usually evident. However, the non-verbal part is intangible and may be more decisive than the verbal part. This intangible non-verbal communication includes the facets of facial expressions, tone of voice, degree of sincerity, subtle mannerisms and feelings. The foregoing implies that the feelings of teachers may be transmitted non-verbally to students and conversely (12).

The purpose of this study was to investigate the attitudes toward mathematics of a group of selected prospective elementary school teachers. Specifically, the major problem was to determine if attitudes toward mathematics are significantly modified during the semester of enrollment in each course of the mathematics sequence for elementary education majors at Oklahoma State University. The courses of the mathematics sequence are Mathematics 2413, Mathematics 2513, and Education 4152. In this study the variables which are examined as possibly being related to the modification of attitudes toward mathematics are (a) grade expectation, (b) enrollment in each course of

the mathematics sequence, (c) concurrently enrolled or not enrolled in courses related to mathematics, (d) liking or disliking a majority of the topics which are related to mathematics, (e) the frequent or infrequent use of mathematics outside of the classroom, (f) changes in the grade level where attitudes toward mathematics were formed, and (g) variations in the types of attitudes.

Scope and Limitations

The basic premises of this study were that attitudes toward mathematics can be indirectly measured along and vary along a linear continum. A study of this nature necessarily includes the belief that attitudes toward mathematics can be modified through the teaching techniques employed by the instructors of the mathematics sequence. It was further assumed that the opinionnaire which was used to collect the data for this study was valid and reliable and that the responses to items on the opinionnaire reflected the predisposition of the participants toward mathematics.

The writer obtained data from 279 prospective elementary school teachers. All of the participants were students at Oklahoma State University and were enrolled in courses of the mathematics sequence. Students from all classifications and both sexes were represented, although a vast majority of the subjects were females. It is to be noted that the female-male sex ratio of this study is fairly consistent with the sex ratio of in-service elementary school teachers which have been observed by the writer.

Significance of the Study

Among the many factors that concern educators, Lee and Lee (35) have cited the need for some understanding of how attitudes develop and ways of changing attitudes, beliefs, and prejudices.

Much research has been done in the area of elementary school mathematics education. The previously completed research in mathematics education has been a consideration of the entire spectrum of the elementary school curriculum. In addition, the development of the present modern mathematics programs have relied heavily upon the results of research (77).

It seems that past research has reflected both the concern and interest of educators in students and in learning processes. Some studies have made use of lists of topics and concepts to be taught and learned at various grade levels. Some investigations have pertained to (a) the amount of content being taught, (b) the adequacy of teaching facilities and materials, (c) varied teaching methods, (d) the educational background of teachers, and (e) the attitudes of teachers. Research reported in the Educational Index and The Review of Educational Research supports these notions.

The research and commentaries relating to attitudes have substantiated educators' need for and further study about teachers' attitudes as they pertain to formal instruction. Rosenbloom (56) reported that in relation to teacher effectiveness, "the teachers' attitude is a more important factor than his formal preparation." Banks (5) is in agreement with the previous statement. He has put forth the thesis that undesirable student attitudes toward mathematics may

result from a number of causes, but the main contributing factor is the teacher's behavior. Harrington (23) has confirmed the position taken by the two previously named researchers. In his study he reported that teachers were the persons who most influenced attitudes toward mathematics. Also, Banks (5) reported that teachers who have confidence, understanding, interest, and enthusiasm for mathematics have done a great deal toward insuring the success of their mathematics programs.

Some research studies have been based on traditional programs and others on modern programs. However, none of the literature reviewed involved a cross-sectional-paired study of selected prospective elementary school teachers; nor were the modifications of their attitudes toward mathematics investigated through the use of non-parametric statistical techniques. The teachers who participated in the field testing of School Mathematics Study Group reported that students now seemed more interested in studying mathematics than formerly and that classroom sessions were very stimulating and challenging to the teacher and student alike (77). The above statement indicated that attitudes toward mathematics may be altered. Attitude change in mathematics is indicated by current feelings toward mathematics contrasted with former feelings toward mathematics. Thus, this study was undertaken to determine if, among selected prospective elementary school teachers, attitudes toward mathematics could be significantly modified. And if there were significant modifications of attitudes toward mathematics while students were enrolled in the mathematics sequence, where and in what direction did the modifications occur.

Researchers often desire to use words, concepts or terms to imply a particular meaning. Hence, in order to convey the same ideas to everyone, there arises the need to clarify some terminology.

Clarification of Terms and Concepts

Certain terms used in the study require definitions. The selected terms or concepts and their definitions are as follows:

Attitudes

Attitudes are typically defined as predispositions to respond in a particular way toward a specified class of objects (25). In this study it will be used synonymously with the term dispositions. Attitudes toward mathematics will be measured in this study by the mean scores on the Dutton Attitude Scale. The mean score attained by each participant is arrived at by summing the numerical values which correspond to the statements on the instrument with which the participant has indicated he is in agreement and then dividing this sum by the number of statements he has agreed to.

Attitude Modification

Generally, attitude modification in mathematics is indicated by current feelings toward mathematics contrasted with former feelings toward mathematics. In this study it is indicated by the mean score of the post-test minus the mean score of the pre-test. It may be called changed attitude toward mathematics, or modified attitude toward mathematics.

Attitudes Toward Mathematics

Attitudes toward mathematics are indicated by the mean scores achieved by students on the measuring instrument. A mean score that is near zero is representative of a negative attitude toward mathematics. A mean score that is near ten suggests a positive attitude toward mathematics.

Classification

The term classification is used in reference to the grade level of the respondent, specifically freshman, sophomore, junior, senior, or graduate student enrolled in a college or a university. This information was obtained from data section on the instrument.

Course(s) Related to Mathematics

Courses which are not offered for study by the Department of Mathematics, and make use of mathematics as one of the principal tools, are referred to as courses related to mathematics or as mathematics related courses. This information was obtained by requesting the participants to indicate on the questionnaire agreement or disagreement with statement 25 of Appendix A, "I am currently enrolled in a non-mathematics course that makes use of mathematics as a principal tool." Physics and Chemistry are examples of these kinds of courses.

Current Enrollment in a Course of the Mathematics Sequence

This statement means that a respondent is enrolled in at least one of the three courses which comprise the mathematics sequence. The manner

of collecting the data fulfilled the criterion that each participant be enrolled in at least one course which belongs to the mathematics sequence.

Cross-Sectional Study

A cross-sectional study is a study such that the sample is representative of all characteristic parts of the parent population. In this particular case the definition carries the implication that all classifications of college students are included in the study.

Education 4152

Education 4152 is entitled, Mathematics in the Elementary School Curriculum. It is taken during the senior year and is designed to meet the needs of elementary school teachers in the area of mathematics. The primary considerations are the purposes for teaching mathematics, selection and organization of content, teaching and learning procedures, and evaluation of outcomes in the area of mathematics, grades one through eight (43).

Elementary School

Elementary school is that portion of the American school designated grades one through six.

Grade Expectation

Grade expectation refers to student anticipation toward earning a grade of C or above or a grade below that of C. This information was obtained from the questionnaire.

Grade Level in Which the Present Attitudes Were Formed

This statement appeared on the questionnaire and was indicated by the subject circling the numeral which denoted the grade that the respondent was attending when his present attitude toward mathematics was formed.

Mathematics

In this study the term mathematics is applied to both the usual areas of mathematics and arithmetic. This is a commonly accepted definition. It was possible to define mathematics in this manner, because mathematics is generally thought of as the science of numbers and their operations, interrelations, combinations, generalizations, and abstractions. It also includes space configurations and their structures, measurements, and transformations. Arithmetic is more restrictive in that it connotes operations as well as the computation and calculation with real numbers. Arithmetic is a proper subset of mathematics, and the two are not synonymous.

Mathematics 2413

Mathematics 2413, Arithmetic for Teachers, constitutes a study of the foundations of arithmetic for elementary school teachers (43).

Mathematics 2513

Mathematics 2513, is named Structural Concepts for Teachers. The course included analysis of the structure of the number system and informal geometry for elementary school teachers (43).

Mathematics Sequence

The mathematics sequence will be used to denote Mathematics 2413, 2513, and Education 4152.

Prospective Elementary School Teacher

The phrase prospective elementary school teacher applied to persons who are currently enrolled in at least one course which is a part of the mathematics sequence.

Reasons for Liking or Disliking Mathematics

The above phrase is self-explanatory. Data for it was obtained by the use of an open-end question on the instrument. The responses were so dissimilar that no attempt was made to tally them.

The Frequent Practical Use of Mathematics

This variable also appeared on the instrument which was used to collect data. Each student indicated agreement or disagreement with statement 23, Part I of Appendix A, "Within the past two weeks I have frequently used mathematics."

Topics in Mathematics Liked and Disliked

This premise was used to determine if students after taking the course have different feelings toward certain topics in mathematics than before. This data was obtained by having the students indicate a like or dislike for each item on a list of topics found in Appendix A, Part II. See the instrument for the listing. Similar responses were categorized.

The clarification of terms is fundamental to the understanding of an investigation and for most studies it is sufficient. However, this is an attitudinal study and some consideration must be given to the many views of what constitute the nature of attitudes.

Nature of Attitudes

In the literature of psychology there are numerous definitions for the term attitudes. For example, Nelson (42) has reviewed thirty sources and listed twenty-three terms which are used to define attitudes.

Some definitions of attitudes are:

> The sum-total of a man's inclinations and feelings, prejudices or biases, preconceived notions, ideas, fears, threats, and convictions about any specific topic. Thus, a man's attitude about pacificism means...all that he feels, and thinks about peace and war. It is admittedly both a subjective and personal affair (72).

> A felt disposition arising from the interaction of experiences and innate tendencies which disposition modifies in a general way the responses to psychological objects (42).

> An expression by word, or deed of one's reaction toward, or feeling about a person, a thing, or a situation (26).

> A relatively permanent determining tendency to find an interest in, to form an opinion about, or to act with respect to values, persons, or events to which it has direct reference. It is the readiness to respond intellectually, emotionally, and volitionally, and to act in accordance with whatever tendencies are aroused (58).

> A mental, and neural state of readiness organized through experience, exerting a directive and dynamic influence upon the individual's response to all objects, and situation with which it is related (3).

> A tendency to evaluate an object, or the symbol of that object in a certain way (30).

> The readiness to react toward, or against some object of value. Attitudes may be considered as a sort of charge or potential that an individual has. When we are stimulated by the appropriate stimulus, our responses usually follow a pre-determined pattern (13).

> A learned, emotionally toned predisposition to react in a consistent way, favorable or unfavorable, toward a person, object or idea. An attitude of an individual is inferred from his behavior and cannot be measured as directly as skills, facts, and concepts. An attitude is that something which influences the individual's acceptance or rejection of persons, things, and ideas (32).
>
> A particular feeling about something. Attitudes therefore involve a tendency to behave in a certain way in situations which involve that something, whether it be a person, an idea, or an object. An attitude is partially rational and partially emotional, and an attitude is acquired by an individual; it is inherent in an individual (64).
>
> The positions the individual upholds and cherishes about objects, issues, persons, groups, or instructions (60).

The unity or similarity of these definitions is exemplified by a common thread of terms synonymous to feelings, predispositions, or readiness to respond, as a consequence of a stimulus, toward objects, symbols, or situations in a certain way. The consequential actions may be observable or unobservable, negative or positive. Recognizing that a definition of attitudes should be broad and inclusive, the writer preferred the definition of attitudes attributed to Hovland and Rosenberg (25), "Attitudes are predispositions to respond in a particular way toward a specified class of objects." In addition, the term "predisposition" is considered by the writer to be synonymous with the term "attitude".

The above definitions are indicative of the general nature of attitudes. Hence, these definitions also apply to teachers' and prospective elementary school teachers' attitudes toward mathematics. For example, the definition of attitudes as used herein can be specifically stated as "a predisposition to respond in a particular way toward mathematics."

Some consideration of the dimensions of attitudes is a natural sequel to any discussion of the nature of attitudes. Therefore, the next section is a brief general treatment of this aspect of attitudes.

Dimensions of Attitudes

The types of responses that are commonly used as indices of attitudes are cognitive, effective, and behavioral (25). To a large extent, the response classes are abstractions or concepts and are inferred from specific types of measurable responses.

Cognitions include perceptions, concepts, and beliefs about the attitude object and these are usually elicited by verbal questions in printed or oral form. Similarly, how an individual will act toward a given situation may be evaluated by how he does respond when directly confronted with the situation but may also be inferred from what he says he will do in a given situation.

An individual's response toward another individual may be inferred from measures of such psychological variations as blood pressure or galvanic response. Nevertheless, the responses belonging to the effective category are more generally inferred from verbal statements of an individual about how much he likes or dislikes someone.

The behavioral category makes use of overt behavior as the main index of attitudes. This category also utilizes body actions as well as verbal statements concerning behavior.

Some researchers have described attitudes through other dimensions. For example, Remmers and Gage (51) described attitudes as having six dimensions. They suggested that a knowledge of attitudes would increase

teachers' understanding of the attitudes of their pupils. The dimensions named by these two investigators are (a) favorableness, (b) intensity, (c) salience, (d) generality, and (e) degree of commonness.

Favorableness seems to be the dimension most often measured in attitude investigations. It may be thought of as the degree to which one is for or against an attitude object. It appears to be the basic dimension of attitudes.

The intensity of attitudes vary. This dimension is considered to be the strength of the feeling toward a particular attitude object. The more favorable or unfavorable the attitude, the more intense the feeling seems to be. Persons with neutral or indifferent attitudes toward something do not appear to have intense predispositions toward that object. Thus, there appears to be an increase in the intensity of negative or positive attitudes toward an attitude object, as one moves from the center of the attitude continuum toward the favorable or unfavorable ends.

Salience is the readiness with which the attitude can be aroused, or it is the closeness to the surface in a person's mind. That which is closest to the surface of the mind differs from person to person, and may often change within a person as his chronological age changes. For example, some people would immediately think of the United States' domestic problems as the most pressing contemporary issue facing America. Others would think of the war or morality.

Some individuals tend to have highly generalized attitudes. Thus, there may exist a large number and a variety of attitude objects toward which a person has a single consistent attitude. For example, terms

such as "Conservative", "Liberal", and "Moderate" are representative of some general labels given to individuals. These labels are used and are considered to be fairly accurate predictors of a person's attitude toward conditions relevant to some situations such as economic, political, and social issues.

There is a variation in the degree to which people will freely express attitudes in public social situations. Attitude toward air pollution is an example of a public attitude. There exist some attitudes which are not expressed in social situations, and only the individual is aware of the attitudes. Attitudes toward extra-marital sexual behavior are usually regarded as private predispositions in our society. In general, the more a person feels that his attitudes are likely to be disapproved or punished, the more unwilling and unlikely he is to express them in public.

Some attitudes are common and others are individual. Many persons have attitudes that are near the same degree of favorableness and intensity toward the same psychological object. An attitude toward a political party is an example of a common attitude. On the other hand, a woman's attitude toward a particular brand of perfume is an illustration of an individual attitude. In summary, predispositions are not directly measurable. Thus, they must be inferred from various conditions, situations, responses, and mannerisms.

In mathematics, the teacher's attitude toward mathematics or a particular topic in mathematics may be displayed by his enthusiasm for teaching the subject or topic. Sometimes mathematics teachers make favorable or unfavorable comments which pertain to mathematics. At other times, teachers of mathematics may indicate their predispositions

toward mathematics by mannerisms which depict confidence or a lack of confidence, and security or insecurity with regard to mathematical skills or concepts. Still other teachers may express their predispositions toward mathematics through verbal or non-verbal contempt for the academic subject or for a particular course or class.

Concomitant with a discussion of "attitudes" is a treatment of attitude development, because of the interrelationship of two concepts. Consequently, the research model for this study presents this aspect of attitudes.

The Development of Attitudes

Attitudes are the result of many influences working together. There are a variety of ways in which attitudes are developed, and the developmental process is complexed. It is difficult to say the formation of an attitude depends upon one specific factor in the life of an individual.

Allport (3) has identified four primary factors in the origin of attitudes. These factors are (a) accretion and integration of experience and response, (b) individuation, differentiation, or segregation of experiences, (c) dramatic experience or trauma, and (d) imitation and adoption of attitudes ready made. From a psychological viewpoint, these factors are important because they aid in the identification of more specific sources.

Droba (14) and Carlson (11) have been engaged in studies which pertained to attitudes. They reported that among the factors which condition the formation of attitudes are religious affiliation,

economic status of the family, locality, social facilitation, intelligence, and the influence of instruction.

Schneiders (58) is listed among those who have given a more detailed identification of the sources and determinants of attitudes. He has discussed the development of attitudes as being dependent upon (a) experience and activity, (b) family influence, (c) cultural milieu, (d) psychological factors such as intelligence, needs, feelings, and beliefs, (e) social facilitation, and (f) instruction and propaganda, including suggestions.

The effect of new experiences on attitudes is proportional to the influence of other factors on previous experiences. For example, experience cannot always withstand the pressure of effective propaganda and sometimes result in brainwashing. Similarly, education, social facilitation, and cultural milieu will alter the effects of given experiences.

The role of the family and home influence, which range from factors like father's employment to religious affiliation and practices of the family, are not to be minimized in their importance in the development of attitudes. For example, consider the attitudes of children.

> Children's attitudes often reflect those of the parents and other family members. Imitation, suggestion, instruction, and training are some factors which aid in the outright adoption of the attitudes of others. From a psychological viewpoint, identification is of particular importance. In the majority of cases, the extent to which parental attitudes will influence the child will vary in direct proportion to the degree to which the child identifies himself with one or another of the parents. Thus, if the child rejects, or is rejected by the parents, the likelihood of his assuming the preferences, or aversions of the parent is rather remote. This concept partially explains the diversification of attitudes found among members of the same family (39).

Children are supervised by teachers while attending school and they often imitate and identify themselves with teachers through school games and conversations. Therefore, from a psychological viewpoint the attitudes of elementary school teachers are related to the attitudinal development of children.

Everyday observation afford the opportunity for an individual to observe cultural milieu as a factor that conditions the formation of attitudes. Consider the cultural heritage of some Americans which makes it extremely unlikely that they will develop attitudes of social equality toward racial minority groups. Telford (69) has reported there is a need for people to regard practice as valuable and desirable so that the proper attitudes may be formed through the medium of activities in which they are participants. It seems very unlikely that a child who attends school very irregularly will have a favorable attitude toward school; whereas, one may fairly safely assume that the person who practices his religion faithfully, votes, drinks, attends movies regularly, or takes a yearly vacation will develop attitudes in line with these activities. That is, one who usually votes is very likely to have a positive attitude toward voting; drinkers usually have an attitude of acceptance toward drinking; movie goers normally regard movies as good recreation or entertainment; and vacationers tend to include this activity on their yearly agenda. Thus, when participation by individuals is optional and regular, there appears the tendency to produce positive predispositions which may be associated with the activities in which an individual has been a participant.

Factors such as intelligence make propaganda and similar techniques effective or ineffective in the shaping of attitudes. Of course, if the techniques used arouse basic needs, feelings, and desires, or if they stimulate the functioning of a desired quality, then these techniques are likely to be effective in molding that desired attitude, otherwise not. Relative to intelligence, it may be assumed that the higher the level of intelligence and the more critical an attitude is, the more difficult will be the task of forming or changing predispositions to conform to a desired pattern. This is especially true when negative attitudes are being molded.

According to Schneiders (58), attitudes often change with age, and this may mean that as critical faculties develop, the role of intelligence in the shaping of attitudes become more and more prominent. The changes in attitudes that do occur are conditioned by physical, mental, and social developmental alterations.

In the growth process, the child has a variety of experiences that aid the development of attitudes. Many of the experiences of the child enable him to modify, alter or expand his attitudes through learning and learning situations. The classroom is one of the places which provide for a large portion of one's formal training, learning, and learning situations. Accordingly, the personnel of educational institutions are in a strategic position for inducing favorable or unfavorable attitudes. Many persons have an excellent command of thought processes which they owe, in part, to certain of their former school teachers or institutional influences. Also, it follows that many conditions of anti-intellectualism, lack of self confidence, overt

expressions of hostility, dislike and like for particular subjects, failure to appreciate specific subjects, and failure to appreciate abstract thought can be traced to former school teachers and institutions of education which have been instrumental in instilling certain patterns of behavior or attitudes (12, 29).

Probably the primary source of teachers' attitudes toward mathematics results from the developmental factors listed by Schneiders (58). In a teaching situation the factors identified by Schneiders interact with the school or classroom setting, a student's chosen vocation, and various patterns of reward or reinforcement which teachers utilize.

Overview

In Chapter I the writer has attempted to present the problem and its significance. In addition, the (a) nature, dimensions, and development of attitudes, (b) clarification of terms, and (c) scope and limitations have been discussed. In addition, a discussion of the nature, the dimensions, and development of attitudes was given a brief summary of what attitudes are, what is measured, and how they are cultivated.

Chapter II is a review of selected related literature, and includes a discussion of the assumptions upon which the study is based, including the statement of hypotheses. Several types of attitude studies are reviewed. Some of the studies pertain to selected factors, such as academic performance and parental influence, which are related to attitudes toward academic subjects. The review of attitudinal studies also includes results relative to student ranking of academic subjects

according to their predispositions toward various academic subjects. Another category of studies was concerned with attitude change toward some disciplines and toward some social issues.

The description of the methodology and the design of this study is contained in Chapter III. It includes a discussion of (a) the instrument used in the study, (b) how the data was collected, (c) the sample for the study, and (d) the statistical procedures used to analyze the data.

Chapter IV will contain the analysis of the data. Tables and similar devices will be used when considered appropriate to aid in explaining the treatment of the data, or the testing of hypotheses.

The summary of the findings and the conclusions of this study are given in Chapter V. In addition, this chapter will contain suggestions, recommendations, and implications of the study for future research related to student attitude changes toward mathematics.

CHAPTER II

REVIEW OF RELATED LITERATURE AND HYPOTHESES

Previously it was stated that the primary purpose of this investigation was an attempt to determine if the attitudes toward mathematics which are held by selected prospective elementary school teachers are altered while they are enrolled in the required courses of the mathematics sequence. A review of selected literature which is related to attitudes and attitude changes is contained in this chapter. The hypotheses and theory derived from the review of the literature follow.

Selected Related Literature

Many studies have investigated students' attitudes toward school and individual academic subjects within the school. Studies of this nature have been concerned with all levels of instruction, namely, elementary, junior high, secondary, and college. The ones that follow are representative of the studies of this nature that have been done.

Dutton (15, 16, 17) completed several studies of attitudes associated with learning arithmetic. One study, whose sample consisted of 289 students of the University of California at Los Angeles, reported on the attitudes of prospective school teachers toward arithmetic (17). The major conclusions of the study were that attitudes toward arithmetic can be objectively measured, and that useful data is obtainable for

assistance in the education of prospective elementary school teachers. The analysis of the data revealed that the intermediate grades and the junior high school are the crucial levels in the development of attitudes toward arithmetic.

A second study of attitudes toward arithmetic by Dutton (15) utilized 459 Los Angeles area public junior high school students with wide variations in language and cultural backgrounds. The participants came from three levels of income. The main findings were that pupil dislike for arithmetic was dependent upon a lack of understanding and difficulty in working problems, as well as poor achievement. Stated another way, variations in language, cultural backgrounds, and economic levels were not factors which caused significant differences in attitudes toward mathematics.

In a third study, Dutton (16) used 211 students of the University of California at Los Angeles and surveyed the predispositions of prospective elementary school teachers toward arithmetic. The summary revealed that 74 per cent of the subjects reported unfavorable feelings toward arithmetic. The findings also indicated deep seated, highly emotionalized attitudes about mathematics which had persisted from childhood and which were prominent in the thinking of these prospective elementary school teachers as they progressed through the teacher education program.

The objective measurement of attitudes toward elementary school subjects has also been investigated. In this area Sister Josephina (62) did an investigation of the attitudes toward school subjects of 900 elementary pupils in grades five through eight in nine parochial

schools of New York City. The primary conclusion was that in every grade except grade eight, arithmetic ranked as the second most liked subject. In the one other case, science ranked second.

Of interest are two studies by Anderson (4) concerning the predispositions of 534 pupils in three Pennsylvania schools. In the eighth grade, pupils were asked to rank the subjects English, history, geography, and mathematics according to the "subject best liked." The procedure was repeated with the same group of students in grade eleven, and at both grade levels the students reported they liked mathematics the best.

Poffenberger and Norton (48) reported a study of two groups of entering freshmen of the University of California at Davis. One group of students had positive attitudes toward mathematics, whereas, the other group of students had negative attitudes toward mathematics. The results supported the concept that fathers of the two groups of students differed in their predispositions toward mathematics. Also, both parents of each of the two groups differed in their expectation of the child's academic achievement in mathematics. The case of parental encouragement is similar to that of academic expectation. The achievement expectations on the part of the parents were the same for the two groups in regard to school subjects in general. However, the two groups were not significantly different in their attitudes toward school nor in their overall high school grades.

Ferguson (18) made a study of a class at Stanford University that was concerned with the effect on student attitudes which resulted from a course in political history since 1890. When the course began, students were asked to rank the presidents of the United States in

order of merit from first to last. The same procedure was applied a second time at the end of the one-semester course. The initial correlation between the rankings of presidents by Democratic and Republican students was .72, but the final correlation between the rankings was .98. He concluded that predispositions can be significantly changed when instruction is used as the treatment.

An investigation of changes that occur in college students' attitudes over a four-year period of college instruction was done by Webster (76) at Vassar College, using 274 students. His findings were (a) girls became less orthodox in religion, (b) students developed attitudes that were democratic, and (c) students became more unconventional, more inquiring, and more liberal. Some parallel findings are supported by Plant (47) who revealed in a study, of 271 San Jose State College students, that during their college careers students showed a decline in ethnocentrism. Again these studies tend to indicate that students' attitudes may be transformed over a time period.

A study of attitudes toward mathematics by Aiken (1) has some interesting results. This study was done with 160 college females from a southeastern women's college. He was able to conclude that (a) individuals with apparently identical abilities and seemingly similar experiences with mathematics may have quite different attitudes toward the subject, and (b) feelings toward mathematics are determined by the specific pattern of reward that the individual receives in mathematics. The remaining findings suggest that attitudes toward mathematics are not highly related to attitudes toward other academic subjects. However, he found attitudes toward mathematics to be highly related to students' statements about previous teachers of mathematics.

This has been exemplified in various studies through statements written by the students as reasons for liking or disliking mathematics. There were statements such as "I liked mathematics until I got to grade ___ and then the teacher.....," and "I did not like mathematics until in Mr. _____ class, and he made it so clear and interesting until I now like it." Statements collected from participants of this study is one source of reference for such statements.

Aiken and Dreger (2) did an investigation of a freshman class at a southeastern college and were able to identify the variables of numerical ability, intellective factors, achievements, and experiences with former mathematics teachers as being related to mathematics attitudes. They were very careful to point out that general excessive irritability of students is not related to attitudes toward mathematics. That is, the type of attitude toward mathematics that one has can not be predicted by a tempermental personality.

Stright (68) conducted a study of the attitudes toward arithmetic of 1023 students and 29 teachers of the third, fourth, and sixth grades of five public school districts in Pennsylvania and one public school district in Ohio. The purpose of this study was (a) to note changes of attitudes among children from third to fourth grade, (b) to note trends in attitudes of both children and teachers, and (c) to compare the attitudes of boys and girls toward arithmetic. It is possible to conclude from Stright's study that a large percentage of elementary teachers enjoy arithmetic and use many devices while attempting to make it interesting. Variables such as the teachers' educational background, recency of training, teachers' age, and

teachers' years of experience made no significant difference in the teachers' attitude toward the teaching of arithmetic nor the attitudes toward arithmetic of the children in the group.

Bendig and Hughs (7) developed a set of thirty negative statements about statistics and mathematics and presented them to fifty pupils of the University of Pittsburgh to be rated on a five point scale according to how well the statements reflected the participants' feelings toward a course in introductory psychological statistics. Correlation was done with other variables such as the students' attitude scores on the Kuder Preference Record, their major subject, their sex, amount of high school mathematics, and classification. The conclusion was that the greater the familiarity with mathematics, the less the possibility of fear and a negative attitude toward the statistics course. Stone (67) has theorized that elementary school pupils go into secondary schools with a deep-seated fear of mathematics. Thus, educators know that among a group of students negative and positive attitudes toward mathematics may be present. In the meantime, they are interested in converting negative predispositions or fears toward mathematics to feelings of favorableness and confidence.

A study comparing the attitudes of two groups of fifth grade pupils toward the mathematics of School Mathematics Study Group and traditional elementary school students was done by Phelps (46). The 623 students of this study comprised 24 classes from twelve schools in seven different cities in the geographical area of Oklahoma State University. Twelve of the classes were in their second year of study of School Mathematics Study Group materials and the remaining twelve classes had not been exposed to experiences in an organized modern

program in mathematics. From this study, Phelps concluded that with regard to dispositions toward the mathematics courses of School Mathematics Study Group and those of traditional elementary school mathematics, there was no significant difference between the two groups of students. It was also revealed that School Mathematics Study Group materials could be taught to students of average ability without causing or implanting negative attitudes. Hence, it was concluded that the teaching materials, teacher, and teaching techniques may influence students' attitudes toward mathematics.

A study of attitudes by Malone and Freel (38) which involved 143 lower division college students of Massachusetts State Teachers College supports the conclusion that students' attitudes toward mathematics are changed in relation to the increase in the practical value of mathematics. From an investigation which used freshmen from a southeastern college as the population, Aiken and Dreger (2) concluded that attitudes toward mathematics are related to achievement and are possibly modified when related to applications.

Studies by Remmers, Knower, Peterson, and Thurstone have yielded similar results. Peterson and Thurstone (45), using secondary school students primarily from small towns of Illinois and different sized groups ranging from 133 to 300 students, demonstrated that attitudes toward various attitude objects could be changed by seeing a single movie. The changed attitudes persisted for as much as one and one-half years. Knower (33) investigated the attitudes of a group of high school pupils and discovered that attitudes may be changed in the directions anticipated, negative or positive. This was attained when

he measured the modifications of attitudes toward the prohibition of alcohol. The media used in the study by Knower were oral arguments and printed materials. Likewise, Remmers (50) and his students found that after high school pupils enrolled in four senior social science classes of Peru, Indiana, had studied materials on social insurance, capital punishment, conservation measures, and labor unions, they showed significant shifts in attitudes in the planned direction and that these changes persisted for at least one school year. In this instance the emphasis was upon the cultivation of positive attitudes.

A majority of the studies which have been reviewed emphasized the generalization that attitudes are modifiable. There were a variety of sources which may be related to modifications. For example, movies, printed materials, oral arguments, and classroom instruction were used to substantiate the notion that attitudes may be changed. The acceptance of the idea that predispositions are alterable is the genesis of the theory for this investigation.

The Theoretical Basis

In general, among educators there is agreement that a knowledge of students' attitudes is helpful to the teacher.

A number of different techniques have been employed by various researchers to appraise attitudes. For example, Rice (54) used the summation of endorsements by each individual to do his study. On the other hand, Remmers (49) has used the mean value of the statements endorsed by an individual as that individual's attitude score. The method cited by Remmers (49) was employed by this investigator to obtain individual attitude scores toward mathematics.

Many studies of attitudes have been completed and reflect the idea that attitudes toward an academic subject can be objectively measured. Dutton (17) has done such a study. Investigations of this nature have often revealed the intensity of feelings for or against a particular academic course. Among other things, some of the past studies support the concept that attitudes do change while students are enrolled in a course and can be measured by pre- and post-testing (38, 18). Hence, these concepts provide the rationale for this study, which is the modification of the attitudes toward mathematics held by selected prospective elementary school teachers.

Instruments for measuring attitudes have sometimes included questions to elicit responses concerning the time when the disposition was formed. Through the use of this type of question, Dutton (16) was able to determine the crucial grade-levels relative to the formation of unfavorable or favorable attitudes toward arithmetic. A cross-sectional study at the college level of prospective elementary school teachers who are currently enrolled in the mathematics sequence hopefully will reveal the grade level in which attitudes toward mathematics were instilled.

Rice (54) has investigated attitudes toward modern mathematics programs utilizing in-service teachers within a 100-mile radius of Oklahoma State University. He concluded that formal instruction in modern mathematics materials was a factor that influenced attitudes toward mathematics as well as attitudes toward modern mathematics programs. In a sense, Sorenson (64) supports the findings of Rice (54),

in as much he has reported:

> If a person has a satisfying experience, he will develop a favorable attitude toward the situation in which he had that experience. If, on the other hand, he has an unsatisfying experience, his attitude toward the situation involved in that experience will be unfavorable (64).

From the two previous points of view, one is able to predict that satisfactory or unsatisfactory school experiences may be related to the development of attitudes. Change of predispositions toward mathematics may be related to current enrollment or experiences in courses of the mathematics sequence. Thus, students enrolled in different courses of the mathematics sequence may not have the same types of attitude modifications toward mathematics, because they may have had different experiences.

Dutton (17) concluded that attitudes toward mathematics are related to how students view the practical aspects of mathematics. This result has led to the implication that attitudes toward mathematics may be related to concurrent enrollment in mathematics and courses related to mathematics, or the frequent use of mathematics. In addition, one would suspect that there is a significant difference in the types of attitude changes toward mathematics among pupils who use mathematics frequently or among pupils who are enrolled in courses related to mathematics.

The attitudes of selected prospective elementary school teachers toward mathematics may be modified while they are enrolled in a course in the mathematics sequence. If so, the modifications of attitudes toward mathematics will seemingly be related to two factors, one group of factors which plays a major role in the influence of attitude changes

toward mathematics and another group of factors which plays a minor role. The application of a proper statistical technique to each factor of the first group of factors would be expected to show significant modifications of attitudes toward mathematics. Similarly, the attitude changes toward mathematics may sometimes be potent enough for statistical analysis to reveal significant differences in topics in mathematics which are liked, and a change in the grade level where attitudes toward mathematics were formulated by the participants. Whereas, at other times the attitude changes toward mathematics by this group may be less potent or more subtle and probably would not reflect significant differences among certain variables. Nevertheless, topics in mathematics which are liked, topics in mathematics which are disliked, and the grade level where attitudes toward mathematics were formulated should be considered in an investigation of this nature.

Finally, none of the reviewed literature reflected a relationship between attitudes toward mathematics and student grade expectation. The writer considered many of these aspects worthy of investigation.

The variables which are to be examined in relation to attitude changes toward mathematics are (a) enrollment in selected courses, (b) concurrent enrollment or non-enrollment in courses related to mathematics, (c) frequent or infrequent use of mathematics, (d) grade expectation in the course, (e) liking or disliking a majority of the topics related to mathematics, and (f) the grade level where attitudes toward mathematics are formulated. Significant differences in the types of attitudes will be examined relative to the variables previously mentioned. All of these variables were related to the independent variables and formulated into testable hypotheses.

The independent variables of this study are the pre- and post-tests responses which were made by students on the Dutton Attitude Scale when it was administered during the spring semester of 1967-68. See Appexdix A for the instrument. The attitude responses from students on the Dutton Attitude Soale were examined through the hypotheses which follow.

Hypotheses

This investigation will involve testing two types of hypotheses. Those numbered one through six pertain to the modification of attitudes toward mathematics and seven through ten are concerned with significant differences between types of modified attitudes toward mathematics. These hypotheses follow and are stated in null form.

I. There is no significant modification of attitudes toward mathematics among students enrolled in each course of the mathematics sequence for elementary education majors (Mathematics 2413, Mathematics 2513, and Education 4152).

II. There is no significant modification of attitudes toward mathematics among students who enrolled in courses of the mathematics sequence and:

   A. concurrently enrolled in courses related to mathematics.

   B. not enrolled in courses related to mathematics.

III. There is no significant modification of attitudes toward mathematics among students who:

   A. frequently used mathematics within the two week period prior to the administration of the post-test.

B. infrequently used mathematics within the two week period prior to the administration of the post-test.

IV. There is no significant modification of attitudes toward mathematics among students who:

A. expected a grade of C or better in their present mathematics course.

B. expected a grade of less than C in their present mathematics course.

V. There is no significant difference between pre-test and post-test designation of grade levels where attitudes toward mathematics were formulated.

VI. There is no significant change by students relative to liking or disliking a majority of the selected mathematics topics.

VII. There is no significant difference in types (directions: positive, negative, or zero) of modified attitudes toward mathematics among students enrolled in the three courses of the mathematics sequence.

VIII. There is no significant difference in the types of modified attitudes toward mathematics between students enrolled in courses of the mathematics sequence and concurrently enrolled or not enrolled in courses related to mathematics.

IX. There is no significant difference in types of modified attitudes toward mathematics between students who expected a grade of C or better and students who expected a grade of below C in their present course of the mathematics sequence.

X. There is no significant difference in types of modified attitudes toward mathematics between students who used mathematics frequently and students who used mathematics infrequently within the two week period prior to the administration of the post-test.

Summary

The review of selected related literature, the theory and the hypotheses of the study were presented in this chapter.

The review of literature revealed that attitudes toward mathematics are frequently measured by the Dutton Attitude Scale (17), and emphasized that attitudes toward mathematics are:

1. Modifiable and exist after the experiences which have altered them.
2. Indirectly measurable.
3. Either negative or positive in direction.
4. Developed during instruction in mathematics.
5. Of practical value to educators for planning techniques of mathematical instruction.

Among the variables found to be related to attitudes toward mathematics are:

1. Familiarity with subject matter.
2. Numerical ability.
3. Experiences with former teachers of mathematics.
4. Specific patterns of reward.

In the present study, the basic theory was that attitudes toward mathematics are modifiable and indirectly measurable. The basic theory leads to the selected independent variables, such as grade expected in present mathematics course, and current enrollment in courses of the mathematics sequence, which may be hypothesized as being related to attitude modification.

The description of the sample, the experimental design, the instrument used to collect the data, and the procedures for collecting and statistically treating the data are presented in Chapter III.

CHAPTER III

PROCEDURE

The Experimental Design and Sample

The investigation involved the use of two experimental designs, a paired experiment and a cross sectional study.

First, since the investigation was pertinent to modification this necessitated the administration of a pre-test and a post-test. In addition, Steel and Torrie (66) have reported that "when pre-test and post-test are administered to a sample the scores of each individual must be paired." Therefore, the design was basically a paired experiment.

Secondly, the investigation was to include prospective elementary school teachers from each college level of classification. This condition required that the investigation be a cross sectional study.

The investigator established two criteria to select a sample compatible with the experimental design. The criteria were that (a) each student was in attendance at Oklahoma State University during the spring semester of 1968, and (b) each student was enrolled in at least one course of the mathematics sequence for elementary education majors (Mathematics 2413, Mathematics 2513, and Education 4152).

There were no formal prerequisites for enrollment in Mathematics 2413. However, the completion of Mathematics 2413 was the prerequisite

for enrollment in Mathematics 2513. Finally, Education 4152 generally is taken during the senior year prior to the students' enrollment in student teaching and after completing the two mathematics courses. For a more detailed discussion of each course see Chapter IV.

With the given prerequisites, the investigator had no control over the classification constituency of the sample. Thus, the sample consisted of 60 freshmen, 83 sophomores, 87 juniors, 41 seniors, and 8 graduate students. All 279 of the participants were Oklahoma State University students, and among the participants there were eight males and 271 females.

The Measuring Instrument

The investigator had one of two alternatives for obtaining an instrument, either develop one or use one previously developed. The first alternative would have been time consuming. Therefore, the decision was to use an instrument previously developed by another investigator.

Relative to instruments, the original plan was to use two attitude instruments to collect data for the study, and the results obtained from the two instruments were to have been compared. However, relative to the sample, the instrument developed by Rice (54) comprising a part of Appendix A contains some statements that are ambiguous. For example, consider statement number 15, "Sometimes I give extra assignments in mathematics as punishment." The investigator was of the opinion that these types of statements possibly permitted different interpretations by members of the sample. That is, some students probably

responded as if they were teachers and others in terms of what they thought had been their experiences. This belief provided a basis for the decision to not use the instrument in the study. Therefore, the Dutton Attitude Scale (17), contained in Parts I and II of Appendix A, was used to assess the students' attitudes toward mathematics.

The Dutton Attitude Scale (17) was originally constructed in 1954. The construction consisted of compiling statements reflecting negative and positive feelings about mathematics. The statements were collected over a five year period from approximately 600 students. Eighty-three statements were selected from these resources, and these statements were edited for correct English and subjected to the following criteria:

1. The statements should be brief.
2. The statements should be primarily concerned with feelings toward arithmetic.
3. The statements should be easily endorsed or rejected by the reader.
4. The statements should not be ambiguous.
5. There should be adequate coverage of all attitude areas that are to be measured.

A random sample of 120 students representing all levels of classifications enrolled in the University of California at Los Angeles were selected to sort the statements. The sorting proceeded as follows:

1. Slips of numbered mimeographed paper with the 45 statements were given to the students who did the sorting.
2. Groups of students, usually 8 or 10, were seated at tables and given directions for sorting the slips into piles numbered from one (extreme disliking) to eleven (extreme liking).

3. The slips sorted by 20 students were eliminated because of their failure to follow the directions of the sorting procedures.

Twenty-two of the 45 statements sorted by the remaining 100 students appear on the final attitude scale. Among the criteria for statements selected were:

1. Statements representative of an adequate distribution of scale values from 1.0 to 10.5.
2. An equal number of statements indicative of favorable and unfavorable attitudes toward mathematics.
3. Two statements very close to the neutral position on the scale.
4. Statements with a low Q value.

All criteria is the spread between the upper and lower quartiles. It measures the ambiguity of statements. If statements convey nearly the same meaning to all persons the Q value is small, but when statements do not do this they are ambiguous and have large Q values.

Procedures developed by Thurstone and Chave (73) were used to determine a scale value for each statement. These procedures required the plotting of a graph from the accumulative proportions in which the statements had been sorted. For example, when the curve on the graph crossed the 50 per cent level at the scale value of 5.6, this was the scale value assigned to the statement that was being graphed. This occurred when more than 50 per cent of the sorters classified the statement as more favorable than the position 5.6, and the remaining students placed the statement less favorable than this portion in the eleven piles. Both negative and positive statements were assigned

scale values from 1.0 to 10.5. The statements and their corresponding scale values are included in Appendix A. In addition, the statements which reflect positive attitudes toward mathematics are interspersed with those reflecting negative attitudes. That is, statements representative of similar feelings toward mathematics are not listed consecutively.

Part II of the attitude scale provides students with an additional opportunity to estimate their general attitude toward mathematics. This part permits students to indicate a liking or disliking for some topics related to mathematics.

The reliability of the experimental scale was established by the test retest method. The correlation between the two sets of scores, taking an average scale value for the total test for each student, was 0.94.

Collection of the Data

The data for the investigation was obtained through the use of the Dutton Attitude Scale which has been discussed in the previous section. The investigator, a graduate assistant, and the instructor of each class involved administered the instrument to prospective elementary school teachers enrolled in each of the selected mathematics classes. A copy of the instrument was given to each participant, after which the investigator gave an overview of the study and read the instructions aloud. Students were told to work at a pace comfortable to them and when finished to give the completed questionnaire to one of the three persons that passed out the same. This procedure was followed when the pre-test was administered on January 29 and 30, 1968, and again

when the ppst-test was administered on May 16 and 17, 1968.

Of the 315 students who took the pre-test, 296 took the post-test. However, the final useable data involved responses from 279 of the participants. The data for the remaining 36 students was discarded because of such things as the failure to take both tests, to respond to all mandatory items, to properly identify one's self, or because of withdrawal from the college or the course. The investigator was justified in discarding data if both matched completed forms were not available, in as much as pre-test and post-test responses are treated as a paired experiment. The usable data represented a correlation of 0.885 for paired completed questionnaires. According to Steele and Torrie (66) a correlation of this level is significant.

Once the data was collected a decision was made relative to the selection of appropriate statistical procedures.

Treatment of the Data

An indirect measurement of attitudes toward mathematics for each student was yielded by the Dutton Attitude Scale. For example, the measurement of the attitude toward mathematics of student number one was obtained by summing the assigned numerical values of the responses agreed with by student number one. The mean score of student number one was then derived by dividing the sum by the number of statements endorsed by student number one. Shaw (59) has reported that this is an acceptable method of scoring attitude tests. In addition, statements on the instrument which reflected similar attitudes toward mathematics were not clustered or grouped. Therefore, the scoring procedure for individual students is compatible with a procedure endorsed by Remmers

who reported:

> By the use of a reasonable large number of items, an average of the scale values endorsed by any individual is that individual's score. It has been found that this technique yields a reasonable satisfactory attitude measurement. (49)

Based on Siegel's (61) assumption that data pertinent to the behavioral sciences has the ordinal property (the scores of the attitudes of individuals toward mathematics can be ranked or ordered), a non-parametric technique was chosen to test the ten hypotheses that were developed by theoretical assumptions. Techniques of inferences were chosen which did not assume that the sample represented a normal distribution. Such techniques result in conclusions which require fewer qualifications. Consequently, the Wilcoxon Test was used to test for significant modifications of attitudes toward mathematics among students relative to the theoretical assumptions.

The Wilcoxon Test was selected because this particular test permitted the detection of a significant modification in attitudes by getting the difference between the individual mean scores computed for the pre-test and post-test performances of students. Siegel (61) further substantiates the significance of this technique by asserting:

> This test provides not only direction of change (positive, zero, negative), but also the magnitude of change for each participant, and the magnitude of the least frequent sign.

The investigator chose as a second statistical technique, the McNemar Test for the Significance of changes. This particular test was used because it was applicable for testing for the significance of changes when there has been a "before and after" design in which each person is used as his own control and in which measurement is in the

strength of either a nominal or an ordinal scale. Thus, it may be used to test the effectiveness of a given course of study (61), and it was used to test Hypotheses V and VI.

The use of this statistical technique required the investigator to segregate the students into categories. Hence, on the basis of the pre-test the students were separated into two groups: (a) those students who formed their present attitude toward mathematics before entering college, and (b) those students who formed their present attitude toward mathematics after entering college. A fourfold table of frequencies to represent the first and second set of responses from the same individuals was set up to test the significance for any observed changes.

The selected mathematical topics were interpreted in terms of each individual liking or not liking a majority of the topics listed on the pre-test. The same procedure as outlined above was followed on the post-test and results were combined in tabular form. According to Ostle and Siegel (44, 61) since the results or score are only classifications this technique is both suitable and usable.

The responses to open-end statements were so varied until the writer made no attempt to categorize these responses. Hence, no attempt was made to perform any statistical techniques on this data.

Four hypotheses pertained to differences among types of modified attitudes toward mathematics. The Chi-square Test was used to test these four hypotheses (Hypotheses VII through X) for differences among the types of modified attitudes which students held toward mathematics relative to: (a) types of courses in the mathematics sequence for elementary education majors, (b) students concurrently enrolled and not

enrolled in courses related to mathematics, (c) those students who used mathematics frequently and students who did not frequently use mathematics within the two week period prior to the administration of the post-test, and (d) students who expected a grade of C or better and students who expected a grade of less than C in their present mathematics course.

The Chi-square Test, in addition to being a non-parametric test, was suitable for this investigation because the data of this research constitutes frequencies which were placed in distinct categories. Runyon and Haber (57) state that the Chi-square Test:

> ...is a test that permits us to determine whether or not a significant difference exists between the observed number of cases falling in each category, and the expected number of cases, based on the null hypothesis. In other words, it permits us to answer the question, 'how well does our observed distribution fit the theoretical distribution?'(57)

The Chi-square Test requires that the expected frequencies in each cell should not be too small. This does not mean that the observed or actual frequencies should not be small; reference is made only to expected frequencies. When this requirement is not met, the result of the test is meaningless. However, the term "small" has not been uniformly defined. Walker and Lev (75) suggest that if there are two or more degrees of freedom and roughly approximate probabilities are acceptable for the test of significance, an expectation of only two in a cell is sufficient. Snedecor and Cochran (63) state "the Chi-square Test is accurate enough for single classifications if the smallest expectation is at least 1." More recent findings attributed to Lewontin and Felsenstein (36) state:

> The rule requiring an expectation of 5 or greater in a 2 x n table is far too conservative and that nearly any 2 x n table which is non-degenerate can be safely tested by the conventional Chi-Square criterion. If one wished to make a safely conservative rule it would be that: the 2 x n table can be tested by the conventional Chi-square criterion if all the expectations are one or greater. Even this rule is extremely conservative and in general the Chi-square criterion can be used for any non-degenerate case with expectations in excess of 15 successes in the smallest cells (36).

One other suggestion may be noted in effecting changes to improve requirements for the use of the Chi-square test. Siegel (61) has recommended that adjacent categories should be combined in order to increase the expectations in the various cells of the frequency table.

Following the consideration and implementations of the techniques reviewed above, the hypotheses were treated in the manner recommended by Siegel (61):

1. The null hypothesis was stated for each general hypothesis.
2. The statistical tests were selected and the results were presented in tabular form.
3. The level of significance was selected in advance at the .05 level.
4. The sampling distribution was dependent upon and interpreted from the statistical tables presented in the Appendix of Siegel's Non-Parametric Statistics (Table A and Table C).
5. The region of rejection was predicted in advance and lay at either end of the distribution and thus implied a two-tailed region of rejection.
6. The decision or disposition of the hypotheses in the study was stated during a discussion of the results of the investigation.

Believing that the chosen statistical techniques were appropriate for the analysis of behavioral data, the investigator gave the data and the IBM Code Sheet found in Appendix B to the Oklahoma State University Computer Center to be coded, card punched, and analyzed. There were instances when the investigator used desk calculators to analyze the data.

Summary

This chapter has been a consideration of (a) the sample, and the design, (b) the instrument, (c) the collection of data, and (d) the statistical procedures of the study.

This investigation was designed as a cross-sectional study utilizing the students enrolled in the courses of the mathematics sequence for prospective elementary school teachers at Oklahoma State University. The investigation was conducted to determine if students' attitudes toward mathematics were modified as a result of enrollment in the courses of this sequence.

Data for the study was collected during the Spring Semester of the 1967-68 school year. Pre-test and post-test were administered to facilitate data collection. The instrument used for this purpose in the investigation was the Dutton Attitude Scale.

The data for the study was analyzed by the use of desk calculators by the investigator and by the Oklahoma State University Computer Center. The statistical techniques for the study were those of non-parametric statistics, including the Wilcoxon, McNemar, and X^2 Tests.

CHAPTER IV

RESULTS AND DISCUSSION

The analysis of data concerning the attitudes of selected prospective elementary school teachers toward mathematics is presented in this chapter. The data analysis which is presented shows test results of hypotheses pertaining to modifications of attitudes and types of modified attitudes toward mathematics.

The procedure used in applying the statistical tests followed Siegel (61). The term significant as used in this study refers to a .05 level of probability. Table I was used to determine the level of significance for the interpretation of the Wilcoxon Test.

Wilcoxon Test Results Relative to Attitude Modification

The Wilcoxon Test was the first statistical technique applied to the data. When the pre-test and post-test scores used to determine modifications of attitudes toward mathematics for pupils enrolled in Mathematics 2413 were analyzed, two students did not modify their attitudes toward mathematics. Of the 128 students who had scores which indicated modifications of attitudes toward mathematics, there were 58 scores with a negative difference and 70 scores which represented a positive difference. The difference was not statistically significant.

TABLE I

WILCOXON TEST RESULTS

Variables	Number of Students	Number of Kinds of Attitude Changes		Unchanged	Sum of Rank with less Frequent Sign	Z Score
		Positive	Negative			
Mathematics 2413	130	70	58	2	3434.0	-1.6500NS
Mathematics 2513	73	41	29	3	951.5	-1.7030NS
Education 4152	76	40	26	10	737.0	-2.3546*
Enrolled in mathematics related courses	64	36	25	3	647.0	-2.1440*
Not enrolled in mathematics related courses	215	115	88	12	8339.5	-2.4026*
Used mathematics frequently	208	117	79	12	12265.0	-3.5049*
Used mathematics infrequently	71	34	34	3	1168.5	-0.0274NS
Expected a grade of C or better	259	140	104	15	13332.7	-1.4600NS
Expected a grade of below C	20	11	9	0	103.5	-0.0560NS

* Significant at the .05 level of probability
NS Not significant at the .05 level of probability

Hence, the writer did not reject the null hypothesis, "there was no significant modification of attitudes toward mathematics by students enrolled in Mathematics 2413."

Mathematics 2413 is a course which is based on mathematical content. Each week the instructor of this course presented two one-hour lectures to a multiple sectioned class. A programmed textbook (20) was used to supplement the lectures. In addition, a graduate mathematics major conducted a one-hour per week discussion session with the students of the large lecture organized in groups of about 30 to 35 students.

The one-hour per week discussion period was intended to give added clarification to mathematical concepts discussed during the large lecture. To accomplish this result, the graduate mathematics major served as a mathematics specialist and divided the students attending each discussion period into subgroups containing four or five members. Each subgroup discussed the mathematical ideas and concepts presented in the lectures as well as in the textbook. The graduate mathematics major was called whenever a subgroup failed to agree on the proper interpretation of the subject matter assigned for a given period of time.

The final 15 or 20 minutes of each discussion hour was set aside to administer a quiz. The immediate feedback provided by the instructor, a programmed textbook (20), and interaction in small groups were some of the features of this mathematics course.

The contents of Mathematics 2413 and Mathematics 2513 are presented in Appendix D. The first seven chapters of the text were taught in Mathematics 2413 and the remaining five chapters were taught in Mathematics 2513.

In Mathematics 2513, the scores of 73 students indicated no change of attitudes toward mathematics. The remaining 70 students' scores showed 29 negative differences and 41 positive differences in attitudes toward mathematics. This difference was not statistically significant. Based upon the absence of statistical significance, the writer did not reject the null hypothesis, "there was no significant modification of attitudes toward mathematics by students enrolled in Mathematics 2513."

Mathematics 2513 was conducted in the same manner as Mathematics 2413. Therefore, the statements attributed to Mathematics 2413 are also applicable to this course.

Education 4152 is the final course in the mathematics sequence. When the scores used to determine modifications of attitudes toward mathematics for students enrolled in this course were contrasted, 26 of 76 students enrolled had negative changes of attitudes, 10 had no changes in attitudes, and 40 had positive changes of attitudes toward mathematics. This difference was statistically significant. Therefore, the writer rejected the null hypothesis, "there was no significant modification of attitudes toward mathematics by students enrolled in Education 4152." Instead, the alternate hypothesis, "there was a significant modification of attitudes toward mathematics by students enrolled in Education 4152 in a positive direction," was accepted.

A consideration of the teaching techniques utilized in Education 4152 may provide clues to the seeming relationship between the significant modification of the attitudes of prospective elementary school teachers toward mathematics and Education 4152. Education 4152 is a methods course. The teaching techniques of the course required student participation. Films, filmstrips, graphs, models, current literature

pertaining to teaching procedures, and other training aids were freely used by the instructor and students alike, whenever they deemed that such aids were appropriate. Thus, the course was not directly concerned with mathematical content but was concerned with how various mathematical ideas and concepts should be taught.

Concurrent with enrollment in courses of the mathematics sequence, a student is either "enrolled or not enrolled" in at least one course related to mathematics. An attempt was made to determine if such enrollment or non-enrollment significantly affects the modification of attitudes toward mathematics.

The Wilcoxon Test was also applied to the 64 attitude scores contained in Appendix C that corresponded to students enrolled in courses of the mathematics sequence who were concurrently enrolled in mathematics-related courses. The scores of 25 students indicated negative differences and 3 students had scores showing no attitude change toward mathematics. The scores of the remaining 36 students suggested positive changes of attitudes toward mathematics. This difference was statistically significant. Hence, the writer rejected null hypothesis II-A, "there was no significant modification of attitudes toward mathematics by students enrolled in courses of the mathematics sequence and concurrently enrolled in courses related to mathematics." Instead the alternate hypotheses, "there was a significant modification of attitudes toward mathematics by students enrolled in courses of the mathematics sequence and concurrently enrolled in courses related to mathematics," was accepted.

The science courses, which are required of elementary education majors, rely heavily upon computation and measurements along with the

mastering of concepts. Hence, in many instances science classes afford students the opportunity to apply some aspects of mathematics which were previously discussed or may be a part of future discussion in courses of the mathematics sequence.

Hypothesis II-B, "there was no significant modification of attitudes toward mathematics by students enrolled in courses of the mathematics sequence and not enrolled in courses related to mathematics" was next tested. The pre-test and post-test scores for this group are also given in Appendix C.

For the 215 students in this group, the scores of 12 students indicated no modification of attitudes toward mathematics. The scores of 115 students showed a positive change of attitude toward mathematics, and the scores of 88 students implied a negative modification of attitudes toward mathematics. This difference was statistically significant. Therefore, the writer rejected null hypothesis II-B, "there was no significant modification of attitudes toward mathematics by students enrolled in courses of the mathematics sequence and not enrolled in courses related to mathematics. Instead, the alternate hypothesis, "there was a significant modification of attitudes toward mathematics by students enrolled in courses of the mathematics sequence and not enrolled in courses related to mathematics," was accepted.

It seemed somewhat inconsistent to reject null hypotheses II-A and II-B while not rejecting all categories of hypothesis I. The explanation for this occurrence is found partly in the grouping which is required to test the hypothesis and partly in the variation of signed-ranks of the differences between post-test and pre-test scores. According to the Wilcoxon Test, the signed-rank for a given score y is

not fixed. Instead, it varies as the score y assumes different numerical values which correspond with the mean value of the score y. However, the mean value of the score y is dependent on the number of times the score y occurs in a given group and the rank of y, relative to the group of scores being tested. In each instance, the variable which was tested determined the set of scores used for each testing of the Wilcoxon Test.

Closely allied with the previously discussed concept is the idea that attitudes toward mathematics may be influenced by whether a student has used, or has not used mathematics often within the two week period prior to the administration of the post-test. Data representing these variables are also presented in Appendix C.

Table I presents the analysis of the pre-test and post-test scores of 208 students who indicated they had frequently used mathematics within the two week period prior to the administration of the post-test. Twelve students had scores which suggest that their attitudes toward mathematics were not modified while enrolled in courses of the mathematics sequence. The remaining scores revealed a modification of 79 students' attitudes toward mathematics in a negative direction and of 117 students' attitudes in a positive direction. Analysis of the data which comprises Table I revealed that this difference was statistically significant. Hence, the writer rejected null hypothesis III-A, "there was no significant modification of attitudes toward mathematics by students who frequently used mathematics within the two week period prior to the administration of the post-test. The alternate hypothesis, "there was a significant modification of attitudes toward mathematics by students who frequently used mathematics within

the two week period prior to the administration of the post-test," was accepted.

Some thought should be devoted to students who participated in the study but indicated they had infrequently used mathematics within the two week period prior to the administration of the post-test. The analysis of data about attitudes toward mathematics for this group of 71 students is also presented in Table I.

The analysis revealed that the scores of 3 students did not indicate a modification of attitudes toward mathematics. The other 68 scores showed that as many students had positive attitude changes toward mathematics as negative attitude changes. According to these results, this difference was not statistically significant. Hence, the writer did not reject null hypothesis III-B, "there was no significant modification of attitudes toward mathematics by students who infrequently used mathematics within the two week period prior to the administration of the post-test."

In general, educators have felt that there is some relation between academic performance in given school subjects and attitudes toward these school subjects. Thus, it was considered worthwhile to investigate the modification of students' attitudes toward mathematics relative to the grades expected in their present mathematics course.

The analysis of the pre-test and post-test scores of the 259 students who expected a grade of C or better in their present mathematics course is presented in Table I. The test scores of 140 students showed a positive modification of attitudes toward mathematics; whereas, 15 students showed no modification of attitudes, and 104 students showed a negative modification of attitudes toward mathematics. This

difference was not statistically significant. Therefore, the writer did not reject null hypothesis IV-A, "there was no significant modification of attitudes toward mathematics by students who expected a grade of C or better in their present mathematics course."

The analysis of data relating to the modification of attitudes toward mathematics among students who expected a grade of less than C in their present course of the mathematics sequence is also presented in Table I. Of the 20 students included in this category, the scores of nine pupils indicated a modification of attitudes toward mathematics in a negative direction. The scores of eleven students belonging to this category showed a modification of attitudes toward mathematics in a positive direction. This difference was not statistically significant. Therefore, the writer did not reject null hypothesis IV-B, "there was no significant modification of attitudes toward mathematics by students who expected a grade of below C in their course of the mathematics sequence."

McNemar Test Results Relative to Attitude Modification

Two hypotheses were concerned with the attitude changes of participants, collectively. The results obtained from testing these two hypotheses by McNemar Test techniques are given in the discussion which follows.

Grade levels where attitudes toward mathematics were reported to be formulated may possibly be statistically significantly related to the modification of attitudes toward mathematics. This notion prompted the subsequent discussion and the formulation of hypothesis V.

The frequencies of the pre-test and post-test scores which designate the grade levels where the participants said they had formulated their present attitudes toward mathematics are contained in Table II. These results are consistent with the findings of Dutton (17). In particular, the pre- and post-tests responses of students indicated that the junior high school grades were the most critical ones in the formation of attitudes toward mathematics.

TABLE II

FREQUENCY DISTRIBUTION OF STUDENTS' GRADE LEVEL WHERE PRESENT ATTITUDES TOWARD MATHEMATICS WERE FORMULATED

Tests	Grades															
	1	2	3	4	5	6	7	8	9	10	11	12	All Grades	College	Cannot recall	Total
Pre-test	1	2	12	15	11	9	28	17	38	31	16	5	38	31	25	279
Post-test	2	7	12	7	8	11	30	13	34	22	9	2	33	53	35	279

The writer was aware of the fact that the ability to recall facts or events decreases over time. This means that students may have made errors in the designation of the grade where their present attitudes toward mathematics were formulated. But there is a distinct division between college and pre-college education and one is more likely to be able to reconstruct events by placing them in one of two major categories than by placing them in several smaller categories. Therefore, in an effort to lend credibility to determining if there were significant changes in the designation of the grade levels where attitudes toward mathematics were formed, the grade designations were collapsed into two categories, college and pre-college, presented in Table III.

TABLE III

FREQUENCY DISTRIBUTION OF STUDENTS' DESIGNATION OF COLLEGE OR PRE-COLLEGE FORMATION OF PRESENT ATTITUDES TOWARD MATHEMATICS

		Post-test	
		College	Pre-college
Pre-test	Pre-college	34	214
	College	19	12

$X^2 = 12.25$, df = 1, $P < .05$

The greater change in the direction toward present attitudes made at the college level was statistically significant, according to the McNemar Test which was used to compute a X^2 value. Therefore, the writer rejected null hypothesis V, "there was no significant difference between pre-test and post-test designation of grade levels where attitudes toward mathematics were formulated." The alternate hypothesis, "there was a significant difference between pre-test and post-test designation of grade levels where attitudes toward mathematics were formulated," was accepted. These findings indicated that there was a statistical significant number of students who now designated the college level as the point where their present attitudes toward mathematics were formulated.

Table III shows that on the pre-test 31 students reported they formed their present attitudes toward mathematics while enrolled in college. However, on the post-test 12 of the 31 students reported pre-college as the place where their present attitudes toward mathematics were formulated. On the post-test an additional 34 pupils reported that they formed their present attitudes toward mathematics while

enrolled in college. The results also show that 214 students reported on the pre-test and post-tests that their present attitudes toward mathematics were formulated in pre-college grades. Apparently, the 34 students who changed their designation of present attitude formation from college to pre-college was a frequency large enough to effect a statistically significant modification.

Closely akin to attitude modification toward mathematics is the possibility that shifts in students' likes or dislikes for a majority of selected mathematics topics take place while enrolled in courses of the mathematics sequence. The results of the McNemar Test were used to reach a decision relative to hypothesis VI, "there was no significant change by students relative to liking or disliking a majority of the selected mathematics topics," are shown in Table IV. The procedural discussion of this variable was given in paragraph two, page 44.

TABLE IV

FREQUENCY DISTRIBUTION OF STUDENTS' LIKING OR DISLIKING A MAJORITY OF THE TOPICS RELATED TO MATHEMATICS

		Post-test	
		Like	Dislike
Pre-test	Dislike	16	9
	Like	248	6

$X^2 = 3.68$, df = 1, $P > .05$

Table IV indicated that between the administration of the pre-test and the post-test, 16 pupils changed from liking to disliking a majority of the selected mathematics topics. The opposite results were indicated by six students. The remaining 257 pupils indicated no shifts between liking or disliking a majority of the selected mathematics topics.

The statistical results on the 22 students who had shifted their opinions in either direction was not statistically significant. Hence, the writer did not reject null hypothesis VI, "there was no significant change by students relative to liking or disliking a majority of the selected mathematics topics."

Chi-square Test Results Relative to Types of Modified Attitudes

The directions of attitude modifications toward mathematics were arrived at by subtracting the pre-test score from the post-test score. This resulting score was positive, negative or zero. It was considered fruitful to investigate the relationship among these types of modified attitudes toward mathematics and other variables. This was first accomplished by relating the type of modification of attitude to the courses in the mathematics sequence. This data and the results are presented in Table V.

TABLE V

FREQUENCY DISTRIBUTION OF STUDENTS' TYPES OF MODIFIED ATTITUDES TOWARD MATHEMATICS RELATIVE TO THE COURSES IN THE MATHEMATICS SEQUENCE

Types of Modified Attitudes	THE MATHEMATICS SEQUENCE			Total
	Mathematics 2413	Mathematics 2513	Education 4152	
Positive	70	41	40	151
Zero	2	3	10	15
Negative	58	29	26	113
Total	130	73	76	279

$X^2 = 13.744$, df = 4, $P < .05$

The Chi-square Test for a significant difference was applied to frequencies of 151, 15, and 113, which represented the number of students whose attitudes had changed in positive, zero, or negative directions, respectively. A X^2 value as extreme as the one observed from the analysis of this data was statistically significant. Thus, the writer rejected null hypothesis VII, "there was no significant difference in the types of modified attitudes toward mathematics among students enrolled in the three courses of the mathematics sequence." The alternate hypothesis, "there was a significant difference in the types of modified attitudes toward mathematics among students enrolled in the three courses of the mathematics sequence," was accepted.

A careful look at Table V suggested that the rejection of the hypothesis was perhaps due to the different proportions of students classified by types of modified attitudes toward mathematics. The number of students enrolled in Mathematics 2413 was approximately twice that of each of the two other courses, Mathematics 2513 and Education 4152. The ratio of the frequency of students who reported positive attitude changes toward mathematics to the number of students enrolled in the course was roughly the same for each of the courses included in this study. A similar analogy existed for students who reported negative attitudes toward mathematics. However, an obviously different proportionality existed relative to the zero type of modified attitudes toward mathematics.

Using the Chi-square Test to analyze the data presented in Table VI the writer did not reject null hypothesis VIII, "there was no significant difference in the types of modified attitudes toward mathematics between students enrolled in courses of the mathematics sequence

and concurrently enrolled or not enrolled in courses related to mathematics."

TABLE VI

FREQUENCY DISTRIBUTION OF TYPES OF MODIFIED ATTITUDES TOWARD MATHEMATICS RELATIVE TO STUDENTS ENROLLED AND NOT ENROLLED IN COURSES RELATED TO MATHEMATICS

Types of Modified Attitudes	COURSES RELATED TO MATHEMATICS		Total
	Enrolled	Not Enrolled	
Positive	36	115	151
Zero	3	12	15
Negative	25	88	113
Total	64	215	279
$X^2 = 0.28574$, df = 2, P > .05			

The data contained in Table VII relates to differences between types of modified attitudes toward mathematics and grade expectation. Again, the Chi-square Test was used to analyze the data.

TABLE VII

FREQUENCY DISTRIBUTION OF STUDENTS' TYPES OF MODIFIED ATTITUDES TOWARD MATHEMATICS RELATIVE TO GRADE EXPECTED

Types of Modified Attitudes	GRADES EXPECTED IN COURSE		Total
	C or Better	Below C	
Positive	140	11	151
Neutral	15	0	15
Negative	259	20	279
$X^2 = 1.2689$, df = 2, P > .05			

Table VII shows that 20 students anticipated a grade of less than C in their present mathematics course; whereas, 259 students expected a grade of C or above. This observed value of X^2 was not statistically significant. Thus, the writer did not reject null hypothesis IX, "there was no significant difference in types of modified attitudes toward mathematics between students who expected a grade of C or above and students who expected a grade of below C in their present course of the mathematics sequence."

The significance of the difference between the frequent or infrequent use of mathematics and types of modified attitudes toward mathematics was tested and is reported in Table VIII.

TABLE VIII

FREQUENCY DISTRIBUTION OF STUDENTS' TYPES OF MODIFIED ATTITUDES TOWARD MATHEMATICS RELATIVE TO THE FREQUENT OR INFREQUENT USE OF MATHEMATICS

Types of Modified Attitudes	Uses Mathematics		Total
	Frequently	Infrequently	
Positive	117	34	151
Neutral	12	3	15
Negative	79	34	113
Total	208	71	279
$X^2 = 2.1979$, df = 2, $p > .05$			

The analysis of the data resulted in an observed value of X^2 that was not statistically significant. Thus, the writer did not reject null hypothesis X, "there was no significant difference in types of modified attitudes toward mathematics between students who used mathematics frequently and students who used mathematics infrequently within the two

week period prior to the administration of the post-test."

Summary

This chapter has presented the findings of the present investigation resulting from the analysis of attitude modification as interpreted according to the (a) Wilcoxon Test, (b) McNemar Test, and (c) Chi-square Test.

Significant differences in the modification of attitudes toward mathematics were detected at the .05 level of confidence for the following independent variables:

1. Students enrolled in Education 4152.
2. Students enrolled in courses of the mathematics sequence and concurrently enrolled in mathematics related courses.
3. Students enrolled in courses of the mathematics sequence and not enrolled in mathematics related courses.
4. Students who frequently used mathematics within the two week period prior to the administration of the post-test.
5. The designation of the pre-test and post-test of grade levels, grouped as pre-college and college, where present attitudes toward mathematics were formulated.
6. Students enrolled in the various courses of the mathematics sequence and types of modified attitudes (i.e., positive, negative, or zero) toward mathematics.

Chapter V will present the conclusions, implications, and recommendations of the study based on these findings.

CHAPTER V

CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Review of the Study

One of the two major objectives of this study was to investigate if prospective elementary school teachers' attitudes toward mathematics were significantly modified during the semester of their enrollment in a course of the prescribed mathematics sequence. The other major objective of this study was to test significant differences between selected variables and types of attitude modification (i.e., positive, negative, or zero).

This study was conceived as a cross-sectional one using pre- and post-tests. Data for this investigation was collected from 279 Oklahoma State University students enrolled in the mathematics sequence during the Spring Semester of the 1967-68 school year.

Non-parametric statistical techniques were used to analyze the data. These techniques included the (a) Wilcoxon Test, (b) McNemar Test for Significant Changes, and (c) Chi-square Test. On the basis of the statistical design and analyses deemed appropriate for this kind of study each hypothesis was tested, according to methods prescribed by Siegel (61) at the .05 level.

Conclusions and Theoretical Implications

Investigations often yield results and conclusions whose occurrence may be explained in relation to the variables investigated. The implications and conclusions of this study have been combined.

On the basis of this research and subject to the specified limitations, certain conclusions were drawn. The conclusions herein were arrived at as a consequence of the statistical tests which made it necessary to reject some of the hypotheses.

1. There was a statistically significant modification of attitudes toward mathematics of those students enrolled in Education 4152. This modification was in a positive direction. The statistical technique yielded a result too extreme to be associated with an occurrence by chance. This result suggests that if teachers associated with the mathematical training of prospective elementary school teachers are interested in modifying the attitudes of these students toward mathematics in a positive direction, the students should be enrolled in course offerings and/or taught by methods of teaching similar to the ones of Education 4152. These include student participation and the appropriate use of films, filmstrips, graphs, models and other teaching aids. Learning is more active than in other mathematics courses.
2. There was a statistically significant modification of attitude toward mathematics of those students enrolled in courses of the mathematics sequence and concurrently enrolled in courses related to mathematics. The modification was in a positive

This suggests that it is probably worthwhile for mathematics courses to be structured to emphasize the applied aspect of mathematics as well as for courses related to mathematics to emphasize the theoretical aspects of pure mathematics that are used in mathematics courses at various times. That is, an attempt should be made by mathematics teachers among others to show the relationship between the content and process of mathematics courses and the content and process of courses related to mathematics. The basic implication appears to be that we should teach for transfer of learning and application.

3. There was a statistically significant modification of attitudes toward mathematics of those students enrolled in courses of the mathematics sequence and not enrolled in mathematics related courses. The modification which occurred was in a positive direction. This research result suggests that a relationship existed between the variable and the modification of this group of students' attitudes toward mathematics. Hence, it appears that educators should provide mathematics experiences for students like or similar to the ones of this sequence of courses if they are desirous of modifying students' positive attitudes toward mathematics. The results given here and those given in statement number two, are seemingly contradictory. However, they are not, and an explanation for this occurrence was given on page 51. The two conclusions suggest that the educational experiences of students while enrolled in the courses of this sequence were conducive to the positive modification of attitudes toward mathematics. These

experiences included the routines of the regular mathematics class (lecture, discussion, and problem solving) as well as reports of pertinent outside readings, small group discussions (4 or 5 students), and the extensive use of teaching aids. However, each course of the sequence was taught by a different teacher and there is the possibility that the personalities of teachers were contributees to the modification of attitudes toward mathematics.

4. There was a statistically significant modification of attitudes toward mathematics of those students enrolled in courses of the mathematics sequence who frequently used mathematics within the two week period prior to the administration of the post-test. This result implies that the frequent use of mathematics outside of the mathematics classroom may be a contributor to the modification of a positive attitude toward mathematics. Therefore, teachers of all levels of mathematics should encourage students to frequently engage in activities outside of the mathematics classroom that are mathematically oriented, and emphasize that activities such as consumer purchasing, cooking, budgeting, and game scoring rely heavily on mathematics.

5. There was a statistically significant difference between pre-test and post-test designation of grade levels where attitudes toward mathematics were formulated. The shift in the designation of grade levels where present attitudes toward mathematics were formulated was from pre-college to college. On the basis of this finding, enrollment in courses of the mathe-

matics were formulated. Therefore, this variable appears to contribute to the change by students in the designation of the grade level where their present attitude toward mathematics was formulated. This implies that all teachers of mathematics probably should use techniques of instructions similar to the ones previously listed as being used in these courses to effect positive attitude changes. In addition, it may be that the maturity level of students and/or recency of experiences with mathematics contributed to positive attitude modification.

6. There was a statistically significant difference in the types of modified attitudes toward mathematics occurring among students enrolled in the three courses of the mathematics sequence. On the basis of this finding, the courses of the mathematics sequence do not have the relationship of contributing in the same proportions to the development of types of modified attitudes toward mathematics. This implies that teachers of mathematics probably should duplicate the techniques of instruction that produce the most favorable ratio of the number of negative to positive modified attitudes toward mathematics. At the same time some consideration probably should be given to adopting techniques of instruction similar to the ones that develop the best ratio of non-modified (zero) attitudes to modified attitudes toward mathematics. This suggests a merger of the techniques of instruction used in Mathematics 2413, Mathematics 2513, and Education 4152. That is, the teacher of the mathematics courses probably should

utilize more teaching aids and might assume the role of a mathematics laboratory. On the other hand, the teacher of the education course might well incorporate small group discussion into the present methods of teaching.

A statistical test was not performed for the individual grade levels of designation for the formation of attitudes toward mathematics. However, the frequencies revealed that the junior high school grades are the critical ones in the formation of pre-college attitudes toward mathematics. This conclusion implies that apparently these are the grade levels where students are most susceptible to the formation of attitudes toward mathematics. Hence, these are the grades on which educators probably should concentrate to develop positive attitudes toward mathematics using whatever variables and techniques of instruction that are known to have a positive relationship with this development.

Finally, some conclusions relative to the modification of attitudes toward mathematics were arrived at even though the null hypotheses pertaining to the variables were not rejected.

1. There was no significant modification of attitudes toward mathematics of those students enrolled in Mathematics 2413.
2. There was no significant modification of attitudes toward mathematics of those students enrolled in Mathematics 2513.
3. There was no significant modification of attitudes toward mathematics among students who expected a grade of C or better in their present course of the mathematics sequence.
4. There was no significant difference in types of modified attitudes toward mathematics, relative to students enrolled in

courses of the mathematics sequence while concurrently enrolled in courses related to mathematics.

5. There was no significant difference between the pre-test and post-test relative to students liking or disliking a majority of the selected topics related to mathematics.
6. There was no significant difference among types of modified attitudes toward mathematics between students who expected a grade of C ro better and students who expected a grade of less than C in their present course of the mathematics sequence.
7. There was no significant modification of attitudes toward mathematics of those students who used mathematics infrequently within the two week period prior to the administration of the post-test.
8. There was no significant difference among types of modified attitudes toward mathematics of those students who used mathematics frequently within the two week period prior to the administration of the post test.

Obtaining non-significant statistical results by an investigator does not imply that the relationship does not exist. Instead, the relationship may exist but was not determined by the investigator of this research and may have been due to such factors as:

1. The kind of analysis: the statistical techniques may not have been selective enough, too rigorous, or it may be that parametric statistical techniques would have provided different results.

2. The theory and hypotheses: it may be that relative to some variables the investigator theorized and hypothesized incorrectly.
3. The kinds of categories used to test some of the hypotheses: For example: One question asked was, "did the student expect a grade of C or better in the present course of the mathematics sequence." This category may have been too broad. It may be that choosing grades by the usual stratification (A, B, C, D, and E) would have provided different results.
4. The lack of controlled experimentation: This may have permitted participants to have different mathematical experiences outside of the class.

However, based on the findings of this study teachers of courses of the mathematics sequence should experiment within their classes in an attempt to determine through the use of valid statistical techniques if the variables identified as not being related to attitude modifications toward mathematics are related.

In summary, some broad conclusions were revealed by the analysis of the data. One conclusion was that attitudes toward mathematics can be and were modified in a positive direction while students were enrolled in courses of the mathematics sequence. Secondly, the courses of the mathematics sequence are not significantly modifying students' attitudes toward mathematics in a negative direction. Finally, the smallest percentage of students who reported scores which indicated that there was no modification of attitudes toward mathematics were enrolled in Mathematics 2413. This led the investigator to conclude that if mere attitude changes toward mathematics are desired, Mathe-

matics 2413 is perhaps the course of the mathematics sequence in which this can be most effectively done. (However, if the techniques of instruction used in Education 4152 were adapted to this course, it may be that this course would contribute the most to the modification of positive attitudes toward mathematics).

In the course of a study the investigator is likely to observe or encounter problems which he deems are worthy of further investigation. Some of this writer's suggestions for further research or study are given as recommendations.

Recommendations for Further Research

The investigator of the present study is of the opinion that the stated findings or conclusions made from this research are important and significant to educators engaged in the field of mathematics for elementary school teachers. Some variables were identified as being related to the modification of attitudes toward mathematics, others were not. With this information educators may now discuss with more certainty the relationships between the identified variables and attitude changes. However, more research can and should be done to further clarify the areas considered in this study. The investigator recommends the following specific areas for further research.

1. More studies should be conducted pertaining to all phases of attitude change. Such questions as, "Do modern curricular programs aid this phase of attitude development?" and "Are there other variables associated with attitude modifications toward mathematics?" should be investigated.

2. Research should be conducted in the area of negatively and positively modified attitudes. A few of the questions which might be investigated are: "What can be done to minimize the development of attitudes which are negative?"; "What can be done to develop and hold attitudes which are positive?"; and "What can be done for students once they have developed negative attitudes?"
3. Another question which should be investigated is "What greater use can be and should be made of attitude scales in guiding and counseling students at all grade levels?"
4. An analysis of data of a study of this nature with a less rigorous statistical test such as the Sign Test should be conducted to determine if the findings will confirm the ones of this study.
5. Some investigation should be carried out relative to the impact of particular mathematics topics in relation to attitude changes toward mathematics. Then, instead of testing the items collectively for changes in liking or disliking a majority of the topics, as was done in this study, one could and should consider each item separately relative to identified changes.

A SELECTED BIBLIOGRAPHY

(1) Aiken, Lewis R. "Personality Correlates of Attitudes Toward Mathematics." Journal of Educational Research, LVI (May, 1963), 467-80.

(2) _____ and Robert M. Dreger. "The Effect of Attitudes on Performance in Mathematics." Journal of Educational Psychology, LII (February, 1961), 19-24.

(3) Allport, Gordon W. Attitudes: A Handbook of Social Psychology. Ed. C. Murchison. Worcester: Clark University Press, 1935.

(4) Anderson, George R. "Reported to the United States Department of Health, Education, and Welfare." Analysis of Research in the Teaching of Mathematics. Washington: U.S. Government Printing Office, 1963, p. 29.

(5) Banks, John Houston. Learning and Teaching Arithmetic. 2nd Ed. Boston: Allyn and Bacon, 1964.

(6) Bell, H. M. Youths Tell Their Story. Washington: American Council on Education, 1938.

(7) Bendig, A. W. and J. B. Hughes. "Student Attitude and Achievement in a Course in Introductory Statistics." Journal of Educational Psychology, XCV (May, 1954), 268-75.

(8) Buck, Walter. "A Measurement of Changes in Attitudes and Interest of University Students Over a Ten Year Period." Journal of Abnormal Social Psychology, XXXI (April, 1936), 12-19.

(9) Butler, Charles H. and F. Lynwood Wren. The Teaching of Secondary Mathematics. New York: McGraw-Hill Book Company, 1960.

(10) Cambridge Conference on School Mathematics. Goals for School Mathematics. Boston: Houghton Mifflin Company, 1963.

(11) Carlson, Hildin of Bror. "Attitudes of Undergraduate Students." Journal of Social Psychology, V (May, 1934), 202-3.

(12) Davis, Robert B. "Emotions and Thoughts: Subtle Emotional Influences." Improving Mathematics Programs Trends and Issues. Ed. M. Vere Devault. Columbus: Merrill Book, Inc., 1961, 108-21.

(13) Dorunie, N. M. Fundamentals of Measurements. New York: Oxford University Press, 1958.

(14) Droba, Daniel D. "The Nature of Attitudes." Journal of Social Psychology, IV (Sept, 1933), 444-63.

(15) Dutton, Wilbur H. "Attitudes of Junior High School Pupils Toward Arithmetic." School Review, LXIV (January, 1956), 18-22.

(16) _____. "Attitudes of Prospective Teachers Toward Arithmetic." The Elementary School Journal, LII (October, 1951), 84-90.

(17) _____. "Measuring Attitudes Toward Arithmetic." The Elementary School Journal, LV (Sept, 1954), 24-31.

(18) Ferguson, Leonard W. "Attitudes of Stanford Students Toward U.S. Presidents." School and Society, XLIV (August, 1936), 190-192.

(19) Fishlein, Martin. Readings in Attitude Theory and Measurement. New York: Wiley, 1967.

(20) Goff, Gerald and Milton E. Berg. Basic Mathematics: A Programmed Introduction. New York: Appleton-Century-Crofts, 1968.

(21) Griffiths, Daniel. Paper Presented at the 1967 Convention of the American Association of School Administrators. "The Ten Most Significant Educational Research Findings in the Past Ten Years." New London: Croft Educational Services, 1967.

(22) Guttman, Louis. Measurement and Prediction. Princeton: Princeton University Press, 1950.

(23) Harrington, Lester G. "Attitudes Toward Mathematics and the Relationship Between Such Attitudes and Grades Obtained in Freshman Mathematics Courses." (unpub. Doctoral Dissertation, University of Florida, 1960).

(24) Hilgard, Ernest R. Theories of Learning. 2nd Ed., New York: Appleton-Century-Crofts, Inc., 1956.

(25) Houland, Carl I. and Milton J. Rosenberg. "Cognitive, Affective and Behavioral Components of Attitudes." Yale Studies in Attitudinal Communication: Attitude Organization and Change. Vol. 3. Ed. Carl I. Houland and Milton Rosenberg. New Haven: Yale University Press, 1960, 1-28.

(26) Hurrocks, John E. The Psychology of Adolescence Behavior and Development. 2nd ed. Boston: Houghton-Mifflin Company, 1962.

(27) Hytche, William P. "A Comparative Analysis of Four Methods of Instruction in Mathematics", (unpub. Doctoral Dissertation, Oklahoma State University, 1968).

(28) Insko, Chester A. Theories of Attitude Change. New York: Appleton-Century-Crofts, Inc., 1967.

(29) Isaac, Nathan. "Mathematics: The Problem." New Approaches to Mathematics Teaching. Ed. Frank W. Land. London: Macmillian and Company, 1963, 20-27.

(30) Katz, D. and E. Statlard. "A Preliminary Statement to a Theory of Attitude Structure and Change." Theories of Attitude Change. Ed. Chester A. Insko. New York: Appleton-Century-Crofts, Inc., 1967, II-XI.

(31) Kinsella, John J. Secondary School Mathematics. New York: The Center for Applied Research in Education, 1965.

(32) Klausmeier, Herbert J. and William Goodwin. Learning and Human Abilities. 2nd Ed. New York: Harper and Row Publishers, 1966.

(33) Knower, F. H. "Experimental Studies of Changes in Attitudes." "A Study of the Effects of Oral Arguments on Changes of Attitude." Journal of Social Psychology, VI (June, 1933), 315-47.

(34) Kock, I. S. A Study of Service. Vol. 3. New York: McGraw-Hill Book Company, 1959.

(35) Lee, J. Murray and Dorris Mae Lee. The Child and His Development. New York: Appleton-Century-Crofts, Inc., 1958.

(36) Lewontin, R. C. and Felsenstein. "The Roluistness of Homogeneity in 2XN Tables." Biometrics, 1 (March, 1965), 19-33.

(37) Likert, Renesis. "A Technique for the Measurement of Attitudes." Archives of Psychology, No. 140, 1932.

(38) Malone, W. H. 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), 599-608.

(39) Metzer, H. "Hostility and Tolerance in Children's Nationality and Race Attitude." American Journal of Orthopsychiatry, VI (May, 1941), 662-76.

(40) Mood, A. M. "On Asymptotic Efficiency of Certain Non-Parametric Two Sample Tests." Annals of Mathematics, XXV 514-22.

(41) Murphy, Gardner and Renesis Likert. Public Opinion and the Individual. New York: Harper and Brothers, 1938.

(42) Nelson, Erland. "Attitudes 1: Their Nature and Development." The Journal of General Psychology, XXI (October, 1939), 380-429.

(43) Oklahoma State University Catalog. Stillwater: Oklahoma State University Press, 1967.

(44) Ostle, Bernard. Statistics in Research: Basic Concepts and Techniques for Research Workers. 2nd Ed. Ames: The Iowa State University Press, 1963.

(45) Patterson, Ruth C. and L. L. Thurstone. Motion Pictures and the Social Attitudes of Children. New York: Macmillian Company, 1933.

(46) Phelps, Jack. "A Study Comparing Attitudes Toward Mathematics of SMSG and Traditional Elementary School Students." (unpub. Doctoral Dissertation, Oklahoma State University, 1963).

(47) Plant, Walter T. "Changes in Enthnocentrism With a Four-Year College Education." Journal of Educational Psychology, XLIX (June, 1958), 162-65.

(48) Poffenberger, Thomas and Donald Norton. "Factors in the Formation of Attitudes Toward Mathematics." Journal of Educational Research, LII (January, 1959), 171-76.

(49) Remmers, H. H. Introduction to Opinion and Attitude Measurement. New York: Harper and Brothers, 1954.

(50) _____. "Studies in Attitudes: Series I, II, and III." Purdue University Studies in Higher Education. Bulletin Nos. 26, 31, and 34. Lafayette: Purdue University Press, 1934, 1936, and 1938.

(51) _____ and N. L. Gage. Educational Measurement. New York: Harper and Brothers, 1955.

(52) _____, _____, and T. Francis Rammel. A Practical Introduction to Measurement and Evaluation. New York: Harper and Brothers, 1960.

(53) Reeve, William D. Mathematics for the Secondary School. New York: Henry Holt and Company, 1954.

(54) Rice, Jimmy Marshall. "A Study of Attitudes of Elementary Teachers Toward Modern Mathematics Programs." (unpub. Doctoral Dissertation, Oklahoma State University, 1964).

(55) Rosenberg, Milton J. "The Experimental Investigation of a Value Theory of Attitude Structure." (unpub. Doctoral Dissertation, University of Michigan, 1953).

(56) Rosenbloom, Paul C. "A Conference: The Minnesota School Mathematics and Science Center Teaching Project." New Developments in Elementary School Science. Oklahoma City: Frontier of Science Foundation of Oklahoma, Inc., 1964.

(57) Runyon, Richard and Audrey Haber. Fundamentals of Behavioral Statistics. Boston: Addison-Wesley, 1968.

(58) Schneiders, Alexander A. The Psychology of Adolescence. 2nd Ed. Milwaukee: Bruce Publishing Company, 1955.

(59) Shaw, Marvin E. and Jack W. Wright. Scales for the Measurement of Attitudes. New York: McGraw-Hill Book Company, 1967.

(60) Sherif, Carolyn N., Muzafer Sherif, and Roger E. Nebergall. Attitude and Attitude Change: The Social Judgment-Involvement Approach. Philadelphia: Saunders Company, 1965.

(61) Siegel, Sidney. Non-Parametric Statistics. New York: McGraw-Hill Book Company, 1956.

(62) Sister Josephina, C.S.J. "A Study of Attitudes in the Elementary Grades." Journal of Educational Sociology, (October, 1959), 56-60.

(63) Snedecor, George W. and William G. Cochran. Statistical Methods. 6th Ed. Ames: Iowa State University Press, 1967.

(64) Sorenson, Herbert. Psychology in Education. 4th Ed. New York: McGraw-Hill Book Company, 1964.

(65) Stagner, R. "Facist Attitudes: Their Determining Conditions." Journal of Social Psychology, VII, 1936, 438-54.

(66) Steel, Robert, G. D. and James H. Torrie. Principles and Procedures of Statistics. New York: McGraw-Hill Book Company, 1960.

(67) Stone, Marshall H. "Some Crucial Problems of Mathematical Instruction in the United States." School Review, LXV (Spring, 1958), 64-77.

(68) Stright, Virginia M. "A Study of Attitudes Toward Arithmetic of Students and Teachers in the Third, Fourth, and Sixth Grades." The Arithmetic Teacher, VII (October, 1960), 280-86.

(69) Telford, C. W. "An Experimental Study of Some Factors Influencing the Social Attitudes of College Students." Journal of Social Psychology, V, 1934, 421-28.

(70) Thesis Writing Manual: A Guide for Graduate Students. Stillwater: Oklahoma State University Press, 1967.

(71) Thurstone, L. L. and E. J. Chave. The Measurement of Attitudes. Chicago: University of Chicago Press, 1929.

(72) _____ and _____. The Measurement of Attitudes. Chicago: University of Chicago Press, 1948.

(73) Travers, Robert M. W. An Introduction to Educational Research. 2nd Ed. New York: Macmillian Company, 1964.

(74) Van Daleu, Deobold B. Understanding Educational Research. Rev. Ed. New York: McGraw-Hill Book Company, 1966.

(75) Walker, Helen M. and Joseph Leu. Statistical Inference. New York: Holt, Rinehart, and Winston, 1953.

(76) Webster, Harold. "Changes in Attitudes During College." Journal of Educational Psychology, XLIX (June, 1958), 209-17.

(77) Wooton, William. SMSG The Making of a Curriculum. New Haven: Yale University Press, 1965.

(78) Zant, James H. "Mathematics at the College and University Level." Review of Educational Research, XXXIV (June, 1964), 347-53.

APPENDIX A

STUDENT ATTITUDES TOWARD MATHEMATICS AND MODERN MATHEMATICS PROGRAMS

OKLAHOMA STATE UNIVERSITY

STILLWATER, OKLAHOMA

SPRING SEMESTER

1968

A Study Prepared in Conjunction With a Series of Research Projects in Mathematics Education

RICE ATTITUDE SCALE

The five following categories will be used to indicate your feelings about each statement:

(SA) strongly agree
(A) agree
(U) undecided
(D) disagree
(SD) strongly disagree

Please check one category for each item.

SA	A	U	D	SD	
					1. I am enthusiastic about modern mathematics programs.
					2. Mathematics serves the needs of a large number of boys and girls.
					3. I hope I never have to teach in a modern mathematics program.
					4. Students who are taught in modern programe have a better general overview of mathematics.
					5. The modern mathematics programs are better than the old ones.
					6. I didn't like mathematics in school and I still don't.
					7. I think parents would prefer that their children not be given instruction in a modern mathematics program.
					8. Modern mathematics programs arouse anxiety in both teachers and students.
					9. Those school systems which do not put emphasis on modern mathematics programs are not being fair to their students.
					10. I like to teach mathematics but I prefer to teach other subjects.
					11. I would like to teach in a modern mathematics program.
					12. Modern mathematics is challenging and intriguing.
					13. I feel that I make mathematics interesting to most of my pupils.
					14. I think set theory helps to clarify and unite mathematics.
					15. Sometimes I give extra assignments in mathematics as punishment.
					16. Placement of concepts and learning tasks in modern mathematics programs is not well adapted to student maturity level.
					17. Modern mathematics programs encourage inappropriate departmentalized instructions in the elementary school.
					18. I wish I did not have to teach mathematics.
					19. Traditional mathematics programs are better suited to the philosophy and objectives of today's society.
					20. I think the emphasis on modern mathematics will cause more children to be afraid of mathematics.
					21. I think most students would be enthusiastic about a modern mathematics program.
					22. The movement toward modern mathematics has developed too rapidly.
					23. Mathematics is the subject I like least of all to teach.
					24. I think the emphasis on modern mathematics may result in such concern for mathematics that the child as a learner will be overlooked.
					25. A child will learn better if he is provided with a learning situation in which he discovers the meanings and concepts in mathematics.
					26. I would enjoy studying set theory.
					27. I see little need for my school to offer a modern mathematics program.
					28. Modern mathematics programs cause too many transitional problems.
					29. All elementary teachers should have formal training in the use of modern mathematics program materials.
					30. I think it would be exciting to teach in a modern mathematics program.
					31. That mathematics which is taught in modern programs is most appropriate to the world today.
					32. I have the feeling that my students hate mathematics.
					33. Modern mathematics programs introduce many concepts and processes at too low a grade level.
					34. I get frustrated when I study modern mathematics materials.
					35. Mathematics is very practical.
					36. Modern programs over-stress terminology.
					37. I can teach mathematics well without reading mathematics magazines and methods books.
					38. I believe that students at the elementary level are capable of learning more mathematics than they are presently being taught.
					39. I really enjoy teaching mathematics.
					40. Teaching in a modern program represents a challenge for me.
					41. Mathematics is just a skill with a little practical application.
					42. Concepts and materials stressed in modern mathematics programs are more difficult for students.
					43. I see no practical purpose in emphasizing mathematics.
					44. Many concepts presented in modern programs are too abstract for the students at the level for which they are intended.
					45. Mathematics is one of the most useful subjects I know.

NAME_____ SEX M F CLASSIFICATION Fr. Soph. Jr. Sr.
(Last) (First) (M. Init.) (Circle One) (Circle One)

GENERAL INFORMATION

The following pages contain a number of statements about which there is no general agreement. People differ widely in the way they feel about each item. There are no right nor wrong answers. Read each item carefully and indicate the choice which best expresses your feeling about the statement. Whenever possible let your personal experience determine your answer. Note: Your responses on this instrument will not in any manner affect your grade, and your answers will be treated confidentially. Arithmetic and mathematics may be thought of as being intsrchangeable.

DUTTON ATTITUDE SCALE

PART I

You are to indicate your agreement with the statement by placing a capitol "A" beside it, and your disagreement with a statement by placing a capitol "D" beside it.

Scale Value		
9.5	___	1. I think about arithmetic problems outside of school and like to work them out.
3.7	___	2. I don't feel sure of myself in arithmetic.
8.6	___	3. I enjoy seeing how rapidly and accurately I can work arithmetic problems.
5.6	___	4. I like arithmetic but I like other subjects just as well.
7.7	___	5. I like arithmetic because it is practical.
4.6	___	6. I don't think arithmetic is fun but I always want to do well in it.
5.3	___	7. I am not enthusiastic about arithmetic but I have no real dislike for it either.
5.9	___	8. Arithmetic is as important as any other subject.
3.3	___	9. Arithmetic is something you have to do even though it is not enjoyable.
7.0	___	10. Somstimes I enjoy the challenge presented by an arithmetic problem.
2.5	___	11. I have always been afraid of arithmetic.
9.0	___	12. I would like to spend more time in school working arithmetic.
1.0	___	13. I detest arithmetic and avoid using it at all times.
6.7	___	14. I enjoy doing problems when I know how to work them well.
3.2	___	15. I avoid arithmetic because I am not very good with figures.
10.5	___	16. Arithmetic thrills me, and I like it better than any other subject.
9.8	___	17. I never get tired of working with numbers.
2.0	___	18. I am afraid of doing word problems.
8.1	___	19. Arithmetic is very interesting.
1.5	___	20. I have never liked arithmetic.
10.4	___	21. I think arithmetic is the most enjoyable subject I have taken.
3.0	___	22. I can't see much value in arithmetic.
	*___	23. Within the last two weeks, I have frequently used arithmetic.
	*___	24. I expect to earn a grade of C or better in my present mathematics course.
	*___	25. I am presently enrolled in a non-mathematics course which requires the use of a good deal of mathematics.

PART II

Estimate the grade that you were in when you formed your present attitude toward arithmetic (mathematics) by circling the appropriate number or statement.

1 2 3 4 5 6 7 8 9 10 11 12 All grades College Cannot recall

Indicate your feeling toward each of the following topics related to mathematics by placing a check under like or dislike in correct relation to each topic.

	Like	Dislike		Like	Dislike
1. Sets	___	___	16. Mastering numerical relationships	___	___
2. Whole numbers	___	___	17. Mastering geometric relationships (e.g., ratio)	___	___
3. Common fractions	___	___	18. Mastering computational algorisms	___	___
4. Decimal fractions	___	___	19. Counting	___	___
5. Negative numbers	___	___	20. Adding	___	___
6. Non-decimal numeration systems	___	___	21. Subtracting	___	___
7. Finite number systems	___	___	22. Multiplying	___	___
8. Geometric figures	___	___	23. Dividing	___	___
9. Geometric construction	___	___	24. Extracting square roots	___	___
10. Measurement	___	___	25. Finding common multiples	___	___
11. Social applications	___	___	26. Finding common factors	___	___
12. Ordering and describing data	___	___	27. Checking answers	___	___
13. Puzzles and games	___	___	28. Using Computational shortcuts	___	___
14. Percentage	___	___	29. Drill as a learning device	___	___
15. Mastering basic facts	___	___	30. Others (List)	___	___

*Statements added to the original instrument.

The numerical scale was omitted from the instrument during the data collection period, but was incorporated into a program to analyze the data. These corresponding values were used for data whenever a student indicated he agreed with a statement.

APPENDIX B

IBM CODE SHEET FOR ORIGINAL DATA

Initial Column	Final Column	Number of Columns	Item	Remarks
1	3	3	Identification number	
4	4	1	Card number	1
5	5	1	Test number: Pretest=1 Posttest=2	1 or 2
6	6	1	Sex: Male=1, Female=2	1 or 2
7	7	1	Class: Freshmen=1, Soph=2 Jr=3, Sr=4, Grad=5	1, 2, 3, 4, or 5
8	8	1		
9	9	1		
.	.	.		
.	.	.	Responses indicated on the instrument for items 1 to 25, Part I, are A=1, D=2	1 or 2
.	.	.		
.	.	.		
.	.	.		
32	33	1		
33	34	2	Grade=1-15	1, 2, 3,... 14 or 15
35	35	1		
.	.	.		
.	.	.	Responses indicated on the instrument for items 1 through 29, Part II are like=1, dislike=2	1 or 2
.	.	.		
.	.	.		
65	65	1		

APPENDIX C

PRE-TEST AND POST-TEST RESULTS OF DUTTON ATTITUDE SCALE ADMINISTERED TO PRO-SPECTIVE ELEMENTARY SCHOOL TEACHERS

Student Number	Post-Test Score	Pre-Test Score	Sex	Classification	Course	Question 23	Question 24	Question 25
1	6.6	6.1	F	4	3	•	•	
2	5.7	6.1	F	4	3	•	•	•
3	5.2	4.6	F	4	3	•	•	•
4	6.8	7.8	F	4	3	•	•	
5	6.9	5.7	F	4	3	•	•	•
6	5.9	6.1	F	4	3	•	•	
7	7.4	6.0	F	4	3	•	•	
8	5.5	5.2	F	4	3	•	•	
9	5.7	5.5	F	3	3	•	•	
10	7.7	7.4	F	4	3	•	•	•
11	6.9	6.9	F	3	3	•	•	
12	6.8	7.6	F	4	3	•	•	
13	7.4	7.4	F	3	3		•	
14	5.0	4.9	F	3	3	•	•	
15	5.8	5.9	F	4	3	•	•	
16	5.0	4.2	F	4	3		•	
17	4.8	5.6	F	3	3	•	•	•
18	7.0	6.7	F	3	3	•	•	•
19	3.8	4.0	F	3	3		•	
20	8.0	7.0	F	4	3		•	
21	6.0	5.9	F	4	3		•	
22	7.2	6.1	F	4	3	•	•	
23	6.0	5.9	F	4	3	•	•	•
24	8.5	8.5	F	3	3	•	•	•
25	7.1	6.9	F	5	3		•	•
26	6.5	6.4	F	3	3		•	•
27	6.2	6.6	F	4	3	•	•	
28	5.3	5.7	F	3	3	•	•	•
29	3.3	4.0	F	4	3		•	
30	7.0	6.5	F	4	3	•	•	•
31	5.6	6.5	F	3	3		•	
32	5.7	4.9	F	3	3	•	•	
33	8.3	8.3	F	4	3	•	•	
34	6.1	5.1	F	3	3		•	•
35	8.2	8.2	F	3	3	•	•	
36	7.1	6.5	F	3	3	•	•	•
37	5.9	5.3	F	3	3	•	•	
38	5.1	5.4	F	3	3	•	•	•
39	4.9	4.9	F	3	3	•	•	
40	7.3	7.3	F	5	3	•	•	
41	6.7	6.8	F	3	3		•	
42	4.7	3.6	F	4	3		•	
43	7.6	7.1	F	3	3	•	•	
44	4.6	4.2	F	4	3		•	
45	7.4	7.0	F	3	3		•	
46	5.7	6.2	F	4	3	•	•	•
47	7.1	6.5	F	4	3	•	•	•
48	4.7	4.5	F	3	3	•	•	
49	4.7	5.0	F	5	3	•	•	
50	6.4	7.1	F	3	3		•	
51	4.9	5.3	F	3	3		•	
52	5.6	4.9	F	3	3	•	•	
53	8.1	8.1	F	3	3	•	•	•
54	6.6	6.9	F	3	3		•	
55	4.7	4.3	F	3	3	•	•	•
56	7.5	7.4	F	3	3	•	•	•
57	4.9	5.2	F	3	3		•	
58	7.1	6.9	F	3	3	•	•	
59	6.1	5.8	F	3	3	•	•	
60	6.3	6.6	F	4	3		•	
61	6.1	6.2	F	3	3		•	
62	7.2	5.9	F	4	3	•	•	•
63	6.8	7.1	F	3	3	•	•	•
64	8.0	8.0	F	3	3	•	•	
65	7.5	7.6	F	4	3	•	•	•

Student Number	Post-Test Score	Pre-Test Score	Sex	Classification	Course	Question
66	7.8	6.3	F	5	3	•
67	6.0	6.1	F	3	3	•
68	4.4	4.5	F	3	3	•
69	5.5	4.7	F	3	3	•
70	7.3	7.1	F	3	3	•
71	8.3	7.6	F	4	3	•
72	5.5	5.2	F	3	3	•
73	7.3	7.6	F	3	3	•
74	4.8	4.2	F	3	3	•
75	7.9	7.2	M	4	3	•
76	8.1	8.1	F	3	3	•
77	3.9	4.0	F	3	2	•
78	7.0	7.0	F	3	2	•
79	7.6	7.0	M	4	2	•
80	5.6	5.6	F	2	2	•
81	5.9	6.2	F	2	2	•
82	7.2	7.6	F	4	2	•
83	5.3	5.1	F	2	2	•
84	8.2	6.2	F	2	2	•
85	6.5	6.6	F	3	2	•
86	5.0	5.1	F	2	2	•
87	7.4	5.2	F	2	2	•
88	7.9	7.3	M	3	2	•
89	4.7	5.7	F	3	2	•
90	4.8	5.7	F	2	2	•
91	7.1	6.2	F	2	2	•
92	8.5	8.0	F	1	2	•
93	4.9	4.8	F	3	2	•
94	7.8	7.3	F	1	2	•
95	6.2	5.6	F	1	2	•
96	7.8	7.5	F	2	2	•
97	3.4	3.9	F	3	2	•
98	7.1	6.6	F	3	2	•
99	8.0	7.7	F	1	2	•
100	6.8	7.4	F	2	2	•
101	5.9	6.3	F	4	2	•
102	4.2	3.7	M	3	2	•
103	4.5	4.6	F	2	2	•
104	7.6	5.5	F	2	2	•
105	5.3	6.7	F	3	2	•
106	4.8	4.8	F	2	2	•
107	5.9	5.5	F	3	2	•
108	8.1	8.3	F	2	2	•
109	3.1	5.3	F	3	2	•
110	4.7	4.8	F	4	2	•
111	6.7	6.6	F	1	2	•
112	8.0	7.6	F	2	2	•
113	8.1	8.2	F	1	2	•
114	5.3	5.7	F	2	2	•
115	5.0	4.0	F	3	2	•
116	7.6	7.9	F	3	2	•
117	5.4	5.5	F	2	2	•
118	5.9	6.2	F	1	2	•
119	6.0	5.3	F	2	2	•
120	5.0	5.7	F	2	2	•
121	6.1	5.1	F	2	2	•
122	6.4	6.0	F	2	2	•
123	4.9	4.5	F	2	2	•
124	5.8	5.9	F	2	2	•
125	7.7	7.1	F	2	2	•
126	4.6	4.7	F	2	2	•
127	5.4	5.3	F	3	2	•
128	5.7	5.3	F	2	2	•
129	5.0	4.9	F	2	2	•
130	7.2	6.9	F	2	2	•
131	7.2	6.5	F	2	2	•
132	5.3	6.0	F	2	2	•
133	3.2	3.0	F	3	2	•
134	7.8	7.6	F	2	2	•
135	6.5	7.3	F	3	2	•
136	6.1	6.3	F	3	2	•
137	5.6	5.3	F	3	2	•
138	5.4	5.1	F	1	2	•
139	5.8	5.5	F	4	2	•
140	6.2	6.0	F	2	2	•
141	4.5	3.1	F	3	2	•
142	7.1	6.5	M	4	2	•
143	6.7	6.5	F	3	2	•
144	5.3	5.1	F	3	2	•
145	7.2	6.3	F	3	2	•
146	7.0	6.7	F	3	2	•
147	6.4	6.6	F	2	2	•
148	3.9	4.2	F	2	2	•
149	2.8	6.8	F	2	2	•
150	5.1	5.4	F	2	1	•
151	8.5	7.0	F	1	1	•
152	5.6	5.2	F	1	1	•
153	3.9	4.4	F	2	1	•
154	5.4	5.3	F	2	1	•
155	6.0	6.0	F	2	1	•
156	4.9	3.7	F	1	1	•
157	5.4	4.6	F	1	1	•
158	5.7	5.2	F	1	1	•
159	7.6	7.8	F	2	1	•
160	3.8	4.8	F	2	1	•
161	4.4	4.3	F	3	1	•
162	4.0	4.4	F	3	1	•
163	5.0	4.8	F	1	1	•
164	4.2	4.5	F	1	1	•
165	7.8	7.1	F	1	1	•
166	6.7	6.5	F	1	1	•
167	5.0	5.3	F	3	1	•
168	4.8	5.1	F	2	1	•
169	5.6	7.5	F	1	1	•
170	8.0	8.2	F	1	1	•
171	4.0	5.6	F	1	1	•
172	5.4	4.9	F	3	1	•
173	5.7	6.5	F	1	1	•
174	5.6	5.9	F	2	1	•
175	4.0	3.6	F	2	1	•
176	4.0	3.6	F	2	1	•
177	8.0	7.9	F	1	1	•
178	5.8	4.7	F	2	1	•
179	4.5	4.9	F	1	1	•
180	6.1	5.6	F	1	1	•
181	6.1	5.5	F	1	1	•
182	5.0	6.3	F	1	1	•
183	6.3	6.1	F	2	1	•
184	7.3	7.1	F	1	1	•
185	4.0	3.7	F	2	1	•
186	5.5	5.0	F	3	1	•
187	4.2	3.4	F	3	1	•
188	5.0	5.6	F	2	1	•
189	7.1	7.7	F	5	1	•
190	7.8	7.1	F	2	1	•

Student Number	Post-Test Score	Pre-Test Score	Sex	Classification	Course	Question 23	24	25
191	3.3	4.2	F	2	1		*	
192	5.7	5.4	F	5	1	*	*	
193	5.7	4.9	F	2	1	*	*	*
194	7.4	5.8	F	2	1	*	*	*
195	6.4	5.0	F	1	1	*	*	
196	3.7	4.8	F	3	1		*	
197	4.8	4.6	F	1	1	*	*	
198	5.1	4.8	F	2	1	*	*	
199	5.6	5.0	F	1	1	*	*	
200	5.7	5.6	F	2	1	*	*	*
201	5.4	6.1	F	1	1	*	*	
202	3.7	3.6	F	1	1	*	*	
203	7.8	8.0	F	5	1	*	*	*
204	5.3	5.4	F	2	1		*	
205	3.7	2.7	F	3	1	*	*	
206	5.0	5.3	F	2	1	*	*	
207	4.7	5.9	F	4	1		*	*
208	5.9	4.9	F	3	1	*	*	
209	4.8	4.3	F	2	1		*	
210	5.7	5.4	M	4	1	*	*	
211	7.8	8.3	F	1	1	*	*	
212	7.7	6.3	F	2	1	*	*	*
213	5.5	5.3	F	3	1	*	*	*
214	7.1	6.9	F	2	1	*	*	
215	4.3	3.6	F	2	1	*	*	
216	8.9	7.3	F	2	1	*	*	*
217	6.7	8.0	M	2	1	*	*	*
218	6.1	6.1	F	2	1		*	
219	7.3	7.1	F	1	1	*	*	
220	7.1	7.2	F	2	1	*	*	
221	5.5	6.7	F	1	1	*	*	
222	5.9	5.3	F	3	1	*	*	
223	5.5	3.9	F	3	1	*	*	
224	5.9	6.0	F	1	1	*	*	
225	5.4	6.5	F	1	1	*	*	
226	5.3	5.9	F	3	1	*	*	
227	5.4	6.0	F	1	1	*	*	*
228	7.8	7.4	F	2	1	*	*	
229	7.8	5.7	F	1	1	*	*	*
230	6.0	6.1	F	2	1	*	*	
231	4.2	3.6	F	1	1	*	*	
232	7.3	7.1	F	1	1	*	*	
233	8.2	7.3	F	2	1	*	*	
234	5.6	5.8	F	1	1	*	*	
235	7.8	8.0	F	2	1	*	*	
236	4.2	3.9	F	3	1	*	*	
237	4.4	4.5	F	2	1	*	*	
238	7.5	7.0	F	1	1	*	*	
239	5.8	5.4	F	2	1	*	*	
240	4.6	4.1	F	2	1	*	*	
241	4.6	5.9	F	1	1	*	*	
242	5.5	5.9	F	4	1	*	–	
243	5.3	5.9	F	1	1	*	*	
244	6.1	4.7	F	3	1	*	*	*
245	6.5	5.7	F	2	1	*	–	*
246	6.0	5.9	F	1	1	*	–	*
247	6.3	6.0	F	1	1	*	*	*
248	6.2	6.5	F	1	1		–	
249	6.2	5.9	F	1	1		–	
250	5.7	5.9	F	3	1		–	*
251	6.4	5.9	M	3	1	*	*	*
252	6.1	5.5	F	1	1	*	*	
253	6.0	6.0	F	4	1	*	*	
254	4.4	4.1	F	1	1	*	M	
255	5.5	5.7	F	1	1	*	*	
256	5.5	5.6	F	2	1	*	*	
257	5.9	5.2	F	2	1	*	*	
258	5.8	6.1	F	1	1		*	
259	5.8	6.2	F	5	1	*	*	
260	6.4	5.5	M	3	1	*	*	
261	3.9	4.1	F	2	1	*	*	
262	5.3	6.0	F	1	1		*	
263	4.5	4.0	F	1	1	*	–	
264	7.6	6.1	F	2	1		*	
265	5.3	5.8	F	1	1	*	*	
266	6.8	6.3	F	4	1	*	*	
267	5.1	4.6	F	1	1	*	*	
268	6.3	6.4	F	1	1	*	*	
269	4.2	5.0	F	2	1	*	*	*
270	5.3	5.4	F	2	1	*	*	
271	7.2	7.6	F	2	1		*	
272	6.7	6.5	F	2	1	*	*	
273	6.0	5.3	F	2	1	*	*	
274	4.1	4.4	F	2	1	*	–	*
275	4.7	3.6	F	1	1	*	*	
276	5.0	4.4	F	3	1	*	–	
277	6.0	5.0	F	3	1	*	*	
278	6.8	7.3	F	4	1	*	*	
279	4.2	6.2	F	1	1	*	–	

CODE

Sex: Male = M, Female = F

Classification: Freshman = 1
Sophomore = 2
Junior = 3
Senior = 4
Graduate Student = 5

Course: Mathematics 2413 = 1
Mathematics 2513 = 2
Education 4152 = 3

Question: 23. Within the last two weeks I have frequently used arithmetic.
24. I expect to earn a grade of C or better in my present mathematics course.
25. I am presently enrolled in a non-mathematics course which requires the use of a good deal of mathematics.

APPENDIX D

CONTENTS OF MATHEMATICS 2413

ONE: SETS

Examples of sets. Notation for sets and members of sets. Finite and infinite sets. The empty set. One-to-one correspondence. Equal sets. Equivalent sets. The universe of discourse. Subsets. Venn diagrams. Complements of sets. Intersection of sets. Disjoint sets. Union of sets. Commutative and associative properties. Identities. Ordered pairs of elements and the Cartesian cross-product. Distributive property.

TWO: WHOLE NUMBERS

Number properties of sets. Equality. Numeral. Segments and counting. Digits and place-value. Addition. Closure, commutative, and associative properties of addition. Identity for addition. Multiplication. Closure, commutative, and associative properties of multiplication. Multiplication by zero. Identity for multiplication. Distributive property of multiplication over addition. Substraction. Division. Zero in division. Right-distributive property of division over addition. Division algorithm. "Less than" and "greater than". Ordinal numbers.

THREE: SYSTEMS OF NUMERATION

Basic ingredients of a numeration system. Bases. Place-value and numerals. Expanded notation. Positional notation. Addition in various bases. Subtraction in various bases. Multiplication in various bases. Division in various bases. Division algorithm. Changing bases for numerals.

FOUR: FRACTIONS

Partitions and regular partitions. Regions and congruent subregions. Unit and unit fractions. Fractions. Equivalent fractions. Addition. Closure, commutative and associative properties of addition. Additive identity. Multiplication. Closure, commutative, and associative properties of multiplication. Multiplicative identity. Multiplicative inverses. Distributive property of multiplication over addition. "Less than" and "greater than". Subtraction. Division. Right-distributive property of division over addition.

FIVE: INTEGERS

Ordered-pair notation. Equality. Addition. Closure, commutative, and associative properties of addition. Additive identity. Additive inverses. Multiplication. Closure, commutative, and associative properties of multiplication. Multiplicative identity. Multiplication by zero. Distributive property of multiplication over addition. Signed-number notation. Addition of integers as signed numbers. Subtraction of integers as signed numbers. Multiplication of integers as signed numbers. Division of integers as signed numbers. "Less than" and "greater than".

SIX: THE NUMBER LINE

Natural number scale. Addition and the properties of addition. Subtraction. Multiplication and the properties of multiplication. Division. Division algorithm. Whole number scale. Zero and the identity property. Fraction scale. Addition and the properties of addition. Subtraction. Multiplication and the properties of multiplication. Division. Integer scale. Addition. Subtraction. Multiplication.

SEVEN: RATIONAL NUMBERS

Ordered pairs of integers. Equivalence. Addition and multiplication with basis properties. Subtraction. Division. "Less than" and "greater than." Denseness property. Decimal system of notation. Whole numbers and integers as decimals. Exponents. Infinite and terminating decimals. Repeating or periodic decimals. Algorithms for operations with decimals. Fractions and rational numbers as repeating or terminating decimals.

CONTENTS OF MATHEMATICS 2513

EIGHT: LOGIC AND SOLUTION SETS

Statements and open statements. Connectives and compound statements. Truth-values and truth tables. Truth sets or solution sets. Intervals. Venn diagrams as models for statements. Mathematical systems. Tautology and logical equivalence. Direct and indirect proofs.

NINE: RELATIONS AND FUNCTIONS

Relations. Properties of relations. Equivalence relations. Order relations. Inverses. "Divides" relation. Odd and even. Set of divisors. Set of multiples. Greatest common divisor. Least common multiple. Prime and composite integers. Square root. Congruence of integers. Domain and range of a relation. Functions or mappings. Absolute value.

TEN: INTUITIVE GEOMETRY

Point and space. Line, half-line, ray, and segment. Betweenness. Curve and simple curve. Parallel. Angle. Interior and exterior of an angle. Convex sets of points. Congruence of segments and angles. Linear pair of angles. Right angle. Perpendicular. "Less than" for segments and angles. Closed curve. Interior and exterior of a closed curve. Polygon and convex polygon. Triangle. Congruence of triangles. Similarity of triangles. Quadrilateral. Plane region. Circle and circular region. Polyhedron. Prism. Pyramid. Cone. Sphere.

ELEVEN: MEASUREMENT

Measure and measurement. Linear measure. Ruler. Precision and error. Standard units. Angular measure. Protractor. Standard units. Area measure. Grid. Perimeter and circumference. Pythagorean Theorem. Irrational numbers. Volume.

TWELVE: REAL NUMBERS

Rational real numbers and irrational real numbers. Basic properties of real numbers. "Less than," equality, and "greater than." Completeness property. Real number line or coordinate line. Coordinate plane. Rectangular Cartesian coordinate systems. Graphs of relations. Graphs of linear functions. Graphs of inequalities.

VITA

2

Washington Theophilus Taylor

Candidate for the Degree of

Doctor of Education

Thesis: A CROSS SECTIONAL STUDY OF THE MODIFICATION OF ATTITUDES OF SELECTED PROSPECTIVE ELEMENTARY SCHOOL TEACHERS TOWARD MATHEMATICS

Major Field: Higher Education

Biographical:

Personal Data: Born at Plateau, Alabama, July 24, 1931, the son of W. H. and Iona F. Taylor.

Education: Attended Mobile County Training School, Plateau, Alabama, graduating in 1949; received the Bachelor of Science degree of Alabama State College, Montgomery, Alabama, mathematics; received a National Science Foundation Academic Year Institute and obtained the Master of Basic Science degree in August, 1960, with a major in mathematics from the University of Colorado, Boulder, Colorado; did graduate study in mathematics at Atlanta University, Atlanta, Georgia, Louisiana State University, Baton Rouge, Louisiana, Tulane University, New Orleans, Louisiana, and Tuskegee Institute, Tuskegee, Alabama; completed requirements for the Doctor of Education degree at Oklahoma State University, Stillwater, Oklahoma, May, 1969.

Professional Experience: Entered the teaching profession in Mobile, Alabama in 1953 as a mathematics teacher and coach; returned to public school teaching in 1956 after serving in the U.S. Army from 1954 to 1956; presently, an Army Reserve Commissioned Officer; joined the Department of Mathematics, Southern University, Baton Rouge, Louisiana in 1960 as an Instructor and later attained the rank of Assistant Professor; Computer Programmed for IBM, Summer, 1966; most recent employment was as a mathematics teacher in extension services at Oklahoma State University.

Professional and Honorary Organizations: Life member of National Education Association, Phi Delta Kappa, Pi Mu Epsilon Honorary Mathematics Fraternity, Mathematics Association of America.