A COMPARISON OF MATHEMATICAL ATTITUDES AND COMPETENCE OF SELECTED PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHERS IN THE STATE OF TEXAS DURING THE 1971-72 ACADEMIC YEAR

A Dissertation

Presented to

the Faculty of the College of Education

University of Houston

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

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by

Danny W. Higdon

December, 1972

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ABSTRACT

The purpose of the study was: (a) to determine if there was a significant relationship between the mathematical attitudes and competencies of prospective and experienced elementary teachers and the related variables germane to both samples; (b) to determine if there was a significant difference between the mathematical achievement of prospective and experienced elementary teachers; and (c) to determine if there was a significant difference between the attitudes toward mathematics of prospective and experienced elementary teachers.

The study was based on a sample of 724 prospective and 284 experienced elementary teachers in the State of Texas during the 1972 Spring Semester. The prospective elementary teacher population was randomly selected from 13 Texas colleges and universities. Of the 13 institutions, seven were state and six were privately supported. The experienced elementary teacher sample was randomly selected from 10 suburban elementary schools (K-6) within the Greater Houston Area. The study was conducted over a period of four months during the 1972 Spring Semester.

The four instruments used to obtain the data were: (a) a 15 item prospective elementary teacher questionnaire; (b) a 19 item questionnaire designed for experienced

elementary teachers; (c) the arithmetic achievement subtests of the Stanford Achievement Test, Advanced Battery, Form X; and (d) the Revised Math Attitude Scale. The statistical techniques used for analyzing the data collected from the instruments were product-moment correlation coefficients and t tests.

Findings

Results of the correlation coefficients and the t test values indicate that there were significant relationships between the: (a) prospective and experienced elementary teachers' arithmetic achievement, attitudes toward mathematics, and selected variables; and (b) prospective and experienced elementary teachers' arithmetic achievement and attitudes toward mathematics. In addition, significant differences in arithmetic achievement and attitudes toward mathematics were found to exist between the prospective elementary teachers attending state and those attending private schools.

Conclusions

Experienced elementary teachers scored significantly higher in arithmetic applications and had a more positive attitude toward mathematics, than prospective elementary teachers. There were no significant differences between the arithmetic computations, concepts, and total achievement of the prospective and experienced elementary teachers. Prospective elementary teachers attending private institutions had significantly higher arithmetic achievement and attitudes than those attending state institutions. In addition, the number of high school and college mathematics courses completed, appear to be the more dominant factors in determining positive attitudes toward arithmetic and arithmetic achievement.

Recommendations

On the basis of the conclusions of the study, the following recommendations are proposed:

1. That minimum high school mathematics requirements be established as a prerequisite for admission into elementary education programs at all state and private colleges and universities in Texas.
2. That all state and private colleges and universities establish a minimum mathematics requirement for all prospective elementary teachers.
3. That state and private institutions in the State of Texas require a mathematics methods course for all prospective elementary teachers.

TABLE OF CONTENTS

CHAPTER Page

CHAPTER Page

APPENDICES Page

LIST OF TABLES

Table		Page

Table		Page

CHAPTER I

INTRODUCTION

Statement of the Problem

The problem of this study was to investigate the mathematical attitudes and competence of prospective and experienced elementary teachers. The investigation consisted of two primary comparisons: (a) a comparison of the mathematical competencies of prospective and experienced elementary teachers, and (b) a comparison of the attitudes toward mathematics of prospective and experienced elementary teachers. In addition, the study investigated a number of variables and their relationship to mathematical attitudes and competencies of prospective and experienced elementary school teachers.

Prospective elementary teachers were defined as those students enrolled in the teacher education program, elementary division, at Texas colleges and universities. The Texas Education Agency lists 49 institutions (Appendix A) with approved programs leading to a provisional or professional certificate with an elementary education endorsement (Walker, 1971). Sixteen of the 49 institutions were randomly selected for the college and university population of the study. Students from the 16 institutions enrolled in elementary student teaching for education majors during the 1972 Spring Semester were randomly selected and used as the prospective elementary teacher sample for the study.

Experienced elementary teachers were defined as regular full-time classroom teachers teaching in grades K-6 in private and public elementary schools in the Greater Houston Area during the 1972 Spring Semester. Ten elementary schools from four public and one private school systems were randomly selected to form the elementary school population for the study. Teachers at each of the 10 schools comprised the experienced elementary teacher sample for the study.

Purpose of the Study

The purpose of the study was to determine if there was a significant difference between the mathematical attitudes and achievement of the prospective and experienced elementary teachers. Specifically, the study was intended:

(1) To determine if there was a significant difference between the scores of the prospective and experienced elementary teachers on the arithmetic subtests of the Stanford Achievement Test, Advanced Battery, Form X (Kelley, 1964).

(2) To determine if there was a significant difference between the scores of the prospective and experienced elementary teachers on the Revised Math Attitude Scale (Aiken, 1967).

(3) To determine if there was a significant relationship between the mathematical competence and attitudes of the prospective and experienced elementary teachers and certain variables related to mathematics.

Need for the Study

Thousands of prospective elementary teachers are graduated from United States colleges and universities each year. While some of these teachers will never enter the teaching profession as regular classroom teachers, the majority will. As a result, hundreds of thousands of children will be affected by their level of competence. Many first year teachers serve a probationary term which gives supervisors and principals sufficient time to observe and evaluate their skills as teachers, however, objective measures of teacher attitudes and competence are lacking.

Curriculums for grades K-6 have undergone constant change in past years. As a result, teacher training programs have experienced considerable modifications in order to keep abreast of innovations affecting elementary programs at all levels. More recently, school organizational patterns have forced teacher education graduates to become more specialized in order to be better prepared to teach a particular academic area upon entering the teaching profession. This is not to say that self-contained classrooms have outlived their usefulness; rather it might imply that our society places greater emphasis on specific rather than general skills.

As the teaching profession has become more specialized, academic specialization for prospective elementary teachers has become more widespread now than in the past. Departmentalization, team teaching, and open classrooms have created new situations in elementary programs necessitating major changes in college and university curriculums. Many colleges of education are now requiring prospective elementary teachers to have an academic specialization, thereby raising the levels of competence expected for teaching in grades K-6. As a result of these trends, administrators are realizing that many elementary education graduates are not adequately prepared to teach all academic areas of the elementary curriculum, especially mathematics.

Vast amounts of energy and expenditures have gone into programs for the training and retraining of teachers in order that they might become useful components of today's educational setting. During the next few years, professional and non-professional workers will be required to change jobs a number of times or to retrain completely. Changes will come about not because of dissatisfaction with present jobs, but because the jobs for which they were trained are no longer needed in a rapidly changing society (Young, 1970).

Many teachers are reluctant to accept change of any nature, especially if it requires them to become specialized in a given subject area. As new programs in mathematics evolved in the elementary schools, the problem of staffing became a major concern. Teachers who had formerly been trained for teaching in self-contained classrooms were finding themselves emerging as team leaders or master teachers in open-classroom schools. Other schools departmentalized, thereby forcing teachers to choose an area of specialization for teaching. With the change in structure of the elementary school curriculum came a change in the attitudes of elementary teachers. Too often teachers in grades K-6 were selected for teaching assignments in mathematics for reasons other than their attitude toward mathematics or their competence in mathematical skills. The selection process for teachers of mathematics therefore does little in terms of benefiting the students or to enhance the teacher's self-image and attitude toward the subject.

Responding to the need for better teacher training programs in elementary school mathematics, the Mathematical Association of America (MAA) appointed the Committee on the Undergraduate Program in Mathematics (CUPM) in 1959. The committee was to prepare recommendations for a minimum undergraduate teacher training program in mathematics. The Panel on Teacher Training, a subcommittee of the CUPM, divided its work into five levels, each level devoting its time and energies to designing programs for teacher preparation in mathematics. One of the five levels, Level I, was charged with the responsibility of recommending a program for prospective teachers of elementary school mathematics (Wisner, 1961). This committee made recommendations for a 12 semester hour minimum undergraduate teacher training program in mathematics (Weaver, 1963) (Appendix B).

Prior to the time the CUPM recommendations were published in 1960, many educators at all levels believed the elementary mathematics programs in schools had changed little. Changes had certainly occurred in the approach to teaching elementary mathematics, however, there were some that believed that there had been little change in the content of the subject (Riedesel, 1967). As a result of these recommendations, mathematicians and educators began evaluating the offerings in mathematics for prospective elementary teachers at their institutions in an effort to satisfy CUPM recommendations. Many institutions began increasing the number of semester hours in mathematics required for elementary education majors. Others simply restructured existing offerings in an effort to make the content more relevant to specific needs of the prospective elementary teacher.

While the CUPM has made specific recommendations for minimum programs in mathematics for prospective elementary teachers, considerable differences among the many colleges and universities continue. Between 1962 and 1971 a number of surveys were conducted for the purpose of determining the extent of implementation of the CUPM Level I recommendations. During the 1962-63 academic year, CUPM conducted a survey to determine course requirements and offerings for elementary education majors at 762 colleges and universities. Results indicated that 22.4 per cent of the respondents required no mathematics for prospective elementary teachers and 68.9 per cent required the equivalent of four or fewer semester hours. In addition, 55.6 per cent of the responding institutions did not offer a mathematics course specifically designed for prospective elementary teachers (Hardgrove, 1964).

John J. Fisher (1967) consultant in mathematics for the Colorado State Department of Education, reported the results of a 1965 investigation aimed at assessing the change in requirements for prospective elementary teachers as a result of the CUPM recommendations. A random sampling of 822 institutions resulted in the selection of 117 colleges and universities to be used in the study. Results showed that in 1960 over one-half of the institutions required no mathematics, while in 1965 only one-sixth of the institutions fell within this category. In 1966, most teacher training institutions (75.9 per cent) reported that their programs in mathematics for elementary teachers consisted of three to six semester hours, while only 11.5 per cent reported less than three semester hours and 12.5 per cent reported more than six semester hours. The unbelievable statistic was that 8.3 per cent of these institutions did not require one course in mathematics for prospective elementary teachers. Only 1.1 per cent of the institutions surveyed required 11 or 12 semester hours (Slaby, 1966). Between 1962 and 1966 most of the 715 colleges and universities in a CUPM survey increased the number of hours of mathematics required for prospective elementary teachers. Fifty-eight institutions, however, actually reduced the number of required hours in mathematics for elementary education majors (Preparation in Mathematics, 1967).

Richard Hunkler (1971) Slippery Rock State College, investigated the pre-college mathematics background and the CUPM Level I courses completed by 211 sixth grade teachers from the Houston Independent School District. Results indicated that the pre-college mathematics training of elementary school teachers was far above the minimum standards set by the CUPM. Only 19 (9.0 per cent) of the 211 elementary teachers had completed less than two years of high school mathematics. While the pre-college preparation in mathematics met or exceeded the CUPM recommendations, the college level preparation was far below the minimum standard of 12 semester hours. Ninety per cent of the respondents had completed less than six semester hours while 60 per cent had not completed one semester hour in the Level I recommended courses.

While some gains in the CUPM implementation have occurred since the early 1960's, overall recommendations have yet to be realized. Gail S. Young (1970) Professor of Mathematics at Tulane University, reported that "seven years after the final proposals were made, only seven schools offered the entire CUPM program."

Several earlier studies reported that few institutions offered the full Level I CUPM recommendations. Robert E. Reys (1967) Assistant Professor of Education at the University of Missouri, conducted a study of 250 University of Missouri elementary education graduates in 1965 and reported that approximately one-third of the graduates felt that their mathematics preparation was inadequate. Specifically, three-fourths desired additional training in mathematics.

Many programs have been designed to up-grade teacher education curriculums at colleges and universities throughout the United States, however, the CUPM has been responsible for innovating change in the field of mathematics. The CUPM's 12 semester hour minimum mathematics recommendation was intended for all elementary school teachers, not just the mathematics specialist. Teachers of mathematics at all levels must be competent with a sincere appreciation and understanding for the subject. A teacher's understanding of mathematics affects his views and attitudes, and in the classroom, these views and attitudes affect students. A competent teacher of mathematics should not only have a positive attitude about the subject but should have sufficient background to grasp concepts far beyond the content of his own courses (Recommendations for the Training, 1961).

Another group of educators who has had strong influence in implementing change in mathematics was a committee of 25 mathematicians who met at Cambridge, Massachusetts during the summer of 1963 to consider changes in the pre-college mathematics curriculum. The goal of the conference has been described as an attempt to forecast the scope and sequence of the mathematics curriculum of the future. The results of the conference were published in a report called Goals for School Mathematics (Adler, 1966). The report consisted of three parts: (1) Goals, pedagogical principles, and techniques; (2) Outlines for proposed curriculums for grades K-12; and (3) Working papers presented at the conference. While there existed a difference in opinions for the programs in grades 7-12, there was a consensus of opinion that the proposed curriculum for grades K-6 reflected the thinking of all participants at the conference. The main conclusion of the report was stated in these words:

> "A student who has worked through the full thirteen years of mathematics in grades K-12 should have a level of training comparable to three years of top-level college training today; that is, we shall expect him to have the equivalent of two years of calculus, and one semester each of modern algebra and probability theory [p. 210]."

In recent years, greater emphasis has been placed on mathematics programs at all levels. As a result of this emphasis, elementary education graduates should be expected to possess a higher level of mathematical competence than those elementary teachers who have not experienced innovative programs in mathematics. Curricular revisions at the elementary school level now require prospective elementary teachers to specialize in a given academic area. The State of Texas requires a minor of 18 semester hours for elementary certification. With this greater emphasis on teacher specialization, it might be expected that there will be more prospective elementary teachers with mathematics as a teaching minor than experienced elementary teachers.

Current research is needed that will explore the mathematics training of prospective and experienced teachers. It is apparent, as indicated by current research, that specific mathematics recommendations for elementary education majors are not being implemented by colleges and universities.

Research is needed that will: (1) reveal the precollege and college level mathematics preparation of prospective and experienced elementary teachers; (2) provide feedback related to the effectiveness of current elementary teacher training programs in mathematics; and (3) determine the extent to which current programs in mathematics affect prospective and experienced elementary teachers' attitudes and competence. These are but a few of the questions concerning the attitudes and academic preparation of prospective and experienced elementary teachers that need answering.

While most studies investigating teacher attitude and understanding of mathematics were done prior to 1967, there is an apparent need for a more recent survey. This study investigated both prospective and experienced elementary teachers' attitudes and competence in mathematics. A search of the literature revealed that no studies of this nature had been conducted during the last nine years, therefore a study is needed. It is anticipated that a study of this nature will provide teachers, administrators, and college and university faculties with meaningful feedback that may be helpful in evaluating existing programs related to the mathematics training for prospective and experienced elementary teachers.

Scope and Limitations of the Study

This study was based on a sample of 724 prospective and 284 experienced elementary school teachers in the State of Texas during the 1972 Spring Semester. The prospective elementary teacher sample was randomly selected from 13 Texas colleges and universities with approved programs in elementary education. Of the 13 institutions, seven were state supported and six were independently supported (Appendix C). The experienced elementary teacher population was randomly selected from 10 elementary schools (grades K-6) in the Greater Houston Area. The study was conducted over a period of four months during the 1972 Spring Semester.

All prospective elementary teachers were female except 47 (6.5 per cent). All subjects were classified as Juniors or Seniors and were enrolled in a course generally described as Elementary Student Teaching. None of the subjects had previous teaching experience. All experienced elementary teachers were female except 13 (4.6 per cent). Of the 284 experienced teachers, 277 had been awarded the Bachelor's Degree, 57 the Master's Degree, and one the Doctorate. Six respondents had no degree.

A 15 item mathematics questionnaire was completed by each prospective elementary teacher and a 19 item questionnaire relating to mathematics was completed by each experienced elementary teacher. Both questionnaires were devised by the researcher (Appendix D). A standardized mathematics achievement test and a mathematics attitude scale was administered to each prospective and experienced elementary teacher in the study. Any conclusions derived from the study were based upon the analysis of the questionnaire responses, the raw scores of the attitude scale, and the raw scores of the arithmetic achievement test and were thereby dependent upon the reliability and validity of the latter two instruments.

Basic Assumptions

For the purpose of this study, it was assumed that:

(1) The arithmetic subtests of the Stanford Achievement Test, Advanced Battery, Form X, were valid measures of general mathematics understanding for prospective and experienced elementary teachers;

(2) The Revised Math Attitude Scale was a valid measure of attitude toward mathematics for prospective and experienced elementary teachers;

(3) The prospective elementary teacher sample for this study constitutes a representative sample of 1972 Spring

Semester elementary education student teachers in Texas colleges and universities; and

(4) The experienced elementary teacher sample of this study constitutes a representative sample of elementary school teachers in suburban school districts of the Greater Houston Area during the 1972 Spring Semester.

Hypotheses

The purpose of this study was to determine if there was a significant difference in the mathematical attitudes and competencies of prospective and experienced elementary school teachers. Specifically, the following null hypotheses tested were:

H_o1: There is no significant relationship between the mathematical competencies of prospective elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and:

(a) sex;

(b) age;

(c) size of high school graduating class;

(d) the number of high school mathematics courses completed;

(e) the academic specialization selected;

(f) the number of college mathematics content courses completed;

(g) the number of college mathematics methods courses completed;

(h) grade level teaching preference; and

(i) the institution attended.

H_o2: There is no significant relationship between the attitudes toward mathematics of prospective elementary teachers, as measured by the Revised Math Attitude Scale, and:

(a) sex;

(b) age;

(c) size of high school graduating class;

(d) the number of high school mathematics courses completed;

(e) the academic specialization selected;

(f) the number of college mathematics content courses completed;

(g) the number of college mathematics methods courses completed;

(h) grade level teaching preference; and

(i) the institution attended.

H_o3: There is no significant relationship between the mathematical competencies of experienced elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and:

(a) sex;

(b) age;

(c) size of high school graduating class;

(d) the number of high school mathematics courses completed;

(e) the academic specialization selected;

(f) the number of college mathematics content courses completed;

(g) the number of college mathematics methods courses completed;

(h) level of professional training;

(i) the number of years teaching experience;

(j) the number of mathematics classes taught each day;

(k) the grade level teaching assignment; and

(l) the number of years since completing a mathematics content or methods course.

H_o4: There is no significant relationship between the attitudes toward mathematics of experienced elementary teachers, as measured by the Revised Math Attitude Scale, and:

(a) sex;

(b) age;

(c) size of high school graduating class;

(d) the number of high school mathematics courses completed;

(e) the academic specialization selected;

(f) the number of college mathematics content courses completed;

(g) the number of college mathematics methods courses completed;

(h) level of professional training;

(i) the number of years teaching experience;

(j) the number of mathematics classes taught each day;

(k) the grade level teaching assignment; and

(l) the number of years since completing a mathematics content or methods course.

H_o5: There is no significant difference between the mathematical competencies of prospective and experienced elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, Advanced Battery.

H_o6: There is no significant difference between the attitudes toward mathematics of prospective and experienced elementary teachers, as measured by the Revised Math Attitude Scale.

CHAPTER II

REVIEW OF RELATED LITERATURE

Mathematics research has received increased publicity since the early 1960's. Many educators have devoted full attention to investigating certain mathematical topics and their implications for education. Two topics, teacher attitude and subject matter competence, have been researched numerous times during recent years. While most of these studies investigated either attitudes or competencies of prospective or experienced elementary teachers, few large scale studies have investigated both.

Prospective Elementary Teacher Competence in Mathematics

A teacher who will be exposing children to mathematics must be competent in the basic skills of that subject. In order to teach mathematics meaningfully, a teacher must have not only command of the materials he is teaching, but must be able to relate to topics that will be taught in subsequent learning activities. A teacher of sixth grade mathematics surely should know enough mathematics to lend help to students of mathematics at the junior high school level.

In an attempt to discover deficiencies in mathematics, Elbert Fulkerson (1960) tested 158 prospective elementary teachers enrolled in a methods course at Southern Illinois University in 1955. Results of the 40 item test in mathematics indicated that: (1) while the mean number of items answered correctly was 20.0, one student answered as few as one correctly and one answered as many as 39 correctly; (2) freshmen students answered correctly a mean number of 17.0 items, sophomores 19.1, juniors 20.1, and seniors 22.4; (3) experienced teachers enrolled in the course answered correctly a mean of 25.6 items as compared with a mean number of 17.9 for the inexperienced group; and (4) better high school and college preparation in mathematics along with teaching experience leads to better performance. Fulkerson concluded that far too many of the 158 prospective elementary teachers tested had an insufficient knowledge in mathematics to teach the subject effectively.

Wilbur H. Dutton (1961) Director of the Training Department at the University of California at Los Angeles, administered a 46 item arithmetic test to 55 prospective elementary teachers enrolled in a lower division mathematics course at the University of California, Los Angeles. Results based on a pre-test mean of 33.94 and a posttest mean of 38.78 led Dutton to conclude that contrary to other studies, prospective elementary teachers understood many basic arithmetical concepts. Clarence Phillips (1953) studied students entering the Arithmetic for Teachers course at the University of Illinois from 1947-1952 in an attempt to determine the arithmetical understanding of the sample. Results indicated that: (1) elementary and high school mathematics completed gives little indication of the achievement in meaning, understanding, and mechanical mastery. This was evidenced by the fact that 98 per cent had completed high school Algebra and 91 per cent had completed high school Geometry; (2) problem solving achievement involving measurement, fractions, and per cent was very low; and (3) achievement in the meaning and understanding of arithmetic was extremely low.

A study by Mary K. Nafziger (1961) tends to support what Phillips (1953) had concluded about high school mathematics preparation and understandings of various mathematics algorisms. In her study of 82 elementary education majors, Nafziger reported that: (1) differences between students with varying grade point averages and students completing varying units of secondary school mathematics were not significant; (2) there was no significant difference between students completing one course in college mathematics and those completing none, however there was a significant difference between those completing one and those completing two or more; and (3) the least understood algorism involved multiplication of mixed decimals by decimals, division of decimals, and the division of mixed numbers by common fractions, while the best understood algorisms involved addition and subtraction of whole numbers requiring substitution.

Emma C. Carroll (1961) tested 317 elementary education students at five educational levels at the Wayne State University. The testees possessed a few more than half of the understandings agreed upon by the experts as the ones which elementary arithmetic teachers should know. In addition, students were weak in understandings, fractions, decimals, per cent and mensuration processes. There was no significant relationship found between mathematics understanding and the number of high school or college level mathematics courses studied.

John L. Creswell (1964) Professor of Curriculum and Instruction at the University of Houston, conducted a study of 313 prospective elementary teachers from eight teacher-training institutions in Georgia in 1963. Each prospective teacher was administered the Advanced Arithmetic Form AM of the Metropolitan Achievement Test. The 93 item test consisted of 45 problems concerned with computational skills and 48 with concepts and problem solving. Results indicated that 81.6 per cent of the sample scored at or above the ninth grade level on arithmetic computation, while 90 per cent achieved at or beyond the ninth grade level on concepts and problem solving. John R. O'Donnel (1958) conducted a study of 109 prospective elementary education seniors in 1958 that produced mean scores on the California Achievement Test, Mathematics Section (grades 9-14) beyond the twelfth grade level. Results of the last two studies provided somewhat of a contrast to most findings concerning the competence of prospective elementary teachers.

A study by Edward M. Carroll (1964) reported that 358 prospective elementary teachers from 24 private colleges showed between a sixth and eighth grade level in functional competence in mathematics. Of the 24 college groups: (1) three obtained median scores less than the sixth grade norms; (2) eight scored less than the seventh grade norms; (3) seventeen scored less than the eighth grade norms; and (4) only one obtained a median score equal to the ninth grade norms.

Dutton (1965) engaged in another study of prospective elementary teachers' understanding of arithmetical concepts. In this study, the subjects were 160 prospective elementary teachers at the University of California, Los Angeles enrolled in an upper division mathematics methods course during 1965. The test covered basic arithmetical concepts that elementary school pupils were expected to know at the completion of the sixth grade. The median pre-test score for the 160 students was 36.5 and the posttest median score was 41.8 on the 48 item arithmetic test. In contrast to other studies, Dutton reported that prospective elementary teachers understood a wide variety of arithmetical concepts. The most deficient areas seemed to be place value, partial products, decimals, and fractions. The basic mathematical concepts were understood by approximately 50 per cent of the students.

Marian Wozencraft (1960) Professor of Education at State University, Geneseo, New York, studied the arithmetic abilities of 78 students enrolled in an arithmetic methods course. The test was designed for pupils in grades seven to 12 inclusive. The standardized median scores were: Grade Seven, 53.4 (estimated); Grade Eight, 61.3; Grade Nine, 68.8; Grade Ten, 67.3; Grade Eleven, 67.5; and Grade Twelve, 69.7. The median raw score of the 78 prospective elementary teachers was 52.5, or nearly equal to the Seventh Grade estimated median raw score.

A number of studies have been reported that compare prospective elementary teachers' mathematical background to their mathematical achievement. Virginia T. Gilbert (1966) reported that a strong background in high school mathematics produced a significantly higher level of understanding in arithmetic and that at least three semester hours of mathematics seemed to produce a fuller understanding of arithmetic than those that had no hours in mathematics. In addition, student teaching did not contribute to a better understanding of arithmetic. Gilbert concluded that many future elementary teachers did not have a level of mathematics competence which was consistent with that possessed by some seventh and eighth grade students. In a similar study, Cleo Withnell (1967) tested a sample of 2,513 elementary education majors from 13 colleges having different mathematics requirements. Findings indicated that prospective elementary teachers' understanding of mathematics concepts were considerably low. Students attaining the highest mean on the test had completed a third required mathematics course, however, this mean represented a 58 per cent correct response to the 24 basic questions. The best predictors of achievement were ability, attitude, and high school and college mathematics background.

Few studies have investigated the mathematics performance of elementary education majors as determined by contemporary mathematics tests. Robert E. Reys (1968) Professor of Education at the University of Missouri, collected data from 234 elementary education majors at the University of Missouri during the 1965-66 academic year. The Contemporary Mathematics Test, Algebra Level, was administered to each subject. The Algebra Level was designed for high school students who had completed a first course in Algebra. While gains were made between the pre and posttest, elementary education majors scored significantly below the means of eighth and ninth grade students. The elementary education majors appeared to be particularly weak in their knowledge of the real number system, mathematical statements, functions, and graphs.

Frank Smith (1967) Professor of Education at Stephen F. Austin University, tested a sample of 80 elementary education majors to determine how well they could cope with modern mathematical concepts. The sample group had completed an average of 5.3 semester hours of mathematics. Using a 33 item test that had been used in a previous study with first year teachers, Smith compared his results to that of the original study. Pre-test scores for Smith's study revealed that 57 per cent of the sample scored below 50 per cent correct. In addition, 40 per cent scored below 25 per cent correct while only eight per cent scored above 75 per cent correct.

In summary, it appeared that while some gains are being made in the mathematical achievement of prospective elementary teachers, overall performance in this area continues to be deficient. While many studies show that a strong high school and college mathematics preparation increases a student's level of achievement in mathematics, it is not the lone predictor for success in mathematics. Perhaps the changes in understanding and mathematical achievement were brought about by variables other than high school and college mathematics preparation.

Prospective Elementary Teachers' Attitude Toward Mathematics

Attitudes play an extremely important role in the teaching-learning process. It is no different in the teaching of mathematics. Teachers of mathematics must approach the teaching of mathematics with a positive attitude toward the subject and an unquestionable understanding of the content. In addition, teachers must be able to convey to their students a positive attitude toward mathematics that they themselves must have. A lack of understanding of mathematics along with a negative attitude toward mathematics may cause some teachers to dislike and even fear the subject, thereby causing some students to react in a similar nature when confronted with various mathematical concepts.

Teacher attitudes as related to mathematics have been the focal point for much debate. There seems to be little consistence among findings when investigating attitudes toward mathematics of prospective elementary teachers. Reasons for poor attitudes toward mathematics among prospective elementary teachers have been studied numerous times over the last two decades.

Dutton (1951) a pioneer in the field of investigating mathematics attitudes of prospective elementary teachers, elicited written statements about mathematics from 211 students enrolled in elementary curriculum methods courses at the University of California, Los Angeles. The statements reflected the students' favorable or unfavorable attitudes toward mathematics. Seventy-four per cent of all responses were unfavorable. Lack of understanding, word problems, drill, poor teaching, and fear of making mistakes were some of the most frequent causes for unfavorable attitudes. Previously mentioned studies (Gilbert, 1966; Dutton, 1961) cited a lack of understanding and fear of word problems as the most frequent reasons for poor attitudes toward mathematics.

Several attempts have been made to measure the attitude change of prospective elementary teachers toward mathematics over a period of time. Dutton's (1962) interest in this area led him to make comparisons between student responses on an attitude scale used in 1954 to student responses on the same scale used in 1962. Attitudes of 1954 respondents were almost identical with the attitudes of students in 1962. Factors causing poor attitudes toward mathematics were approximately the same in 1954 as in 1962. Findings of other researchers (Phillips, 1953; Smith, 1964) were in agreement with Dutton's conclusion that student attitudes toward mathematics were formed in the elementary school years. The most critical time seemed to be in grades three through six.

Determining the effects various mathematics content, methods, and laboratory courses have had on the attitudes of prospective elementary teachers have been the topic of much concern. Robert E. Reys and Floyd G. Delon (1968) studied a sample of 385 University of Missouri students enrolled in a mathematics preparatory program to determine what effect, if any, the course had on their attitudes toward mathematics. Although the course seemed to cultivate a more favorable attitude toward mathematics, the percentage change in magnitude of some variables was slight. On the pre-course inventory, 55.58 per cent indicated favorable attitudes toward mathematics while the posttest survey revealed 58.70 per cent with favorable attitudes. The pre and posttest gains were statistically not significant.

Burton Cleon Gee (1966) reported a significant improvement in prospective elementary teacher attitude toward mathematics as the result of a required mathematics content course at Brigham Young University. Attitudes toward mathematics and basic mathematics understandings were significantly related to success in the course. William James Purcell (1964) reported conclusions that were similar to those that had been reported by Gee. Purcell reported that understanding concepts resulted in a more favorable attitude and higher grades by prospective elementary teachers in a course described as methods of teaching arithmetic. In the experimental group, over two-thirds showed a more favorable attitude score on the posttest at the end of the course and 97 per cent showed improved concept understanding.

In a recent study by this researcher, it was found that prospective elementary teachers at the University of Houston enrolled in six week mathematics methods and laboratory courses made significant gains in attitude toward mathematics. On the 20 item attitude scale used in the study, a mean score from zero to 39 inclusive was considered negative, a score of 40 was neutral, and scores from 41 to 80 inclusive, were considered positive. Two control and four experimental groups consisting of 160 prospective elementary teachers were used as the sample for the study. The only groups to receive instruction in mathematics methods were the four experimental groups. The control group pretest mean was 35.60 and the posttest mean was 35.70. Both scores connotate negative attitudes toward mathematics. Of the four experimental groups, three reported pre-test attitude scores that were slightly positive with small gains in posttest scores. One experimental group reported a negative pre-test mean score of 36.96 and a positive posttest mean score of 46.00. The difference in mean scores was significant at the .01 level of confidence. It was concluded that the mathematics methods course along with a laboratory period did promote more positive attitudes toward mathematics for prospective elementary teachers (Higdon, 1970).

Robert B. Kane (1968) Professor of Mathematics and Education at Purdue University, reported that attitudes of prospective teachers regarding mathematics was relatively high when compared with other subjects. It was shown that Language Arts and Mathematics rated higher than Social Studies and Science on the positive side of the attitude scale used in Kane's study. There was also a clear difference between the attitudes of students preferring to teach in grades K-3 and those wanting to teach in grades four through six. Prospective elementary teachers in the four through six grade groups had a higher attitude mean score than did those in the K through three group. In addition, it was reported that prospective elementary teachers possessing unfavorable attitudes toward mathematics preferred teaching assignments in the primary grades while teachers with positive attitudes preferred the intermediate grades.

In view of the research related to attitudes of prospective elementary teachers toward mathematics, several conclusions may be drawn. Most students form attitudes toward mathematics while in the elementary (K-6) grades and being able to understand basic mathematical concepts and algorisms, usually produces a more positive attitude toward mathematics. In addition, attitudes toward mathematics are relatively easy to manipulate via various methods of mathematics instruction. While attitudes toward mathematics seem to be improving, there is evidence that attitudes have not changed significantly over the last decade.

Experienced Elementary Teacher Competence in Mathematics

Goals for prospective teacher training institutions of today are quite different in emphasis from those of the early 1960's. With the modernization of schools and the updating and upgrading of teaching procedures and techniques, the training of prospective elementary teachers must meet the demands of the times. Today's era of specialization has had its effect on teacher training institutions and elementary education programs of our nation. Content specialists are being sought in an effort to improve departmentalized and team teaching programs in elementary schools. Prospective elementary teachers are graduated each year with an academic specialization, however, it is not realistic for these teachers to possess a high level of competence needed in all subject matter areas of the elementary curriculum.

Specifically, what level of mathematical competence do elementary teachers have?

In a 1951 study conducted by Jacob S. Orleans and Edwin Wandt (1953) Division of Education, College of the City of New York, 322 experienced elementary teachers from three universities were tested in an effort to determine their mathematical understandings. The teachers were enrolled in summer sessions at the University of Colorado, the University of Illinois, and the University of Houston. Teachers were grouped according to primary (K-3), intermediate (4-6), and junior-senior high school teaching assignments. One group consisted of teachers from all levels that taught in areas other than mathematics. Teachers of mathematics and arithmetic demonstrated a slightly better understanding of the arithmetic concepts than did the group of teachers that did not teach mathematics or arithmetic. There were some items however, that the non-mathematics teachers understood better than the arithmetic and mathematics teachers. It was concluded that few processes, concepts, or relationships in arithmetic are understood by a large percentage of elementary teachers. Most of the teachers admitted to a lack of understanding of the basic processes and concepts and their inability to use arithmetic meaningfully and with confidence.

John E. Bean (1959) Brigham Young University, selected 450 classroom teachers from seven school districts in Utah for a research sample in an effort to determine the basic arithmetical understandings of experienced elementary teachers. Teacher scores on the 80 item test ranged from 18 to 78. The mean score for all teachers was 52.46 or 65.58 per cent. The highest scores were reported for the concepts involving the decimal system of notation and the lowest scores were in basic understandings of the rationale of computation. A positive relationship was found to exist between the teachers' perception of their arithmetic competence before the test and the scores in each of the areas of understanding measured by the test. The study also concluded that as teachers gain experience there is a small cumulative increase in their understanding of arithmetic. In addition, teachers who had done graduate work performed better than those who had not.

In 1961, Jack N. Sparks (1961) Professor of Education at Colorado State College, published a summary of eight research articles that had investigated the mathematics understanding of elementary teachers. The general conclusions that Sparks drew from the studies were that elementary teachers were deficient in problem solving ability, computational skills, decimals and per cents, and were particularly deficient in understanding the underlying principles of mathematics.

A 50 item mathematics test prepared by Russell A. Kenney (1965) Curriculum Coordinator at Bakersfield, California, was administered to 356 California elementary school teachers. The test was devised in an effort to find the strengths and weaknesses of elementary teachers in arithmetic understanding. Correct responses on the test ranged from five to 44 with a median score of 29.7. Kenney cited two basic factors for the teachers' poor showing on the test: (1) the inability to understand the language and vocabulary used in the test, and (2) a lack of understanding of the concepts, relationships, and mathematical generalizations involved.

E. Harold Harper (1964) Professor of Education at the University of Colorado, conducted a study of 396 elementary teachers and concluded that most of the teachers teaching in grades K-6 from 100 randomly selected schools were in critical need of basic training in contemporary mathematics. Teachers with six or more semester hours of college mathematics scored consistently higher on the contemporary mathematics test than teachers with fewer than six semester hours. The number of correct responses on the 61 item test ranged from zero to 55.

Robert M. Todd (1966) Professor of Education at Boston University, administered Glennon's A Test of Basic

Mathematics Understanding to 287 students enrolled in a mathematics content course. All but 18 of the 287 students were experienced elementary, intermediate, or secondary teachers. A mean score of 49.19 on the initial test and a mean score of 54.30 on the final test was reported for the 80 item test administered to the experienced teachers. The mean gain on the Glennon test was significant at the .01 level of confidence. It was also pointed out by Todd that when the scores were corrected for guessing, they were not much better than scores of students reported by Glennon some 15 years earlier. In addition, approximately 29 per cent of the test sample scored below the seventh and eighth grade mean.

Supporting the conclusions reported by Harper (1964) concerning elementary teacher competencies in contemporary mathematics, Ruth Melson (1965) reported that most of the 41 teachers involved in her study were not adequately prepared to teach elementary mathematics concepts recommended by the National Council of Teachers of Mathematics. The median score on the test administered by Melson was 12 out of 33 items correct or 36 per cent.

John Duncan Griffin (1966) reported that elementary teachers had an overall lack of understanding of contemporary mathematics. Griffin constructed a 60 item mathematics test that was administered to 1,107 North Carolina elementary teachers. He concluded that: (1) elementary teachers understood less than half the topics covered on the test; (2) elementary teachers understood one-third of the items pertaining to "modern mathematics"; (3) more teaching experience was not associated with higher test scores; and (4) in-service training of three months or longer did produce significantly higher test scores.

Creswell (1967) reported the results of an in-service workshop that he conducted during the Fall Semester of 1965. A sample of 1,075 elementary school teachers, teaching in grades one through six from five school districts, was administered a 120 item power test on modern mathematics content. The test instrument had previously been administered to 124 sixth grade students that had achieved a mean score of 65.25. The experienced teachers (67.53 per cent) achieved a score of 65 or less with a mean score of 56.31. The range of scores for the teachers was four to 112 correct, while the sixth grade students ranged from 18 to 113 correct. It was Creswell's conclusion that college courses were more effective for preparing teachers in contemporary mathematics than were in-service workshop programs.

In September of 1967, a group of sixth grade teachers participated in a study to determine the effects of teacher in-service training on the achievement of their students. In this study, Fletcher R. Norris (1969) arranged for an experimental group of 18 teachers, a comparison group of 15 teachers, and a group of 844 sixth grade students to participate in the study. During the first three months of the school semester, the experimental group of in-service teachers was studying the mathematics concepts to be taught during the entire year. The comparison group of teachers was not exposed to the in-service program, only the test material. Norris concluded that there were gains by both groups, however, the experimental groups had significantly greater gains than did the comparison groups. In addition, pupils learned more from teachers who had a thorough early, intensive exposure to the entire body of content to be taught. It was pointed out that pupil achievement in the experimental groups could be attributed to the experimental teacher characteristics rather than conceptual knowledge gain through the in-service course.

In summary, research studies have indicated that the mathematics abilities of experienced elementary teachers are far below the acceptable level. Not only are many of these teachers inadequately prepared to teach the contemporary mathematics but it has been reported that traditional mathematics concepts are equally perplexing to elementary teachers. In addition, there were conflicting reports regarding the correlation between teaching experience and mathematics understanding in arithmetic. Whatever the solution may be, it is not unreasonable to expect teachers, especially those teaching sixth grade mathematics, to score considerably higher on an arithmetic achievement test than the students they are teaching.

Experienced Elementary Teachers' Attitude Toward Mathematics

In most research studies investigating teachers' and students' attitudes toward mathematics and related factors, there was the constant warning to teachers to keep in mind the importance of attitudes and their effect on student behavior and performance. A number of studies suggest that teachers should be consciously aware that attitudes are learned and formed at a very early age. Teachers of mathematics must remember that one of the primary objectives of an effective teacher is to provide a positive setting for both positive growth in mathematics achievement and attitudes.

Few studies have reported experienced elementary teachers' attitudes toward mathematics. Seymour Metzner (1971) Director of the Learning Resources Center at Northridge, California, reported that teachers enjoy teaching arithmetic more than almost any other subject in the curriculum. While teacher attitude seemed to be very positive about arithmetic, their level of mathematical competence was at the junior high school level. Metzner's explanation for such an unusual relationship was that teachers viewed the teaching of arithmetic as easy, systematic, highly structured, orderly, and a relatively safe situation for elementary teachers.

Virginia M. Stright (1960) undertook a study in an attempt to discover the attitudes toward mathematics of students and teachers. A total of 29 teachers and 1,023 third grade, forth grade, and sixth grade students participated in the study. It was interesting to note that between 93 and 97 per cent of the teachers enjoyed teaching mathematics. In addition, 90 per cent of the teachers felt that professional educators should keep abreast of modern mathematics methods, however, 21 per cent felt they could teach mathematics effectively without reading mathematics periodicals and methods books. Most teachers acknowledged that mathematics content and methods have changed in recent years, however, 17 per cent of the teachers in Stright's study felt that the teaching of arithmetic had not changed in the past 30 years. In contrast to studies reported earlier, Stright concluded that the teaching experience, educational background, recent training, and age seemed to make no significant difference in the experienced elementary teachers' attitude toward the teaching of arithmetic.

Dutton's scale for measuring attitudes toward mathematics was used by Todd (1966) for testing 287 teachers for the purpose of determining gains in attitude as a result of a mathematics course. The Dutton scale ranged in values from 1.0 (negative) to 10.5 (very positive). Pre-test scores reported for the group were: a median score of 7.1 and a mean score of 6.52, both scores being slightly positive. A post-test median of 7.3 and a mean of 6.90 indicated that a mean gain of 0.38 in scores was significant at the .01 level of confidence.

In summary, studies concerned with experienced teachers' attitude toward mathematics are limited in number. The few studies that have been reported indicate that most experienced elementary teachers have a more positive than negative attitude toward mathematics. Many researchers concluded that there seems to be a direct relationship between teacher attitude and achievement in mathematics, however, studies mentioned earlier indicate that there was no significant difference between mathematical background and attitudes. Since attitudes appear to be easily manipulated as the result of content, level of presentation, and materials, there continues to be the problem of determining exactly what variables do in fact, cause changes in teacher attitude toward mathematics.

Literature Related to Prospective and Experienced Elementary Teachers' Mathematical Attitudes and Achievement

The search of literature revealed that there had been no studies comparing prospective and experienced elementary teachers' mathematical attitudes and achievement since the early years of 1960. One study investigated mathematics achievement of pre-service and in-service teachers in an effort to determine their levels of competence. It was concluded by Thomas C. Gibney, John L. Ginther, and Fred L. Pigge (1970) that pre-service teachers for grades K-4 had significantly higher mean scores than did in-service teachers for the same level. It was also noted that in-service teachers teaching higher grade levels tended to score higher than teachers teaching lower grade levels.

A study comparing prospective and experienced teachers' attitude and achievement in mathematics was conducted by Edward D. Brown (1961) in 1959. The 1959 elementary education graduates of the University of Nebraska comprised the prospective teacher sample while a similar number of experienced teachers attending the University during the 1959 Summer Session comprised the experienced teacher sample. Each sample was administered Glennon's Test of Basic Mathematics Understanding and Dutton's Attitude Toward Arithmetic Scale. After both groups were tested, their college records were examined to determine their mathematics background. Several conclusions, formulated as the result of the study were: (1) experienced teachers had a better grasp of basic mathematical concepts than did prospective teachers, yet number of years teaching experience did not appear to increase their level of achievement in mathematics; (2) teachers who had taught arithmetic had a more positive attitude toward the subject than those teachers who had not taught, however, teaching mathematics for a number of years did not enhance the teachers' attitude toward arithmetic; (3) teachers displaying a high level of mathematical understanding had a positive attitude toward mathematics, however, most teachers had a neutral to favorable attitude toward mathematics; and (4) while the instruments used tested mathematical understandings of a seventh grade level, mean scores for both experienced and inexperienced elementary teachers were lower than expected.

Summary

Studies mentioned earlier have indicated that a number of researchers have investigated factors relating to prospective and experienced elementary teachers' attitudes and competence in the area of arithmetic and mathematics. While many of these studies investigated similar problems, there did not appear to be a consensus of agreement as to the attitudes and levels of mathematics competence possessed by prospective and experienced elementary teachers. The review of research also indicated a need for additional study, such as this one, that will provide the comparative data necessary for establishing more clearly, the mathematical attitudes and competencies of prospective and experienced elementary teachers.

CHAPTER III

METHODS AND PROCEDURES

Preliminary Research

In order to test the hypotheses of the study, as stated in Chapter I, a prospective and experienced elementary teacher population was needed. During the 1971 Spring Semester the investigator requested and received from the Texas Education Agency and the Coordinating Board for Texas Colleges and Universities, information pertaining to institutions of higher learning in Texas that have approved programs in elementary education. The Texas Education Agency lists 49 such institutions; 21 state supported and 28 independently supported (Appendix A).

Each of the 49 institutions was contacted in order to obtain information vital to the proposed research. During April, 1971, a letter was written to the Registrar of Records at each of the institutions requesting the number of elementary education graduates during the 1969-70 academic year (Appendix E). Replies were received from each of the institutions in the survey.

Selecting the Participating Colleges and Universities

After receiving the data from the 49 colleges and universities, the institutions were then categorized according to support (state or independent) and number of 1969-70 graduating elementary education majors. Arbitrary dividing lines were established according to the college or university graduating class size for elementary education graduates, thus both large and small state and independent institutions were represented in the sample. Four categories were used for each state and independent group (Appendix F). Stratified random sampling was used to select two institutions from each of the categories established.

Each of the 16 randomly selected institutions were then contacted by mail in order to explain the proposed research and to request their assistance in the study (Appendix G). One state and two independently supported institutions that returned the request, declined to participate in the study. The other seven state and six independent institutions were willing to cooperate. In order to replace the three institutions which declined to participate, another random sampling in each respective category was made. The replacement institutions were then contacted by use of the same letter of explanation. Positive responses were received from each of the replacements. The 16 participating institutions are listed in Appendix H.

<u>Selecting the Prospective Elementary Teacher Sample</u>

After the final selection of the 16 participating institutions, the Director of Elementary Student Teaching at each institution was contacted first by mail, then by telephone, in order to arrange for the testing at each school. Students enrolled in Elementary Student Teaching during the 1972 Spring Semester at each institution were used as the prospective elementary teacher sample. Due to the large number of subjects, scheduling procedures, geographic location of certain student teaching assignments, and the number of student teaching sections and seminars, it was impossible to use random sampling procedures for selecting individual student teacher participants for the study. The Director of Elementary Student Teaching at each institution arranged the testing schedules in order to get a maximum number of elementary student teachers on campus during a one or two day period. After arrangements had been completed, further confirmation was made regarding location, date(s), time(s), and the possible number of students taking part in the research.

During the months of February, March, April, and the first week of May, 1972, the investigator traveled to 13 of the 16 institutions for the purpose of testing the prospective elementary teacher sample. The Director of Elementary

Student Teaching at one state university administered the survey instruments for the investigator. The arrangement was favorable due to the distance involved. Complete instructions and the necessary equipment were mailed to the university. After the test instruments had been administered, the testor assured the investigator that the testing had been conducted in accordance with the standardized procedures set forth in the instructions.

Due to the change of a testing date at another institution, the Director of Elementary Student Teaching conducted the testing at the request of the investigator. The same standardized procedures were followed as mentioned in the preceding paragraph.

Three institutions that had previously agreed to participate in the study were not surveyed. One school had scheduled the testing for the last regular class meeting of an Elementary Student Teaching Seminar and the meeting was cancelled due to the sudden illness of the professor in charge. A second institution was not surveyed due to a lack of prospective elementary teachers. The investigator was informed that there had been a lack of communication between the Director of Elementary Student Teaching and the elementary student teachers. A third school sample was not tested due to a conflict in testing dates scheduled late in the school term. Re-scheduling of the testing at each school could not be arranged due to the official closing of the Spring Semester.

Selecting the Participating School Districts

During the 1972 Spring Semester, a number of private schools and public independent school districts in the Greater Houston Area were contacted for the purpose of obtaining elementary schools to participate in the research study. Due to the large number of independent school districts and private schools in and around the Greater Houston Area, it was felt that a representative sample of schools and elementary classroom teachers could be obtained and surveyed.

The investigator contacted by letter or telephone, 17 independent school districts and six private schools within the Greater Houston Area for the purpose of securing their assistance in the research project. The purpose of the study was explained to each prospective school district participant (Appendix I). Of the independent school districts and private schools contacted, four districts and one private school were willing to participate in the study. The participating school and districts are listed in Appendix J.

Descriptions of the Participating School Districts

The participating districts in the study have a number of similar characteristics. Each school or district is either within the city limits of Houston, Texas or located in Harris County, Texas within 25 miles from downtown Houston. Three of the school districts, Alief, Cypress-Fairbanks, and Spring, are located in communities not within the city limits of Houston and may be described as primarily residential. Until recently, these communities were rural residential, however, today they may be described as rapidly growing commuter-suburban communities with little industry.

Alief Independent School District

The Alief Independent School District is located approximately five miles west of the Houston city limits in the community of Alief, Texas. The school district covers an area of 36 square miles and serves a community population of approximately 15,000. The school district employs approximately 230 teachers of which 155 are assigned to the elementary (K-6) grades. There are four elementary schools, and one combination junior-senior high school in the district serving approximately 4,700 students.

Cypress-Fairbanks Independent School District

The Cypress-Fairbanks Independent School District is located approximately 20 miles northwest of downtown Houston and serves the community of Cypress, Texas. The school district covers an area of 186 square miles and serves a total population of more than 30,000 residents. The district employs approximately 354 teachers of which 160 are teaching in the elementary (K-5) grades. There are five elementary schools, two junior high schools, and one senior high school in the district serving approximately 8,400 students.

North Forest Independent School District

The North Forest Independent School District is located within the city limits of Houston, Texas. The school district serves a northeast Houston community population in excess of 56,000 and covers an area of 33 square miles. The district employs approximately 600 teachers of which 311 are teaching in the elementary (K-6) grades. The district has nine elementary schools, three junior high schools, and two senior high schools and serves a student population of over 15,800.

Spring Independent School District

The Spring Independent School District is located approximately 25 miles northwest of downtown Houston in the community of Spring, Texas. The school district covers an area of 57.6 square miles and serves a community of approximately 7,100. The district employs approximately 195 teachers of which 82 are in the teaching area of grades K-5. The district is composed of three elementary schools, two junior high schools, and one senior high school and serves a student population of approximately 3,600.

West Briar School

The West Briar School is a private, non-profit elementary (K-7) school located well within the city limits of Houston, Texas. The school primarily serves the residents of the southwest area of the city. The school employs 12 teachers and serves a student population in excess of 200.

Selecting the Participating Elementary Schools and the Experienced Elementary Teacher Sample

Each of the four school districts granted permission for the elementary schools in their district to participate in the study. There was, however, the provision that the investigator should contact each elementary school principal in order to enlist his cooperation. In addition, it was clearly understood that individual school participation in each district was on a volunteer basis only. Of the 22 elementary schools in the cooperating districts, 13 principals indicated that their staffs were willing to participate in the study. Although teacher participation at each school was strictly voluntary, 284 of a possible 411 (69.1 per cent) teachers participated in the study (Appendix K).

Arrangements were made with each principal to test the elementary teachers at his school. Place, date, and time of testing was confirmed by each school principal. The investigator administered the evaluation instruments to all experienced elementary teachers at their respective schools during the month of May, 1972.

Description of the Evaluation Instruments

For the purpose of collecting data from the prospective and experienced elementary teacher samples, two questionnaires (one for the prospective and one for the experienced elementary teachers), an attitude scale, and the arithmetic subtests of a standardized achievement test were used. The order of administering each instrument was the same for the entire prospective and experienced teacher sample. The attitude scale was administered first, taking approximately eight minutes. The prospective or experienced elementary teacher questionnaire was given next, taking approximately 15 minutes. The achievement tests were administered last, taking approximately 97 minutes, including directions. The total time for giving instructions and administering the three instruments to each group of prospective and experienced elementary teachers was approximately two hours.

Prospective Elementary Teacher Questionnaire

A 15 item questionnaire, designed by the investigator and approved by the Research Committee, was used for gathering data on the prospective elementary teacher sample. The prospective elementary teacher questionnaire responses were recorded on seperate machine scored Standard Answer Sheet forms. The questionnaire contained items concerned with the age, sex, high school and college mathematics preparation, academic specialization, grade level teaching preference, and respondents' opinions concerning mathematics content and methods courses (Appendix D).

Experienced Elementary Teacher Questionnaire

A 19 item questionnaire, developed by the investigator and approved by the Research Committee, was used for gathering data on the experienced elementary teacher sample. The questionnaire was essentially the same as the prospective elementary teacher questionnaire. Additional information concerning the years of teaching experience, level of professional training, and the number of years since completing a mathematics content or methods course was obtained from the experienced elementary teacher sample (Appendix D). The procedure for answering the experienced elementary teacher questionnaire was the same as the prospective elementary teacher questionnaire.

Attitude Scale

The scale used for measuring the attitudes toward mathematics of prospective and experienced elementary teachers was the Revised Math Attitude Scale developed by L. R. Aiken and R. M. Dreger (1967). The 20 item scale used the Likert scaling procedure with 10 of the items connoting positive attitudes and 10 connoting negative attitudes toward mathematics (Appendix L). Paragraphs written by 310 college students were used in developing the items for the scale. Items were weighted from zero (strongly disagree) to four (strongly agree) for the 10 negative items and the weights were reversed for purposes of scoring the 10 positive items.

A test-retest reliability coefficient of .94 was reported by the authors. Validity estimates were based upon a sample of 160 female college sophomores in a Southeastern women's college. Attitude scores were found to be significantly related to final course grades of females but not to grades of males. Attitude scores were positively correlated with numerical ability but unrelated to general personality variables. In addition to content validity, Aiken and Dreger reported the scale had discriminant validity. A test of independence between the scores on the Revised Math Attitude Scale and scores on four items designed to measure attitudes toward academic subjects in general, indicated that attitudes specific to mathematics were being measured. In addition, it was reported by the authors that scores on the scale predicted gains in arithmetic achievement when training intervened.

Achievement Test

The test used for measuring mathematical competence of the prospective and experienced elementary teachers was the Stanford Achievement Test, 1964 Advanced Battery, Form X. Tests relating to arithmetic computation, concepts, and applications were the only subtests of the battery administered. A single answer sheet was used for recording the responses of the three subtests. The total testing time for the three tests was 87 minutes.

The 41 item arithmetic computation test measured proficiency in computational skills appropriate for grades 7, 8, and 9. The computational items were taken from the fundamental operations of addition, subtraction, multiplication, and division, and were extended to include fractions, solutions of a number sentence and per cent example, and operations with negative numbers.

The arithmetic concepts test measured in a 40 item multiple-choice test, the understanding of place value, Roman numerals, operational terms, meaning of fractions, interrelationship of fundamental operations, number names, averages, per cent, and geometric terms. The test also measured formulas, operations with negative numbers, exponents, roots, prime numbers, and sets, to name a few.

The arithmetic applications test consisted of 36 multiple-choice items which measured reasoning with problems taken from life experiences. The subjects were required to apply their mathematics knowledge and ability to think mathematically in practical situations. Problems were concerned with area, volume, ratio, graphs, scales, geometric figures, and business transactions and other items related to mathematical problems.

Statistical Characteristics of the Stanford Achievement Test

There were five batteries of the Stanford Achievement Test, with forms W, X, Y, and Z available for each form. For the purpose of this research, the three arithmetic subtests of the 1964 Advanced Battery, Form X, was used. The Advanced Battery was primarily designed for use from the beginning of grade 7 to the end of grade 9.

Reliability

Reliability data for the tests in the Advanced Battery were obtained by use of the odd-even split-half reliability coefficients, Kuder-Richardson reliability coefficients and the standard error of measurement in terms of grade scores for each subject in the battery. A random sample of 1,000 cases for each grade (7.6, 8.6, and 9.6) was selected from 76 school systems participating in a national standardization. Each school system was conducting achievement tests in all grades from one through nine.

Reliability coefficients reported for the arithmetic computation test ranged from .87 for grade 7 to a .92 for grade 9. Coefficients for the arithmetic concepts test ranged from .82 for grade 7 to a .88 for grade 9, while coefficients for the arithmetic application test ranged from .76 in grade 7 to a .81 in grade 8.

Validity

The Stanford Achievement Test authors sought to insure content validity by examining appropriate courses of study and textbooks as a basic for determining the skills, knowledge, and understandings of mathematics to be measured.

Norms

A total of 264 school systems from 50 states participated in the sample. A national norm group of over 850,000 pupils from nine regions were tested as part of the standardization procedure. Student samples distributed across the nine regions were in proportion to the populations of the nine regions according to the 1960 census. Types of school systems involved were: single municipality with a population under 2,500 to a single municipality with a population of over 100,000; county; district; Catholic; and private or church affiliated.

Statistical Treatment of the Data

The data for this study were collected through the use of the following instruments: (a) a prospective elementary teacher questionnaire; (b) an experienced elementary teacher questionnaire; (c) an attitude scale; and (d) the subtests of a standardized arithmetic achievement test. All prospective and experienced elementary teachers in the study were administered the attitude scale, arithmetic achievement subtests, and the prospective or experienced elementary teacher questionnaire.

Questionnaire and attitude responses were recorded on the Standard Answer Sheet-C Forms. Responses to the 117 item arithmetic achievement test were recorded on an answer sheet developed by the investigator. All of the arithmetic achievement subtests were hand scored and the total raw scores for each subtest (computations, concepts, and applications) and the raw score sums of the three subtests were recorded on the Standard Answer Sheets.

The statistical data recorded on the Standard Answer Sheets were scored and tabulated on the OpScan 100 electronic scoring machine. The data were placed on a computer tape, from which the computer card decks were punched.

The statistical programs that were used for analyzing the prospective and experienced elementary teacher data, are contained in the STATJOB library at the University of Houston. The data were processed on the Univac 1108 Computer. The frequency analysis for the arithmetic achievement and attitude raw scores were analyzed on a drum resident Frequency Analysis Program.

Comparisons were made between the arithmetic achievement subtest scores, attitude scores, and the variables contained on the prospective and experienced elementary teacher questionnaires. Point Biserial correlations were used to make comparisons between the dichotomous and continuous variables, and Phi Coefficients were used when the variables were both categorical. The DSTAT2 program, a bivariate subsample method for missing data, was used to obtain the Product-Moment correlation coefficients necessary for testing Hypotheses One through Four.

The means and standard deviations of the prospective and experienced elementary teachers' arithmetic achievement and attitude scores were computed for the purposes of testing Hypotheses Five and Six. The means of the arithmetic achievement and attitude scores were compared by the use of the t test for the Difference Between Two Means for Independent Samples (Ferguson, 1966). All hypotheses were considered at the .05 level of significance.

CHAPTER IV

RESULTS OF THE STUDY

The data collected in the study were sub-divided into four basic areas for purposes of analysis. The first area dealt with the data received from the prospective and experienced elementary teacher samples on the questionnaire and test instruments. The second area consisted of an analysis of relationships among variables within the prospective elementary teacher sample. In the third area, a similiar analysis of relationships among variables within the experienced elementary teacher sample was undertaken. The fourth area was concerned with differences observed between the prospective and experienced elementary teacher samples in terms of arithmetic achievement scores, attitude scores, and other variables.

Data Received from the Prospective and Experienced Elementary Teacher Samples on Questionnaires and Test Instruments

Questionnaire Results. The data presented in the following section of this study were taken from completed questionnaires received from a prospective elementary teacher sample with an N of 724 and an experienced elementary teacher sample with an N of 284. The prospective and experienced elementary teacher questionnaires were described in Chapter Three and presented in Appendix D.

The data related to the sex and age of the respondents in both samples are presented in Tables 1 and 2. The information was organized within the tables according to the number of subjects in each sample and the per cent in each category.

TABLE 1

SEX OF PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHERS

	PROSPECTIVE TEACHERS		EXPERIENCED TEACHERS	
SEX	N	PER CENT	N	PER CENT
Male	47	6.5	13	4.6
Female	677	93.5	271	95.4
TOTALS	724	100.0	284	100.0

The information presented in Table 1 indicated that approximately 95 per cent of all prospective and experienced elementary teachers were female. The frequency distributions of age groups presented in Table 2 reveals that 89.8 per cent

TABLE 2

AGE OF PROSPECTIVE AND
EXPERIENCED ELEMENTARY TEACHERS

	PROSPECTIVE TEACHERS		EXPERIENCED TEACHERS	
AGE	N	PER CENT	N	PER CENT
18-24	535	73.9	78	27.5
25-34	115	15.9	122	43.0
35-44	65	9.0	60	21.1
45-54	8	1.1	18	6.3
55 +	1	0.1	6	2.1
TOTALS	724	100.0	284	100.0

of the prospective and 70.5 per cent of the experienced elementary teachers were under 35 years of age.

The size of high school graduating classes for the prospective and experienced elementary teachers is exhibited in Table 3. The number of high school (grades 9-12) mathematics courses completed by prospective and experienced elementary teachers is presented in Table 4.

TABLE 3

SIZES OF HIGH SCHOOL GRADUATING CLASSES FOR PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHERS

	PROSPECTIVE TEACHERS		EXPERIENCED TEACHERS	
CLASS SIZE	N	PER CENT	N	PER CENT
50 and Under	100	13.8	53	18.7
51 -150	191	26.4	67	23.6
151-300	128	17.7	46	16.2
301-450	124	17.1	29	10.2
451 +	181	25.0	89	31.3
TOTALS	724	100.0	284	100.0

TABLE 4

MATHEMATICS COURSES COMPLETED IN GRADES 9-12 BY PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHERS

	PROSPECTIVE TEACHERS		EXPERIENCED TEACHERS	
NUMBER OF COURSES	N	PER CENT	N	PER CENT
1	12	1.7	10	3.5
2	136	18.8	48	16.9
3	264	36.5	91	32.0
4	145	20.0	53	18.7
5	80	11.0	38	13.4
6	47	6.5	22	7.7
7	21	2.9	12	4.2
8	11	1.5	7	2.5
9	8	1.1	3	1.1
TOTALS	724	100.0	284	100.0

The most common sizes of high school graduating classes for both samples were classes of 51-150 and classes over 450. Over 50 per cent of both samples were graduated from classes in these two categories.

The classifications of the academic specializations for prospective and experienced elementary teachers are presented in Table 5.

TABLE 5

ACADEMIC AREAS OF SPECIALIZATION FOR PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHERS

	PROSPECTIVE TEACHERS		EXPERIENCED TEACHERS	
ACADEMIC AREAS	N	PER CENT	N	PER CENT
Lang. Arts	225	31.1	84	29.6
Mathematics	33	4.6	10	3.5
Science	22	3.0	22	7.7
Soc.-Stud.	113	15.6	63	22.2
Art	71	9.8	28	9.9
Music	23	3.2	17	6.0
Phy. Ed.	54	7.5	20	7.0
Other	183	25.2	40	14.1
TOTALS	724	100.0	284	100.0

The percentage of high school mathematics courses completed by prospective and experienced elementary teachers in each of the nine categories differed only slightly. Experienced elementary teachers completed a mean number of 3.80 courses as compared to a mean of 3.65 courses for the prospective elementary teachers. Prospective and experienced elementary teachers selected Language Arts and Social Studies as the two most common areas of academic specializations. Approximately 47 per cent of the prospective and 52 per cent of the experienced elementary teachers selected these two areas.

Language Arts was the first choice of both samples. The most notable differences among the specializations identified were in the percentage of respondents selecting Social Studies. Within the experienced elementary teacher sample, 22.2 per cent selected this specialization as compared to 15.6 per cent of the prospective elementary teacher sample. Mathematics (3.5 per cent) was the least selected academic specialization of the experienced elementary teachers while Science was the least selected for the prospective elementary teacher sample.

The number of college mathematics content and methods courses completed by the prospective and experienced elementary teachers is revealed in Tables 6 and 7 respectively.

TABLE 6

MATHEMATICS CONTENT COURSES COMPLETED BY
PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHERS

	PROSPECTIVE TEACHERS		EXPERIENCED TEACHERS	
CONTENT COURSES	N	PER CENT	N	PER CENT
None	87	12.0	32	11.3
1	189	26.1	103	36.3
2	268	37.0	74	26.1
3	107	14.8	47	16.5
3 +	73	10.1	28	9.8
TOTALS	724	100.0	284	100.0

TABLE 7

MATHEMATICS METHODS COURSES COMPLETED BY
PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHERS

	PROSPECTIVE TEACHERS		EXPERIENCED TEACHERS	
METHODS COURSES	N	PER CENT	N	PER CENT
None	134	18.5	64	22.5
1	513	70.9	153	53.9
2	51	7.0	48	16.9
3	14	1.9	13	4.6
3 +	12	1.7	6	2.1
TOTALS	724	100.0	284	100.0

Approximately 12 per cent of both samples did not complete a single college mathematics content course. Experienced elementary teachers (36.3 per cent) completed one course as compared to 26.1 per cent for the prospective elementary teachers, while 37 per cent of the prospective elementary teachers had completed two courses as compared to 26.1 per cent of the experienced elementary teachers sample. Both samples, approximately 26 per cent, completed three or more courses. At least 90 per cent of both samples failed to meet the minimum mathematics recommendation of the CUPM for undergraduate elementary teachers. It could not be ascertained from the questionnaire responses whether the remaining 10 per cent had satisfied the CUPM recommendations.

The data presented in Table 7 indicates that experienced elementary teachers had completed a greater number of mathematics methods courses than prospective elementary teachers. Experienced elementary teachers (23.6 per cent) had completed two or more methods courses as compared to 10.6 per cent for the prospective elementary teachers. Since the questionnaires did not distinguish between undergraduate and graduate mathematics content and methods courses, it could not be determined what percentage of the methods courses completed by the experienced elementary teachers were at the graduate level.

Prospective and experienced elementary teachers' ratings of college mathematics content and methods courses and which courses had a positive influence on their attitudes toward mathematics, are presented in Table 8.

TABLE 8

MATHEMATICS CONTENT AND METHODS COURSES WHICH HAD A POSITIVE INFLUENCE ON THE ATTITUDES TOWARD MATHEMATICS OF PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHERS

	PROSPECTIVE TEACHERS		EXPERIENCED TEACHERS	
COURSES AND ATTITUDES	N	PER CENT	N	PER CENT
Content	176	24.3	78	27.5
Methods	247	34.1	73	25.7
Both	196	27.1	67	23.6
Neither	105	14.5	66	23.2
TOTALS	724	100.0	284	100.0

Prospective and experienced elementary teachers' opinions concerning which mathematics courses, content or methods, provided them with the necessary background for teaching mathematics in the grades K-6, are presented in Table 9.

TABLE 9

PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHERS' OPINIONS CONCERNING WHICH COURSES PROVIDED THEM WITH THE NECESSARY MATHEMATICS BACKGROUND FOR TEACHING IN THE ELEMENTARY GRADES

	PROSPECTIVE TEACHERS		EXPERIENCED TEACHERS	
COURSES AND BACKGROUND	N	PER CENT	N	PER CENT
Content	143	19.8	55	19.4
Methods	283	39.0	75	26.4
Both	207	28.6	92	32.4
Neither	91	12.6	62	21.8
TOTALS	724	100.0	284	100.0

Questionnaire results provided in Tables 8 and 9 indicate that prospective elementary teachers felt that mathematics methods courses not only had a positive influence on their attitudes toward mathematics but provided the necessary background for teaching mathematics in the elementary (K-6) grades. Experienced elementary teachers were almost evenly distributed in their opinions of which courses had a positive influence on their attitudes toward mathematics. Experienced elementary teachers (32.4 per cent) indicated that mathematics content and methods courses provided equal background material necessary for teaching mathematics in the elementary school.

The grade level teaching preference for prospective elementary teachers and the grade level teaching assignment for experienced elementary teachers is presented in Table 10. Prospective elementary teachers were asked to indicate the grade level they would prefer to teach and the experienced elementary teachers were asked to indicate the grade level they were presently teaching.

TABLE 10

GRADE LEVEL TEACHING PREFERENCE OR ASSIGNMENTS OF PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHERS

	PROSPECTIVE TEACHER GRADE LEVEL PREFERENCE		EXPERIENCED TEACHERS LEVEL CURRENTLY TEACHING	
GRADE LEVEL	N	PER CENT	N	PER CENT
K-3	472	65.2	156	54.9
4-6	252	34.8	128	45.1
TOTALS	724	100.0	284	100.0

The data presented in Table 10 indicates that experienced elementary teachers with teaching assignments in grades K-3 and those assigned to grades 4-6 differ by approximately 10 per cent. Prospective elementary teachers differ by approximately 30 per cent when comparing their grade level teaching preference. The teaching assignments of the experienced elementary teacher sample may or may not have reflected their grade level teaching preference.

The number of prospective elementary teachers who had received a Bachelor's Degree and who were enrolled in a program leading to a certificate in elementary education in Texas is presented in Table 11.

TABLE 11

PROSPECTIVE ELEMENTARY TEACHERS WITH A BACHELOR'S DEGREE COMPLETING CERTIFICATION REQUIREMENTS FOR THE STATE OF TEXAS

DEGREE CATEGORY	N	PER CENT
Non-Degree	676	93.4
Degree	48	6.6
TOTALS	724	100.0

A summary of high school mathematics courses completed by the prospective and experienced elementary teacher samples is presented in Table 12. The high school mathematics courses completed by prospective and experienced elementary teachers are sub-divided into four groups. Each group lists four mathematics courses and a fifth category labled "None of the Above". The latter category refers to to the number and per cent of respondents that did not complete any of the courses listed within each of the four groups.

The most commonly selected courses for both the prospective and experienced elementary teacher samples were Algebra I, Algebra II, and Plane Geometry. The data present- in Table 12 reveals that approximately 96 per cent of both samples had completed Algebra I and approximately 67 per cent had completed Algebra II. A slightly higher percentage of the prospective elementary teachers (79.7 per cent) had completed Plane Geometry as compared to 75.7 per cent of the experienced elementary teachers. A second course in Elementary Analysis was the least selected subject (1.0 per cent) of the prospective, while a Probability-Statistics course was the least selected (1.8 per cent) subject for the experienced elementary teachers. Over 90 per cent of both samples had not completed any of the courses listed in Group IV.

TABLE 12

HIGH SCHOOL MATHEMATICS COURSES (GRADES 9-12)
COMPLETED BY PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHERS

	PROSPECTIVE TEACHERS		EXPERIENCED TEACHERS	
COURSES	N	PER CENT	N	PER CENT
GROUP I				
Related Math. I	156	21.5	81	28.5
Related Math. II	95	13.1	58	20.4
Consumer Math	51	7.0	30	10.6
Algebra I	693	95.7	271	95.4
None of the Above	9	1.2	0	0.0
GROUP II				
Algebra II	499	68.9	188	66.2
Algebra III	108	14.9	70	24.6
Algebra IV	77	10.6	41	14.4
Trigonometry	124	17.1	52	18.3
None of the Above	183	25.3	64	22.5
GROUP III				
Plane Geometry	577	79.7	215	75.7
Solid Geometry	143	19.8	35	12.3
Analytical Geometry	32	4.4	11	3.9
Elementary Analysis I	47	6.5	12	4.2
None of the Above	125	17.3	61	21.5
GROUP IV				
Elementary Analysis II	7	1.0	8	2.8
Probability-Statistics	8	1.1	5	1.8
Other (Courses not listed in Groups I-IV Above)	29	4.0	13	4.6
None of the Above	678	93.6	258	90.8

Data Collected from the Experienced Elementary Teacher Questionnaire that were not included on the Prospective Elementary Teacher Questionnaire. The data presented in Tables 13 through 17 are taken from responses on the experienced elementary teacher questionnaire. The information provides a description of the number of years teaching experience, the number of experienced elementary teachers that are certified to teach in grades K-6 in Texas, the number of mathematics classes taught each day by experienced elementary teachers, the number of years since completing a mathematics content or methods course, and the professional preparation of experienced elementary teachers.

TABLE 13

EXPERIENCED ELEMENTARY TEACHERS' YEARS OF TEACHING EXPERIENCE

YEARS OF TEACHING EXPERIENCE	N	PER CENT
1 or less	51	18.0
2 -5	116	40.8
6 -10	63	22.2
11-20	41	14.4
More than 20	13	4.6
TOTALS	284	100.0

TABLE 14

EXPERIENCED ELEMENTARY TEACHERS
CERTIFIED TO TEACH IN TEXAS

CERTIFICATION CATEGORY	N	PER CENT
Texas Certification	263	92.6
Not Certified in Texas	21	7.4
TOTALS	284	100.0

An analysis of the data presented in Tables 13 and 14 reveal that 58.8 per cent of the sample had five years or less teaching experience while 81 per cent had less than 11 years of teaching experience. Thirteen (4.6 per cent) of the subjects indicated that they had more than 20 years of teaching experience. Information presented in Table 14 represents the number of experienced elementary teachers (263 or 92.6 per cent) in the sample that were certified to teach in the elementary grades (K-6) in Texas.

The number of arithmetic classes taught each day by the experienced elementary teachers is presented in Table 15.

TABLE 15

THE NUMBER OF ARITHMETIC CLASSES TAUGHT DAILY BY EXPERIENCED ELEMENTARY TEACHERS

NUMBER OF CLASSES TAUGHT	N	PER CENT
None	83	29.2
1	122	43.0
2	61	21.5
3	8	2.8
More than 3	10	3.5
TOTALS	284	100.0

Results of the data presented in Table 15 indicates that approximately 30 per cent of the experienced elementary teacher sample did not teach arithmetic. Forty-three per cent of the sample taught one class, while 21.5 per cent taught two classes in arithmetic each day. Experienced teachers that taught three or more classes in arithmetic each day were represented by a total of 18 respondents, or 6.3 per cent of the total sample.

The number of years since experienced elementary teachers completed a mathematics content or methods course is presented in Table 16.

TABLE 16

EXPERIENCED ELEMENTARY TEACHERS'
NUMBER OF YEARS SINCE COMPLETING A COURSE
IN MATHEMATICS CONTENT OR METHODS

NUMBER OF YEARS	N	PER CENT
1 or less	36	12.7
2-4	107	37.7
5-7	61	21.5
8-10	34	12.0
More than 10	46	16.1
TOTALS	284	100.0

The data presented in Table 16 reveal that more than one-half of the experienced elementary teacher sample reported having completed a mathematics content or methods course within the last four years. Over one-third of the respondents indicated that it had been between five and 10 years since completing a mathematics content or methods course, while 16.1 per cent reported that it had been more than 10 years.

A summary of the professional training of the experienced elementary teachers is presented in Table 17.

TABLE 17

PROFESSIONAL PREPARATION OF
EXPERIENCED ELEMENTARY TEACHERS

EDUCATIONAL TRAINING	N	PER CENT
2 Years or Less	3	1.1
More than 2 Years	4	1.4
Bachelor's Degree	277	97.5
Master's Degree	57	20.0
Doctor's Degree	1	0.4

An analysis of the data presented in Table 17 reveals that 2.5 per cent of the sample had not completed degree requirements for a Bachelor's Degree. Of the 284 experienced elementary teachers, 277 (97.5 per cent) had been awarded the Bachelor's Degree, one-fifth (57 subjects) had been awarded the Master's Degree, and one (0.4 per cent) had been awarded the Doctorate.

Data Received from the Test Instruments. The data gathering instruments used in the study consisted of the arithmetic subtests of the Stanford Achievement Test, Advanced Form, and the Revised Math Attitude Scale. Both instruments are described in Chapter Three.

Frequency distributions of the raw scores made by the prospective and experienced elementary teachers on the arithmetic subtests and attitude scale appear in Tables 18 through 22. The mean raw scores for each subtest and attitude scale indicate the level of mathematical competence and the attitudes toward mathematics of prospective and experienced elementary teachers.

The differences in mean scores of both samples on the arithmetic achievement subtests and attitude scale, reflect a small amount of variance. The mean scores for prospective and experienced elementary teachers show a difference of .08 of one raw score point on the 41 item arithmetic computations subtest. Mean raw scores of 30 (approximately 73 per cent) are reported by both samples on the arithmetic computations test. Mean raw scores reported for the prospective and experienced teacher samples on the 40 item arithmetic concepts subtest are 28 or approximately 71 per cent. A difference of .24 resulted when the mean raw scores of both groups were compared.

The distribution of arithmetic application scores observed in Table 20 reveals that the experienced elementary teachers have a mean raw score of 23.39 as compared to a mean of 21.51 for the prospective elementary teacher sample, a mean difference 1.88. The prospective elementary sample

TABLE 18

FREQUENCY DISTRIBUTION OF ARITHMETIC COMPUTATION SCORES
STANFORD ACHIEVEMENT TEST, FORM X, ADVANCED BATTERY

	PROSPECTIVE TEACHERS		EXPERIENCED TEACHERS	
RAW SCORE INTERVALS	FREQUENCY	PER CENT	FREQUENCY	PER CENT
40-41	69	9.5	25	8.8
38-39	88	12.2	30	10.5
36-37	76	10.4	30	10.5
34-35	79	11.0	24	8.4
32-33	68	9.4	30	10.5
30-31	67	9.2	29	10.2
28-29	44	6.1	27	9.6
26-27	44	6.1	18	6.3
24-25	26	3.6	20	7.0
22-23	38	5.3	10	3.5
20-21	34	4.7	14	4.9
18-19	25	3.5	5	1.8
16-17	23	3.2	7	2.5
14-15	11	1.5	2	.7
12-13	11	1.5	3	1.1
10-11	9	1.2	1	.4
8-9	5	.7	5	1.8
6-7	3	.4	3	1.1
4-5	3	.4	1	.4
2-3	1	.1	0	.0
0-1	0	.0	0	.0
TOTALS	724	100.0	284	100.0

Mean Raw Score for Prospective Teacher Sample = 30.19
Mean Raw Score for Experienced Teacher Sample = 30.11

TABLE 19

FREQUENCY DISTRIBUTION OF ARITHMETIC CONCEPT SCORES
STANFORD ACHIEVEMENT TEST, FORM X, ADVANCED BATTERY

	PROSPECTIVE TEACHERS		EXPERIENCED TEACHERS	
RAW SCORE INTERVALS	FREQUENCY	PER CENT	FREQUENCY	PER CENT
39-40	24	3.4	13	4.6
37-38	54	7.4	14	4.9
35-36	80	11.0	22	7.7
33-34	80	11.0	30	10.5
31-32	98	13.5	41	14.4
29-30	67	9.3	34	11.9
27-28	79	10.9	25	8.8
25-26	50	6.9	24	8.5
23-24	46	6.4	23	8.1
21-22	36	5.0	24	8.5
19-20	32	4.4	8	2.8
17-18	33	4.6	10	3.5
15-16	17	2.3	7	2.5
13-14	10	1.4	5	1.8
11-12	10	1.4	3	1.1
9-10	3	.4	0	.0
7-8	2	.3	0	.0
5-6	2	.3	0	.0
3-4	1	.1	1	.4
1-2	0	.0	0	.0
0	0	.0	0	.0
TOTALS	724	100.0	284	100.0

Mean Raw Score for Prospective Teacher Sample = 28.50
Mean Raw Score for Experienced Teacher Sample = 28.26

TABLE 20

FREQUENCY DISTRIBUTION OF ARITHMETIC APPLICATION SCORES
STANFORD ACHIEVEMENT TEST, FORM X, ADVANCED BATTERY

	PROSPECTIVE TEACHERS		EXPERIENCED TEACHERS	
RAW SCORE INTERVALS	FREQUENCY	PER CENT	FREQUENCY	PER CENT
35-36	2	.3	2	.7
33-34	13	1.8	13	4.6
31-32	26	3.6	13	4.6
29-30	37	5.1	24	8.5
27-28	52	7.2	36	12.7
25-26	88	12.1	33	11.6
23-24	115	15.9	39	13.7
21-22	109	15.0	38	13.3
19-20	85	11.8	33	11.6
17-18	67	9.3	25	8.8
15-16	44	6.1	10	3.5
13-14	35	4.8	10	3.5
11-12	22	3.0	2	.7
9-10	12	1.7	4	1.4
7-8	10	1.4	1	.4
5-6	5	.7	1	.4
3-4	1	.1	0	.0
1-2	1	.1	0	.0
0	0	.0	0	.0
TOTALS	724	100.0	284	100.0

Mean Raw Score For Prospective Teacher Sample = 21.51
Mean Raw Score For Experienced Teacher Sample = 23.39

TABLE 21

FREQUENCY DISTRIBUTION OF ARITHMETIC TOTAL SCORES
STANFORD ACHIEVEMENT TEST, FORM X, ADVANCED BATTERY

	PROSPECTIVE TEACHERS		EXPERIENCED TEACHERS	
RAW SCORE INTERVALS	FREQUENCY	PER CENT	FREQUENCY	PER CENT
113-117	7	1.0	5	1.8
108-112	23	3.1	9	3.2
103-107	44	6.1	17	5.9
98-102	63	8.7	31	11.0
93-97	77	10.7	25	8.8
88-92	88	12.2	28	9.8
83-87	76	10.4	35	12.3
78-82	70	9.7	25	8.8
73-77	61	8.5	30	10.5
68-72	39	5.4	17	5.9
63-67	37	5.1	25	8.8
58-62	38	5.3	10	3.5
53-57	35	4.8	6	2.1
48-52	14	2.0	7	2.5
43-47	17	2.3	5	1.8
38-42	12	1.7	5	1.8
33-37	9	1.2	2	.7
28-32	9	1.2	1	.4
23-27	1	.1	1	.4
18-22	4	.5	0	.0
13-17	0	.0	0	.0
8-12	0	.0	0	.0
3-7	0	.0	0	.0
0-2	0	.0	0	.0
TOTALS	724	100.0	284	100.0

Mean Raw Score for Prospective Teacher Sample = 80.20
Mean Raw Score for Experienced Teacher Sample = 81.76

answered correctly approximately 60 per cent of the 36 item arithmetic applications subtest while experienced elementary teachers answered correctly approximately 65 per cent. A difference of 1.56 in mean raw scores was recorded between the total achievement scores of the prospective and experienced elementary teacher samples. Prospective and experienced teachers answered correctly approximately 69 and 70 per cent, respectively, of the 117 item total arithmetic achievement test.

Attitude scores presented in Table 22 indicate the respondents feelings toward mathematics, as measured by the Revised Math Attitude Scale. The scale measures a person's attitude toward mathematics in terms of a negative, neutral, or a positive attitude. The scoring procedure for the scale was altered for convenience of facilitating the electronic scoring device used to interpret the data. The original scale had a range from zero (negative) to 80 (positive) with a score of 40 connoting a neutral feeling about mathematics.

The scores reported in Table 22 were reversed, thereby, causing a score of 20 to be highly positive and a score of 100 to be highly negative. A score of 60 denotes a neutral feeling toward mathematics. A mean score of 61 or greater was considered to be negative. Prospective elementary had a mean attitude score of 53.45 which resulted in a

TABLE 22

FREQUENCY DISTRIBUTION OF RAW SCORES*
MADE ON THE REVISED MATH ATTITUDE SCALE

	PROSPECTIVE TEACHERS		EXPERIENCED TEACHERS	
RAW SCORE INTERVALS	FREQUENCY	PER CENT	FREQUENCY	PER CENT
97-100	1	.1	2	.7
93-96	7	1.0	1	.4
89-92	10	1.3	2	.7
85-88	12	1.7	6	2.2
81-84	15	2.1	6	2.2
77-80	39	5.4	7	2.5
73-76	49	6.8	18	6.3
69-72	35	4.5	7	2.5
65-68	45	6.2	12	4.2
61-64	41	5.7	25	8.8
57-60	48	6.7	13	4.6
53-56	36	4.9	16	5.6
49-52	65	9.0	20	7.0
45-48	68	9.3	23	8.1
41-44	76	10.4	25	8.8
37-40	42	5.8	30	10.5
33-36	44	6.1	18	6.3
29-32	42	5.8	16	5.6
25-28	20	2.8	14	4.9
21-24	23	3.3	14	4.9
20	6	.8	9	3.2
TOTALS	724	100.0	284	100.0

* Raw scores on the Revised Math Attitude Scale range from a low of 20 to a high of 100.
Mean Raw Score for Prospective Teacher Sample = 53.45
Mean Raw Score for Experienced Teacher Sample = 49.81

positive attitude toward mathematics while the experienced elementary teachers had a slightly higher mean (49.81) representing a more positive attitude toward mathematics.

Comparisons were made between the prospective and experienced elementary teachers' mean raw scores and norm samples of the arithmetic subtests of the Stanford Achievement Test, Advanced Battery. The mean scores of both samples were converted to grade scores, percentile ranks, and stanines in order to compare prospective and experienced elementary teacher scores to raw scores made by students in the standardization norm sample. Conversion tables were not available for the total arithmetic achievement scores, therefore, the arithmetic computation, concepts, and applications scores were the only scores converted (Appendix M).

Converted grade scores of the prospective and experienced elementary teachers on the arithmetic computation subtest were the same, therefore, the data representing percentile ranks and stanines of each group were identical. In addition, both samples had identical grade scores for the arithmetic concepts subtest. Experienced elementary teachers reported a higher grade score (11.5) than the prospective elementary teachers (10.8) on the arithmetic applications subtest.

The grade scores for prospective and experienced elementary teachers reported in Appendix M were compared to a national standardization of student norms for the end of grades six through nine. When prospective and experienced elementary teacher scores were compared to the sixth grade norms, they were projected into the upper ninetieth percentile range and ranked in the eighth and ninth stanines. When the same grade scores of both samples were compared to the ninth grade norm sample, they dropped to within the sixtieth percentile range and the sixth stanine.

Summary. As a result of the analysis of the data presented in Tables 1 through 17, a number of observations were made concerning prospective and experienced elementary teachers.

Respondents reported similar data in numerous areas on the prospective and experienced elementary teacher questionnaire. In the areas of sex, size of high school graduating class, high school mathematics completed, academic specializations, and college mathematics content courses completed, the percentage of prospective and experienced elementary teacher responses in each category showed considerable resemblance. Contrasting data were revealed by both samples in terms of age, number of mathematics methods courses completed, which mathematics courses had a positive influence on their attitudes toward mathematics, and the mathematics courses they believed were responsible for providing them with the necessary background for teaching mathematics in the elementary (K-6) grades.

Data pertinent to the experienced elementary teacher sample were reported in Tables 13 through 17. An analysis of the results disclosed that 92.6 per cent of the experienced elementary teachers held valid Texas teaching certificates and the majority of the sample had five or fewer years of teaching experience and taught one or no classes in arithmetic each day. In addition, information presented in Table 17 revealed that 97.5 per cent of the total sample had been awarded the Bachelor's Degree, 20 per cent the Master's, and .4 per cent the Doctorate.

There were small mean differences reported between prospective and experienced elementary teachers' scores on the arithmetic achievement subtests and attitude scale. Mean scores reported for both samples showed a variance of less than one raw score point on each of the arithmetic computation and concepts subtests. An analysis of the data presented for the arithmetic applications subtest scores pointed out that experienced elementary teachers had a mean score of 23.39 as compared to a mean of 21.51 for the prospective elementary teacher sample. The total arithmetic achievement mean scores for both groups varied by as little as 1.56 raw score points. Both samples reported positive attitudes toward mathematics.

The mean arithmetic achievement scores of prospective and experienced elementary teachers were converted to grade scores, percentiles, and stanines for the purpose of comparing the results to a national standardization norm sample of students in grades six through nine. A comparison of prospective and experienced elementary teacher scores with those of students at the end of grade nine revealed that the teacher sample was rated at the sixtieth percentile range.

An Analysis of Relationships Among Variables Within the Prospective Elementary Teacher Sample

Testing the Hypotheses. The data presented in Table 23 are the correlation coefficients produced as the result of analyzing the relationships existing between arithmetic achievement, attitudes, and selected variables germane to prospective elementary teachers. The variables listed as part of Table 23 were taken from the prospective elementary teacher questionnaire.

There were 722 degrees of freedom associated with the prospective elementary teacher sample. A product-moment "r" of .07 was considered significant at the .05 level of

TABLE 23

PRODUCT-MOMENT CORRELATION COEFFICIENTS AND THE RELATIONSHIP BETWEEN ARITHMETIC ACHIEVEMENT, ATTITUDE, AND SELECTED VARIABLES -PROSPECTIVE ELEMENTARY TEACHER SAMPLE-

VARIABLES	COMP.	CONC.	APPL.	TOTAL	ATT.
Sex	-.047	-.044	-.080*	-.061	.098*
Age	-.111**	-.081*	.013	-.069	-.020
Size of H.S. Graduation Class	.069	.101**	.102**	.096*	.015
No. of H.S. Math. Courses	.250**	.291**	.269**	.292**	-.288**
Academic Specialization	.305**	.321**	.276**	.323**	-.115**
No. of Math. Content Courses	.195**	.237**	.206**	.230**	-.241**
No. of Math. Methods Courses	.020	.028	-.017	.013	-.039
Grade Level Teaching Preference	.089*	.114**	.069	.105**	-.112**

* Significant at the .05 level
** Significant at the .01 level

confidence and a product-moment "r" of .10 was significant at the .01 level. For the purpose of establishing a format for presenting the statistical information, each hypothesis was stated, pertinent data concerning each relationship were presented, and each hypothesis was accepted or rejected at the .05 level of confidence.

$H_o1(a)$: There is no significant relationship between the mathematics competence of prospective elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and sex.

The relationship existing between arithmetic achievement and sex of prospective elementary teachers produced only one coefficient that was significant; arithmetic applications. There was no significant relationship found between sex and the other subtests of arithmetic achievement. Thus, $H_o1(a)$ was rejected for arithmetic applications. $H_o1(a)$ pertaining to the computations and concepts subtests and the total arithmetic achievement on the Stanford Achievement Test was not rejected.

$H_o1(b)$: There is no significant relationship between the mathematical competence of prospective elementary teachers as measured by the arithmetic subtests of the Stanford Achievement Test, and age.

An analysis of the coefficients presented in Table 23 shows a significant relationship between age and arithmetic computations, concepts, and total achievement. There was no significant relationship found to exist between age and arithmetic applications. Younger prospective elementary teachers scored higher on arithmetic computations, concepts, and total achievement, however, older prospective elementary teachers scored higher on the arithmetic applications subtest. As a result of the findings concerning the age and arithmetic achievement of prospective elementary teachers, $H_o1(b)$ was rejected at the .05 level of confidence for arithmetic computations, concepts, and total achievement, however, the hypothesis was not rejected for the arithmetic applications subtest.

$H_o1(c)$: There is no significant relationship between the mathematical competence of prospective elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and the size of their high school graduating class.

The size of high school graduating classes for prospective elementary teachers was significantly related to arithmetic concepts, applications, and total achievement. The graduating class size was not significantly related to arithmetic computation skills. Prospective elementary teachers that graduated from larger high school senior classes reported higher scores in arithmetic achievement than did those prospective elementary teachers graduated from smaller classes. $H_o1(c)$ relating to arithmetic achievement and size of high school graduating class was rejected for the arithmetic concepts and applications subtests and the total arithmetic achievement on the Stanford Achievement Test, but was not rejected for the arithmetic computations subtest.

$H_o1(d)$: There is no significant relationship between the mathematical competence of prospective elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and the number of high school mathematics courses completed.

The coefficients related to arithmetic achievement and the number of high school courses in mathematics completed by prospective elementary teachers were significant at the .01 level of confidence. Each arithmetic subtest and total achievement score produced a coefficient of .250 or greater, thus $H_o1(d)$ was rejected.

$H_o1(e)$: There is no significant relationship between the mathematical competence of prospective elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and their academic specialization.

An analysis of the data presented in Table 23 revealed that the highest correlation coefficients reported were between arithmetic achievement and the academic specializations. Since the variable, academic specialization, was composed of seven sub-variables, an analysis of each component was necessary. Each hypothesis was tested seperatedly, according to each academic specialization area.

Each prospective elementary teacher in the study completed a questionnaire related to certain mathematics background information. One question required each respondent to indicate his or her academic specialization. The eight academic specializations were: Language Arts, Mathematics, Science, Social Studies, Art, Music, Physical Education, and Other. Each respondent was to answer "other" only if his or her academic specialization was not listed. Each specialization area was analyzed and the data computed in order to obtain the number of subjects in each category, mean scores, the standard deviations, and the correlation coefficients showing the degree of relationship existing between arithmetic achievement, attitude, and academic specializations sel-cted.

The tables presenting the correlation coefficients, derived from the relationships between the arithmetic achievement subtests of the stanford Achievement Test and the prospective elementary teachers' academic specializations, are included in Appendix N.

An investigation of the tables in Appendix N discloses that each sub-sample of prospective elementary teachers, grouped according to their academic specialization, reported high correlations between the arithmetic subtests of the Stanford Achievement Test. Prospective elementary teachers selecting Mathematics as an academic specialization had the highest mean achievement scores on each of the arithmetic subtests, while prospective elementary teachers selecting Art, had the lowest mean achievement scores. Since all coefficients, for each prospective elementary teacher specialization area, were significant at the .05 level of confidence, $H_o1(e)$ was rejected.

$H_o1(f)$: There is no significant relationship between the mathematical competence of prospective elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and the number of college mathematics content courses completed.

The data pertinent to arithmetic achievement and the number of mathematics content courses completed by prospective elementary teachers were revealed in Table 23. The coefficients indicate that each of the arithmetic subtests and total achievement of the Stanford Achievement Test revealed significant positive relationships to the number of mathematics content courses completed by prospective elementary teachers. As a result of the coefficients presented, $H_o1(f)$ was rejected.

$H_o1(g)$: There is no significant relationship between the mathematical competence of prospective elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and the number of mathematics methods courses completed.

Coefficients representing the relationships existing between arithmetic achievement and the number of mathematics methods courses completed by prospective elementary teachers were not significant. As a result of the data presented, $H_o1(g)$ was not rejected.

$H_o1(h)$: There is no significant relationship between the mathematical competence of prospective elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and their grade level teaching preference.

An analysis of the data associated with the grade level teaching preference of prospective elementary teachers and their scores on arithmetic achievement were presented in

Table 23. The coefficients representing the relationship between grade level teaching preference and arithmetic computations, concepts, and total achievement were significant at the .05 level of confidence. There was not a significant relationsip between grade level teaching preference and the arithmetic applications subtest of the Stanford Achievement Test. Prospective elementary teachers selecting grades 4-6 as a teaching preference recorded higher scores on the arithmetic achievement tests than their counterparts selecting grades K-3 as their teaching preference. As a result of the findings, $H_o1(h)$ was rejected for arithmetic computations, concepts, and total achievement, however, the hypothesis was not rejected for arithmetic applications.

$H_o1(i)$: There is no significant difference between the mathematical competence of prospective elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and the institution attended (state or independently supported).

In order to test the hypothesis concerned with prospective elementary teacher arithmetic achievement as it relates to the institution they were attending, different statistical techniques were employed.

The prospective elementary teacher sample of 724 was partitioned into a sub-sample of 581 subjects who were attending state supported colleges or universities and a second sub-sample of 143 subjects who were attending independently supported colleges or universities. The mean arithmetic achievement and attitude scores for each sub-sample are calculated and presented in Table 24.

The colleges and universities listed in Table 24 were assigned a coded numeral so that the identity of individual schools within each sub-sample could not be revealed for statistical comparison purposes. An analysis of the data presented in the table indicates that prospective elementary teachers attending independently supported colleges and universities reported composite arithmetic achievement means that were substantially higher than prospective elementary teachers attending state supported colleges and universities.

A t test was used to examine the differences between the arithmetic subtest means for each prospective elementary teacher sub-sample. The statistical findings are presented in Table 25.

An examination of the data exhibited in Table 25 reveals the mean arithmetic achievement scores, differences between the means, and the t test values that resulted from the comparisons made between the arithmetic achievement subtests, total achievement, and attitudes of the prospective

TABLE 24

MEAN ACHIEVEMENT AND ATTITUDE RAW SCORES OF PROSPECTIVE ELEMENTARY TEACHER SAMPLE BY SCHOOL

COLLEGE OR UNIVERSITY	N	COMP.	CONC.	APPL.	TOTAL	ATTITUDE
STATE SUPPORTED						
01	153	28.51	26.22	19.84	74.45	56.14
02	108	31.74	30.30	23.74	85.78	52.94
03	38	16.76	17.16	13.05	46.97	58.76
09	32	26.09	23.72	17.59	67.41	50.78
11	25	29.60	29.60	23.44	82.64	57.00
12	95	33.03	30.94	22.58	86.55	52.14
13	130	32.53	30.33	22.98	85.45	53.69
TOTAL N	581					
MEANS		29.89	28.08	21.30	79.16	54.25
PRIVATELY SUPPORTED						
04	55	29.84	28.47	20.18	78.49	52.04
05	36	33.47	32.64	24.56	90.67	47.69
06	11	29.00	28.36	22.45	79.82	63.36
07	9	32.33	28.67	22.33	88.00	45.89
08	12	32.50	32.42	24.08	89.00	45.75
10	20	32.11	31.21	23.63	88.35	41.85
TOTAL N	143					
MEANS		31.93	30.23	22.40	84.51	49.47

TABLE 25

AN ANALYSIS OF SIGNIFICANT DIFFERENCES BETWEEN THE MEAN ARITHMETIC ACHIEVEMENT AND ATTITUDE SCORES OF PROSPECTIVE ELEMENTARY TEACHERS ATTENDING STATE AND PRIVATE INSTITUTIONS

	PROSPECTIVE TEACHERS ATTENDING STATE INSTITUTIONS N=581	PROSPECTIVE TEACHERS ATTENDING PRIVATE INSTITUTIONS N=143	DIFF.	t
Computations	29.89	31.93	2.04	3.090 **
Concepts	28.08	30.23	2.15	3.981 **
Applications	21.30	22.40	1.10	2.444 *
Total	79.16	84.51	5.35	3.566 **
Attitude	54.25	49.47	4.78	3.083 **

* Significant at the .05 level of confidence
** Significant at the .01 level of confidence

elementary teacher sub-samples. An inspection of the t test values reveals that prospective elementary teachers attending privately supported colleges and universities scored significantly higher on each of the arithmetic subtests than the prospective elementary teachers attending state supported colleges and universities. While there was significant differences between the mean scores of the prospective sample attending state and private institutions, the differences between the mean scores within the state and private groups were much greater. The differences between the mean arithmetic achievement subtests of the prospective elementary teachers attending state colleges and universities ranged from 10.69 to 16.27. The differences between the scores for the same subtests for the prospective elementary teachers attending privately supported institutions, ranged from 4.28 to 4.47. As a result of these finding, $H_o1(i)$ was rejected.

The following hypotheses were related to prospective elementary teachers' attitudes toward mathematics and the variables listed in Table 23. The same format for presenting each hypothesis was used in this section.

$H_o2(a)$: There is no significant relationship between the attitudes toward mathematics of prospective elementary teachers, as measured by the Revised Math Attitude Scale, and sex.

The coefficient representing the relationship between sex and the attitudes toward mathematics of prospective elementary teachers was significant at the .05 level of confidence. As a result, $H_o2(a)$ was rejected.

$H_o2(b)$: There is no significant relationship between the attitudes toward mathematics of prospective elementary teachers, as measured by the Revised Math Attitude Scale, and age.

An analysis of the datum reported, indicated that there was not a significant relationship between the age of prospective elementary teachers and their attitudes toward mathematics. Thus, $H_o2(b)$ was not rejected.

$H_o2(c)$: There is no significant relationship between the attitudes toward mathematics of prospective elementary teachers, as measured by the Revised Math Attitude Scale, and the size of their high school graduating class.

The attitudes toward mathematics of prospective elementary teachers were not significantly related to the size of their high school graduating class. As a result of these findings, $H_o2(c)$ was not rejected.

$H_o2(d)$: There is no significant relationship between the attitudes toward mathematics of prospective elementary teachers, as measured by the Revised Math Attitude Scale, and the number of high school mathematics courses completed.

Prospective elementary teachers that completed a greater number of high school mathematics courses, reported more positive attitudes toward mathematics than those completing fewer courses. As indicated by the coefficient in Table 23, there was a significant positive relationship between the number of high school mathematics courses completed and the prospective elementary teachers' attitudes toward mathematics, hence, the stated hypothesis was rejected.

$H_o2(e)$: There is no significant relationship between the attitudes toward mathematics of prospective elementary teachers, as measured by the Revised Math Attitude Scale, and their academic specialization.

As reported earlier, a more extensive investigation was undertaken concerning the academic specializations selected by prospective elementary teachers. The statistical data pertinent to each specialization were presented in Appendix N.

The correlation coefficients in Appendix N reveal that for each area of academic specialization, except mathematics, there was a significant relationship between the prospective elementary teachers' attitudes toward mathematics and their arithmetic achievement scores. Prospective elementary teachers selecting mathematics as an academic area of specialization did not show a significant relationship between arithmetic computations, applications, and total achievement and attitudes. However, there was a significant relationship between their attitudes toward mathematics and their scores reported for the arithmetic concepts subtest. As a result, H_o2(e) was rejected for all academic specializations except mathematics. The only subtest of arithmetic achievement that was significantly related to the attitudes of prospective elementary teachers selecting mathematics as a specialization, was the arithmetic concepts subtest.

H_o2(f): There is no significant relationship between the attitudes toward mathematics of prospective elementary teachers, as measured by the Revised Math Attitude Scale, and the number of mathematics content courses completed.

Prospective elementary teachers' attitudes toward mathematics were significantly related to the number of college mathematics courses they completed. The portion of the total sample completing a greater number of content courses, reported more positive attitudes toward mathematics. As a result of these findings, H_o2(f) was rejected.

H_o2(g): There is no significant relationship between the attitudes toward mathematics of prospective elementary teachers, as measured by the Revised Math Attitude

Scale, and the number of mathematics methods courses completed.

The correlation coefficient presented in Table 23 did not show a significant relationship between the prospective elementary teachers' attitudes toward mathematics and the number of mathematics methods courses they completed. Thus, $H_o2(g)$ was not rejected.

$H_o2(h)$: There is no significant relationship between the attitudes toward mathematics of prospective elementary teachers, as measured by the Revised Math Attitude Scale, and their grade level teaching preference.

The grade level teaching preference of prospective elementary teachers was significantly related to their attitudes toward mathematics. Subjects selecting to teach in grades 4-6 had more positive attitudes toward mathematics than those subjects selecting to teach in grades K-3. Thus, $H_o2(h)$ was rejected.

$H_o2(i)$: There is no significant relationship between the attitudes toward mathematics of prospective elementary teachers, as measured by the Revised Math Attitude Scale, and the institution they attended (state or privately supported).

An earlier discussion described how the prospective elementary teacher sample was sub-divided into two sub-samples for the purpose of examining the data relating to arithmetic achievement and attitudes. The same division was employed in order to compare the attitudes toward mathemathics of prospective elementary teachers attending state and privately supported colleges and universities. A further investigation of Table 25 revealed that there was a significant difference between the composite mean attitude scores for the sub-sample attending independent institutions as compared with the sub-sample attending state institutions. The prospective elementary teachers attending privately supported colleges and universities had a significantly more positive attitude toward mathematics than prospective elementary teachers attending state supported institutions. While there was significant differences between the means of state and privately supported institutions, a greater difference between the mean attitude scores was observed within each group. As a result of the analysis, $H_o2(i)$ was rejected.

Summary. An analysis of the findings related to the hypotheses tested for the prospective elementary teacher sample, revealed a number of significant relationships. The hypotheses stating that there were no significant relationships between the arithmetic achievement of prospective elementary teachers and the number of high school and college mathematics courses completed, the academic specialization they selected, and the institution they attended, were all rejected. The hypothesis stating that there was no significant relationship between the arithmetic achievement of prospective elementary teachers and the number of methods courses completed was not rejected.

The hypotheses relating to the arithmetic achievement of prospective elementary teachers and their sex, age, size of high school graduating class, and grade level teaching preference were not rejected for all arithmetic subtests. Nine of the 16 coefficients relating to these variables and the arithmetic achievement of prospective elementary teachers were significant.

The hypotheses stating that there were no significant relationships between the attitudes toward mathematics of prospective elementary teachers and sex, the number of high school and college mathematics content courses completed, academic specialization selected, grade level teaching preference, and the institution they attended, were rejected. The hypotheses stating that there were no significant relationship between the attitudes toward mathematics of prospective elementary teachers and their age, size of high school graduating class, and the number of mathematics methods courses completed, were not rejected.

An Analysis of Relationships Among Variables Within the Experienced Elementary Teacher Sample

Testing the Hypotheses. The data related to the experienced elementary teacher sample are presented in Table 26. The correlation coefficients included in the table are the results of an analysis of relationships between arithmetic achievement, attitudes toward mathematics, and selected variables pertinent to the experienced elementary teacher sample. The variables listed within Table 26 were taken from the experienced elementary teacher questionnaire.

For statistical purposes, the experienced elementary teacher sample utilized 282 degrees of freedom for determining the level of confidence for each correlation coefficient. A product-moment "r" of .11 was considered significant at the .05 level of confidence and a product-moment "r" of .15 was significant at the .01 level. The format used for accepting or rejecting the hypotheses discussed earlier, was used in this section.

$H_o3(a)$: There is no significant relationship between the mathematical competence of experienced elementary

TABLE 26

PRODUCT-MOMENT CORRELATION COEFFICIENTS AND THE PRLATIONSHIP BETWEEN ARITHMETIC ACHIEVEMENT, ATTITUDE, AND SELECTED VARIABLES -EXPERIENCED ELEMENTARY TEACHERS-

VARIABLES	COMP.	COMC.	APPL.	TOTAL	ATT.
Sex	.016	-.014	-.030	-.008	.167
Age	-.283**	-.289**	-.181**	-.288**	-.008
H.S. Class Size	.179**	.152**	.139*	.178**	-.045
No. H.S. Math. Courses Completed	.251**	.227**	.200**	.257**	-.343**
Academic Spec.	.034	.077	.091	.071	-.044
No. Math Content	.131*	.172**	.129*	.161**	-.234**
No. Math Methods	.117*	.080	.126*	.120*	-.114*
Prof. Training	-.047	-.102	-.099	-.089	-.070
Teaching Exp.	-.196**	-.250**	-.108	-.212**	.000
Grade Level Assignment	.155**	.138*	.032	.130*	-.156**
No. Math Classes Taught	.153**	.157**	.178**	.180**	-.265
No. of Years Since Last Math Course	-.116*	-.179**	-.030	-.126*	.099

* Significant at the .05 level
** Significant at the .01 level

teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and sex.

An analysis of the data relating to the sex and arithmetic achievement of experienced elementary teachers did not reveal a significant relationship. Thus, $H_o3(a)$ was not rejected.

$H_o3(b)$: There is no significant relationship between the mathematical competence of experienced elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and age.

There was a significant relationship between the age of experienced elementary teachers and their arithmetic achievement. Each subtest produced a coefficient that was significant at the .01 level of confidence. The younger teachers' scores were higher than the older teachers in the sample. As a result of the coefficients presented in Table 26, $H_o3(b)$ was rejected.

$H_o3(c)$: There is no significant relationship between the mathematical competence of experienced elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and the size of their high school graduating class.

An analysis of the data representing the correlations between arithmetic achievement of experienced elementary teachers and the size of their high school graduating class, revealed significant relationships for each subtest. The respondents that were graduated from larger senior classes recorded higher scores in arithmetic achievement than their counterparts graduated from smaller senior classes. Thus H_o3(c) was rejected.

H_o3(d): There is no significant relationship between the mathematical competence of experienced elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and the number of high school mathematics courses completed.

There existed a significant relationship between the number of high school mathematics courses completed and the arithmetic achievement of experienced elementary teachers. Subjects completing the largest number of high school mathematics courses, reported the highest scores on arithmetic achievement. Correlation coefficients reported were significant at the .01 level of confidence, hence, H_o3(d) was rejected.

H_o3(e): There is no significant relationship between the mathematical competence of experienced elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and academic specializations selected.

The data pertinent to the academic specializations selected by experienced elementary teachers, were treated statistically in the same manner as the prospective elementary teacher sample. The academic specialization variable for the experienced elementary teachers was divided into the same seven sub-variables that were described in the preceding section. Each sub-variable was analyzed separately in order to determine the relationships existing between the arithmetic subtests , level of professional training, attitudes toward mathematics, and the academic specializations selected by experienced elementary teachers. The tables providing this data are contained in Appendix O.

A study of the data presented in Appendix O reveals that there were significant relationships between the arithmetic achievement of experienced elementary teachers and each of the academic specializations selected. Experienced elementary teachers selecting Mathematics as an academic specialization, reported the highest mean scores on all of the arithmetic subtests and total achievement. Experienced elementary teachers selecting Art as an academic specialization, recorded the lowest mean scores on two of the three arithmetic subtests and total achievement. Experienced elementary teachers selecting Music as an academic specialization, reported the lowest mean score on the arithmetic subtest involving computational skills. Consequently, H_o3(e) was rejected.

H_o3(f): There is no significant relationship between the mathematical competence of experienced elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and the number of mathematics content courses completed.

Information contained in Table 26 indicates that the coefficients representing the number of mathematics content courses completed by experienced elementary teachers, were significantly related to their arithmetic achievement. Subjects completing a larger number of mathematics content courses reported higher scores on the subtests than those subjects with fewer courses completed. Since each coefficient was significant at the .05 level of confidence, H_o3(f) was rejected.

H_o3(g): There is no significant relationship between the mathematical competence of experienced elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and the number of mathematics methods courses completed.

Significant relationships existed between arithmetic computations and applications subtests and the number of mathematics methods courses completed, however, there were no significant relationships between the arithmetic concepts and total achievement scores and the same variable. As a result, $H_o3(g)$ was rejected for the computations and applications subtests of the Stanford Achievement Test. $H_o3(g)$ was not rejected for arithmetic concepts and total achievement, as they relate to the number of mathematics methods courses completed by the experienced elementary teachers.

$H_o3(h)$: There is no significant relationship between the mathematical competence of experienced elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and their level of professional training.

The data presented in Table 26 revealed that there was no significant relationship between arithmetic achievement of experienced elementary teachers and their level of professional training. In addition, these findings are explicit when interpreting the tables contained in Appendix O. While there were instances of significant relationships between several of the arithmetic subtests and the level of professional training, the findings were inconsistent. As a result, H_o3(h) was not rejected.

H_o3(i): There is no significant relationship between the mathematical competence of experienced elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and the number of years teaching experience.

An analysis of the data revealed that the number of years teaching experience of the experienced elementary teachers, was significantly related to their arithmetic computation, concepts, and total achievement scores. No significant relationship was observed between arithmetic application scores and the number of years teaching experience for the experienced elementary teachers. Subjects with fewer years of teaching experience reported the highest scores on each of the subtests. H_o3(i) was rejected for arithmetic computations, concepts, and total achievement, but was not rejected for the arithmetic applications subtest.

H_o3(j): There is no significant relationship between the mathematical competence of experienced elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and their grade level teaching assignment.

Experienced elementary teachers teaching in grades 4-6, as compared with those teaching in grades K-3, reported the highest arithmetic achievement scores. Significant relationships were reported between arithmetic computation and concept skills and their grade level teaching assignments. There were no significant relationships between arithmetic applications and total achievement and the grade level teaching assignment for experienced elementary teachers. Thus, $H_o3(j)$ was rejected for the arithmetic computations and concepts subtests. The hypothesis was not rejected for the arithmetic applications and total achievement scores.

$H_o3(k)$: There is no significant relationship between the mathematical competence of experienced elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and the number of mathematics classes they teach each day.

The data relevant to this hypothesis were presented in Table 26. An analysis of the coefficients revealed that arithmetic achievement of experienced elementary teachers showed a positive correlation between their achievement and the number of classes in mathematics they taught each day. Thus, $H_o3(k)$ was rejected.

$H_o3(l)$: There is no significant relationship between the mathematical competence of experienced elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, and the number of years that have expired since completing a mathematics content or methods course.

The statistical information contained in Table 26 revealed that there was no significant relationship between the arithmetic applications and total achievement scores of experienced elementary teachers and the number of years since they completed a mathematics content or methods course. there were, however, significant relationships reported between the arithmetic computation and concept skills and the same variable. Thus, $H_o3(1)$ was rejected for the arithmetic computations and concepts subtests, but was not rejected for the applications and total achievement scores.

The following hypotheses tested, were germane to the relationships existing between the experienced elementary teachers' attitudes toward mathematics and the 12 variables previously listed in Table 26 and within the preceding section.

$H_o4(a)$: There is no significant relationship between the attitudes toward mathematics of experienced elementary teachers, as measured by the Revised Math Attitude Scale, and sex.

The coefficients presented in Table 26, representing the relationship between sex and the experienced elementary teachers' attitude toward mathematics, was significant at the .01 level of confidence. Hence, H_o4(a) was rejected.

H_o4(b): There is no significant relationship between the attitudes toward mathematics of experienced elementary teachers, as measured by the Revised Math Attitude Scale, and age.

The hypothesis relating to the age of experienced elementary teachers and their attitudes toward mathematics was rejected. The coefficient of -.008, presented in Table 26, was not sufficient to be significant at the acceptable level of .05 or greater.

H_o4(c): There is no significant relationship between the attitudes toward mathematics of experienced elementary teachers, as measured by the Revised Math Attitude Scale, and the size of their high school graduating classes.

As indicated in Table 26, the coefficient related to this hypothesis was not significant at the .05 level of confidence. Hence, H_o4(c) was not rejected.

H_o4(d): There is no significant relationship between the attitudes toward mathematics of experienced elementary teachers, as measured by the Revised Math Attitude Scale, and the number of high school mathematics courses they completed.

An analysis of the datum presented in Table 26 revealed a coefficient value of -.343, which represents the correlation between the experienced elementary teachers' attitudes toward mathematics and the number of high school mathematics courses they completed. There existed a positive relationship between their attitudes and their high school mathematics background. The coefficient was significant at the .01 level, therefore, the hypothesis was rejected.

$H_o4(e)$: There is no significant relationship between the attitudes toward mathematics of experienced elementary teachers, as measured by the Revised Math Attitude Scale, and their academic area of specialization.

The relationship existing between the academic specialization selected by experienced elementary teachers and their attitudes toward mathematics was not significant. The tables presented in Appendix O revealed that while some correlation coefficients appearing in each academic specialization were significant, the coefficient reported for the composite of the specializations was not. Thus, $H_o4(e)$ was not rejected.

$H_o4(f)$: There is no significant relationship between the attitudes toward mathematics of experienced elementary teachers, as measured by the Revised Math Attitude Scale, and the number of mathematics content courses completed by each subject.

The number of college mathematics content courses completed by experienced elementary teachers was significantly related to their attitudes toward mathematics. This was shown in Table 26 where a coefficient of -.234 can be observed. Respondents completing a greater number of content courses reported a more positive attitude toward mathematics. Thus, $H_o4(f)$ was rejected.

$H_o4(g)$: There is no significant relationship between the attitudes toward mathematics of experienced elementary teachers, as measured by the Revised Math Attitude Scale, and the number of mathematics methods courses they completed.

In contrast to the prospective elementary teacher sample, experienced elementary teachers showed a significant relationship between their attitudes toward mathematics and the number of mathematics methods courses they completed. A coefficient of -.114 was significant at the .05 level of confidence, therefore, the hypothesis was rejected.

H_o4(h): There is no significant relationship between the attitudes toward mathematics of experienced elementary teachers, as measured by the Revised Math Attitude Scale, and their level of professional training.

The level of professional training for experienced elementary teachers was not significantly related to their attitudes toward mathematics. This was substantiated by the correlation coefficients reported in the tables in Appendix O and by the -.070 coefficient listed in Table 26. As a result of these findings, H_o4(h) was not rejected.

H_o4(i): There is no significant relationship between the attitudes toward mathematics of experienced elementary teachers, as measured by the Revised Math Attitude Scale, and the number of years teaching experience.

There was no significant relationship between the experienced elementary teachers' number of years of teaching experience and their attitudes toward mathematics, as revealed in Table 26. Thus, H_o4(i) was not rejected.

H_o4(j): There is no significant relationship between the attitudes toward mathematics of experienced elementary teachers, as measured by the Revised Math

Attitude Scale, and the number of classes in mathematics they teach each day.

As revealed by the datum presented in Table 26, a significant relationship existed between the experienced elementary teachers' attitudes toward mathematics and the number of mathematics classes they taught each day. Teachers assigned to teach more courses in mathematics each day had a more positive attitude toward mathematics than those respondents teaching fewer courses in mathematics. The coefficient was significant at the .01 level of confidence, therefore the hypothesis was rejected.

$H_o4(k)$: There is no significant relationship between the attitudes toward mathematics of experienced elementary teachers, as measured by the Revised Math Attitude Scale, and their grade level teaching assignment.

There was a significant relationship , at the .01 level, between the grade level teaching assignments of experienced elementary teachers and their attitudes toward mathematics. Experienced elementary teachers assigned to teach in grades 4-6 reported more positive attitudes toward mathematics than their counterparts assigned to teach in grades K-3. As a result, the stated hypothesis was rejected.

$H_o4(1)$: There is no significant relationship between the attitudes toward mathematics of experienced elementary teachers, as measured by the Revised Math Attitude Scale, and the number of years expiring since they completed a mathematics content or methods course.

The number of years that had expired since experienced elementary teachers had completed a course in mathematics content or methods, did not show a significant relationship to their attitudes toward mathematics. The coefficient of .099 was not significant at the .05 level of confidence, thus the hypothesis was not rejected.

Summary. An analysis of the data regarding experienced elementary teachers' arithmetic achievement, attitudes toward mathematics, and certain variables taken from the experienced elementary teacher questionnaire, revealed that approximately one-half of the hypotheses stated, were rejected. The hypotheses testing the significant relationship between arithmetic achievement and age, size of high school graduating class, the number of high school and college mathematics courses completed, and the number of mathematics classes taught each day, were all significant, therefore each hypotheses was rejected.

The hypotheses testing arithmetic achievement of experienced elementary teachers and their sex, and level of professional training, was not rejected. The hypotheses relating to the number of mathematics methods courses completed, the number of years since completing a mathematics content or methods course, the number of years teaching experience, and the grade level teaching assignments of experienced elementary teachers and their arithmetic achievement, showed significant relationships between these variables and certain arithmetic subtests, however, not all coefficients were significant.

The hypotheses testing relationships between the experienced elementary teachers' attitudes toward mathematics and sex, the number of high school and college mathematics courses completed, grade level teaching assignments, and the number of mathematics classes taught each day, were significant at the .01 level. As a result, each hypothesis was rejected. The hypotheses testing the relationships between experienced elementary teachers' attitude toward mathematics and their age, size of high school graduating class, level of professional training, number of years teaching experience, and the number of years expiring since completing a mathematics content or methods course, were not rejected.

Differences Observed Between the Prospective and Experienced Elementary Teachers' Arithmetic Achievement and Attitudes Toward Mathematics

The data presented in Tables 27 through 31 represent the mean arithmetic achievement and attitude scores of the prospective and experienced elementary teacher samples. Each table lists the mean arithmetic achievement and attitude scores by school, and the standard deviations for each subtest. The tests of significant differences between the means of two independent samples were presented in Tables 29 and 31.

Testing the Hypotheses. The same format discussed earlier was used to test the hypotheses relating to prospective and experienced elementary teachers' arithmetic achievement and attitudes toward mathematics. Each hypothesis was stated, data relevant to the hypothesis were presented, and the hypothesis was accepted or rejected at the .05 level of confidence.

H_o5: There is no significant difference between the mathematical competence of the prospective and experienced elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test.

The data presented in Table 29 represents the mean arithmetic computations, concepts, applications, and the total arithmetic achievement scores for the prospective and experienced elementary teacher samples. The difference between the means of the prospective and experienced elementary samples, for each arithmetic subtest, was computed and a t test was used in order to check the mean differences for significance.

An analysis of the differences and t values presented in Table 29 reveals that there was no significant difference between the mathematical competence of prospective and experienced elementary teachers, as measured by the arithmetic computation and concepts subtests and the total achievement scores of the Stanford Achievement Test. As a result of these findings, H_o5 is not rejected for these same areas of arithmetic achievement.

The data related to the arithmetic application mean scores for prospective and experienced elementary teachers, were presented in Table 29. An examination of the differences in mean application scores revealed a t value of 4.700, consequently the differences were significant at the .01 level of confidence. As a result, the hypothesis relating to the mathematical competence of prospective and experienced elementary teachers, as measured by the arithmetic subtest

TABLE 27

MEAN RAW SCORES AND STANDARD DEVIATIONS FOR THE PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHER SAMPLES BY SCHOOL

SCHOOL CODE	ARITHMETIC COMPUTATION	S.D.	ARITHMETIC CONCEPTS	S.D.
COLLEGE OR UNIVERSITY				
01	28.51	7.71	26.22	6.72
02	31.74	7.21	30.30	5.72
03	16.76	7.36	17.16	5.87
04	29.84	8.01	28.47	6.50
05	33.47	5.54	32.64	4.87
06	29.00	8.60	28.36	5.28
07	32.33	7.75	28.67	7.41
08	32.50	5.55	32.42	3.90
09	26.09	7.80	23.72	7.16
10	32.11	8.53	31.21	6.01
11	29.60	8.46	29.60	5.08
12	33.03	6.77	30.94	5.08
13	32.53	7.05	30.33	6.23
SAMPLE MEANS	30.19	8.25	28.50	7.00
ELEMENTARY SCHOOL				
20	31.48	6.92	29.52	6.92
21	30.45	5.38	27.60	6.04
22	27.79	9.22	25.71	6.01
23	25.86	9.36	26.14	7.21
24	32.38	6.10	30.29	5.57
25	30.35	7.88	28.19	7.75
26	31.13	6.98	27.00	6.56
27	27.13	8.55	27.43	5.87
28	30.58	8.77	29.30	6.74
29	31.20	5.06	28.60	4.18
SAMPLE MEANS	30.11	7.95	28.26	6.64

TABLE 28

MEAN RAW SCORES AND STANDARD DEVIATIONS FOR THE PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHER SAMPLES BY SCHOOL

SCHOOL CODE	ARITHMETIC APPLICATIONS	S.D.	ARITHMETIC TOTALS	S.D.
COLLEGE OR UNIVERSITY				
01	19.84	4.48	74.45	16.74
02	23.74	5.04	85.78	16.19
03	13.05	4.87	46.97	15.98
04	20.18	6.21	78.49	17.75
05	24.56	3.44	90.67	12.02
06	22.45	3.99	79.82	16.69
07	22.33	5.14	88.00	14.46
08	24.08	5.02	89.00	11.96
09	17.59	5.71	67.41	19.43
10	23.63	3.70	88.35	17.63
11	23.44	5.40	82.64	18.16
12	22.58	5.33	86.55	14.95
13	22.98	5.57	85.45	18.01
SAMPLE MEANS	21.51	5.76	80.20	19.31
ELEMENTARY SCHOOL				
20	25.48	6.07	86.48	18.16
21	25.40	5.73	83.45	14.99
22	23.46	6.04	76.96	17.40
23	20.68	6.49	72.68	21.91
24	23.91	4.02	86.58	13.30
25	22.74	5.72	81.29	18.63
26	22.74	5.44	80.87	17.03
27	21.61	4.45	76.17	16.63
28	23.77	5.39	83.66	19.80
29	23.70	4.82	83.50	11.38
SAMPLE MEANS	23.39	5.55	81.76	17.97

TABLE 29

AN ANALYSIS OF SIGNIFICANT DIFFERENCES BETWEEN THE MEANS OF ARITHMETIC ACHIEVEMENT SCORES OF PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHERS

	PROSPECTIVE ELEMENTARY TEACHERS N=724	EXPERIENCED ELEMENTARY TEACHERS N=284	DIFF.	t
Computations	30.19	30.11	0.08	0.140
Concepts	28.50	28.26	0.24	0.500
Applications	21.51	23.39	1.88	4.700 **
Total	80.20	81.76	1.56	1.181

** Significant at the .01 level

for applications on the Stanford Achievement Test, Advanced Battery, was rejected.

H_o6: There is no significant difference between the attitudes toward mathematics of prospective and experienced elementary teachers, as measured by the Revised Math Attitude Scale.

The mean attitude scores and standard deviations recorded for each college, university, and elementary school, are presented in Table 30. The description of the sample and the statistical techniques utilized for testing the mean differences between the attitudes toward mathematics of prospective and experienced elementary teachers, were discussed in the preceding section.

The mean attitude scores of the prospective and experienced elementary teacher samples, the difference observed between the mean attitude scores, and the t value establishing whether or not the difference was significant, are presented in Table 31.

An investigation of the data contained in Table 31, reveals that there was a significant difference between the attitudes toward mathematics of prospective and experienced elementary teachers, as measured by the Revised Math Attitude Scale. The experienced elementary teacher scores were significantly more positive than the scores reported by the prospective elementary teachers sample. As a result, H_o6 was rejected.

Summary. The statistical information germane to the mathematical competence of prospective and experienced elementary teachers revealed that there was no significant differences

TABLE 30

MEAN RAW SCORES AND STANDARD DEVIATIONS FOR THE PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHER SAMPLES BY SCHOOL

SCHOOL CODE	ATTITUDE SCORES	S.D.
COLLEGE OR UNIVERSITY		
01	56.14	17.68
02	52.94	18.19
03	58.76	16.09
04	52.04	18.53
05	47.69	18.69
06	63.36	11.62
07	45.89	8.86
08	45.75	14.70
09	50.78	18.98
10	41.85	18.09
11	57.00	18.65
12	52.14	16.80
13	53.69	16.32
SAMPLE MEAN	53.45	17.68
ELEMENTARY SCHOOL		
20	49.16	17.28
21	43.35	20.13
22	55.17	15.70
23	50.36	18.12
24	50.33	16.35
25	45.26	20.86
26	49.71	17.03
27	61.52	19.54
28	43.66	14.74
29	58.00	16.39
SAMPLE MEANS	49.81	18.22

TABLE 31

ANALYSIS OF SIGNIFICANT DIFFERENCES
BETWEEN MEANS OF PROSPECTIVE AND EXPERIENCED
ELEMENTARY TEACHERS' ATTITUDE TOWARD ARITHMETIC

	NUMBER OF SUBJECTS	MEAN SCORES	DIFFERENCE	t
Prospective Elementary Teachers	724	53.45		
Experienced Elementary Teachers	284	49.81	3.64	2.912 **

** Significant at the .01 level

between the arithmetic computation and concepts subtests and the total achievement scores of the prospective and experienced elementary teachers. In contrast, the difference between the mean arithmetic application scores of prospective and experienced elementary teachers, as measured by the arithmetic subtests of the Stanford Achievement Test, was significant, with the experienced elementary teachers attaining the higher scores. In addition, the difference between the attitudes of prospective and experienced elementary teachers was significant at the .01 level of confidence, with the experienced elementary teachers having a more positive attitude toward mathematics.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The problem of this study was to investigate the mathematical attitudes and competence of prospective and experienced elementary teachers. The investigation consisted of two primary comparisons: (a) a comparison of the mathematical competencies of prospective and experienced elementary teachers, and (b) a comparison of the attitudes towards mathematics of prospective and experienced elementary teachers. In addition, the study investigated a number of variables and their relationship to mathematical attitudes and competencies of prospective and experienced elementary school teachers.

The purpose of the study was: (a) to determine if there was a significant relationship between the mathematical attitudes and competencies of prospective and experienced elementary teachers and related variables germane to both samples; (b) to determine if there was a significant difference between the mathematical achievement of prospective and experienced elementary teachers; and (c) to determine if there was a significant difference between the attitudes toward mathematics of both samples.

Mathematical achievement of prospective and experienced elementary teachers was measured by the arithmetic subtests of the Stanford Achievement Test, Advanced Battery, Form X. Product-moment correlation coefficients were used to determine the degree of relationship existing between the mathematical attitudes and competencies of prospective and experienced elementary teachers and the related variables. Prospective and experienced elementary teachers' attitudes toward mathematics were measured by the Revised Math Attitude Scale.

The study was based on a sample of 724 prospective and 284 experienced elementary teachers in the State of Texas during the 1972 Spring Semester. The prospective elementary teacher population was randomly selected from thirteen Texas colleges and universities with approved programs in elementary education. Of the thirteen institutions, seven were state supported and six were privately supported.

The experienced elementary teacher sample was randomly selected from ten suburban elementary schools (K-6) in the Greater Houston Area. The study was conducted over a period of four months during the 1972 Spring Semester.

The prospective and experienced elementary teacher samples provided the source of data for the study. The four instruments used to obtain the data were: (a) a 15 item prospective elementary teacher questionnaire; (b) a 19 item experienced elementary teacher questionnaire; (c) the arithmetic subtests of the Stanford Achievement Test; and (d) the Revised Math Attitude Scale.

The statistical techniques used for analyzing the data were product-moment correlations and the t test for examining the difference in means between two independent samples. If the product-moment coefficients and t test values were significant at the .05 level of confidence, the null hypothesis was rejected, otherwise the null hypothesis was not rejected.

Conclusions

An analysis of the data obtained from the prospective and experienced elementary teacher questionnaires revealed a number of facts pertinent to both samples. Respondents from both samples reported similar responses in the areas of sex, size of high school graduating class, high school mathematics courses completed, academic area of specializations, and college mathematics content courses completed.

Approximately 95 per cent of the prospective and experienced elementary teachers were female. The most common sizes of high school graduating classes for all respondents were classes of 51-150 and classes of over 450. In addition, the prospective elementary teachers completed a mean number of 3.65 high school mathematics courses as compared to a mean of 3.80 for the experienced elementary teachers.

Both samples selected Language Arts as the first and Social Studies as the second most common areas of academic specializations. Science and Music were the least selected academic specializations for the experienced elementary teachers.

An inspection of Table 6 revealed that approximately 12 per cent (119 respondents) in both samples did not complete a single college mathematics content course. Prospective elementary teachers (26.1 per cent) completed one course as compared to 36.3 per cent of the experienced elementary teachers. Thirty-seven per cent of the prospective elementary teachers completed two courses as compared to 26.1 per cent of the experienced elementary teachers. Approximately 75 per cent of both samples had completed two or fewer courses in college mathematics content. These statistics are especially important when considering the number of elementary school children that may be affected by those prospective and experienced elementary teachers that did not take a single course in college mathematics.

Significant positive correlations between the number of college mathematics courses completed and the prospective and experienced elementary teachers' arithmetic achievement was revealed in Tables 23 and 26. Respondents that completed a greater number of mathematics courses reported higher scores on the arithmetic subtests, than those respondents with fewer courses.

Nafziger (1961) concluded that there was no significant difference between students completing one course in college mathematics and those completing none, however, there was a significant difference between those completing one and those completing two or more. In a study of 317 elementary education students at Wayne State University, Carroll (1961) reported no significant relationship existing between mathematics understandings and the number of high school or college level mathematics courses studied.

The findings of this study are not in agreement with the results reported by Carroll. Data reported for this study, concerning prospective and experienced elementary teachers' arithmetic achievement and attitudes toward mathematics, seem to agree with other research studies conducted within recent years. Gilbert (1966) reported that a stronger high school and college background in mathematics produced a fuller understanding of arithmetic. Withnell (1967) tested a sample of 2,513 elementary education majors and concluded that students attaining the highest mean on the arithmetic test had completed more mathematics.

Contrasting data were revealed by both samples in terms of age and number of mathematics methods courses completed. As would be expected, the largest percentage of prospective elementary teachers (73.9) fell within the youngest age group of 18-24 years of age. It was noted that 70.5 per cent of the experienced elementary teacher sample was under 35 years of age, while only 8.4 per cent were over 45 years of age.

Experienced elementary teachers completed a greater number of mathematics methods courses than the prospective elementary teachers. The experienced elementary teachers (23.6 per cent) had completed two or more methods courses as compared to 10.6 per cent for the prospective elementary teachers. Since the experienced elementary teacher questionnaire did not distinguish between undergraduate and graduate mathematics methods courses, it was possible that the 23.6 per cent represented a composite of all levels of mathematics methods courses completed. It should, however, be noted that 18.5 per cent of the prospective and 22.5 per cent of the experienced elementary teachers did not complete a course in methods of teaching elementary school mathematics.

Prospective elementary teachers indicated that not only did the mathematics methods courses have a positive influence on their attitudes toward mathematics, but provided them with the necessary background for teaching arithmetic in the elementary grades. In contrast, experienced elementary teachers felt that mathematics content courses had a positive influence on their attitudes toward mathematics, but felt that both mathematics content and methods courses provided an equal background necessary for teaching arithmetic in the elementary grades.

The majority of prospective elementary teachers preferred teaching in grades K-3 as opposed to grades 4-6. Approximately 55 per cent of the experienced elementary teachers reported that their teaching assignments were in grades K-3 as opposed to grades 4-6. This does not mean, however, that the grade level to which they were assigned was their choice.

An analysis of the data presented in Table 17 revealed that 2.5 per cent of the sample had not completed degree requirements for a Bachelor's Degree. Of the 284 experienced elementary teachers, 277 (97.5 per cent) had been awarded the Bachelor's Degree, and one-fifth (57 subjects) had been awarded the Master's Degree, and one (0.4 per cent) had been awarded the Doctorate. Experienced elementary teachers that were certified to teach in Texas, accounted for 92.6 per cent of the sample. Over one-half of the sample had five or less years of teaching experience and approximately 30 per cent of the total sample did not teach a single class in arithmetic.

In order to measure the mathematical competence of prospective and experienced elementary teachers, an arithmetic achievement test was administered to each subject. The three arithmetic subtests of the Stanford Achievement Test were given with the following results:

On the 41 item arithmetic computation subtest, the prospective and experienced elementary teachers obtained a mean raw score of 30 correct or approximately 73 per cent. Both samples obtained a mean raw score of 28 correct or approximately 71 per cent on the 40 item arithmetic concept test. Prospective elementary teachers answered correctly approximately 60 per cent of the 36 item arithmetic application test while experienced elementary teachers answered correctly approximately 65 per cent of the same test. Prospective and experienced elementary teachers answered correctly approximately 69 and 70 per cent, respectively, of the 117 item total arithmetic achievement test.

The results of this study are more encouraging than those reported by Fulkerson (1960) in his study of 158 prospective and experienced elementary teachers in 1955. Fulkerson reported that on a 40 item arithmetic test, prospective elementary teachers attained a mean raw score of 17.9 while the experienced elementary teachers had a mean raw score of 25.6 items correct. Results of this study, like Fulkerson's, indicate that experienced elementary teachers answered correctly a larger percentage of the items than did the prospective elementary teachers.

The raw scores of both samples on the total achievement test (117 items) ranged from a low of 19 to a high of 116. These scores were in agreement with other studies that investigated prospective and experienced elementary teacher competence in mathematics. Creswell (1967) reported a range in raw scores of four to 112 on a 120 item arithmetic test given to 1,075 elementary school teachers in 1965. Approximately 67 per cent of the 1,075 teachers achieved a raw score of 65 or less, with a mean score of 56.31.

The total achievement test scores for prospective and experienced elementary teachers in this study did not differ greatly from the results reported by Bean (1959). Bean reported a mean raw score of 52.46 or approximately 65 per cent items correct on an 80 item test. A mean score of approximately 81 was achieved by prospective and experienced elementary teachers in this study, thus the total per cent correct of 68.54 on the 117 item arithmetic achievement test was quite similar to that reported by Bean.

Achievement subtest scores were converted to grade scores and percentile ranks in order to compare prospective and experienced elementary teacher performance with a standardized population. When comparing both samples to the sixth and seventh grade norms, their scores were sufficiently high enough to place them in the ninety to ninety-eight percentile range. However, when these same grade scores were compared to the eighth and ninth grade norms, they were ranked in the seventy and sixty percentile ranges, respectively.

The product-moment correlation coefficients presented within Tables 23 and 26 were the results of analyzing the relationships existing between the prospective and experienced elementary teachers' scores on the arithmetic subtests of the Stanford Achievement Test, their attitudes toward mathematics, and the variables taken from the prospective and experienced elementary teacher questionnaires. The variables listed for the prospective elementary teachers were:

(a) sex;

(b) age;

(c) size of high school graduating class;

(d) number of high school mathematics courses completed;

(e) academic specialization selected;

(f) number of mathematics content courses completed;

(g) number of mathematics methods courses completed; and

(h) grade level teaching preference.

The variables listed for the experienced elementary teachers were the same as those listed for the prospective elementary teachers, however, additional information was needed in the following areas in order to completed the statistical analysis for the experienced elementary teacher sample. The additional variables were:

(i) level of professional training;

(j) number of years of teaching experience;

(k) grade level teaching assignment;

(l) number of mathematics classes taught each day; and

(m) number of years since completing a mathematics content or methods course.

There were significant positive relationships found between all of the arithmetic achievement subtests and the attitudes toward mathematics of the prospective and experienced elementary teachers, and the number of mathematics courses completed in high school and in college. Results contrasting to those presented here were summarized by

Phillips (1953) when he concluded that: elementary and high school mathematics completed give little indication of the achievement in meaning, understanding, and mechanical mastery. This was evidenced by the fact that 98 per cent of the sample had completed high school Algebra and 91 per cent had completed high school geometry, and yet their achievement in the meaning and understanding of arithmetic was extremely low.

There was a significant positive relationship found between all of the arithmetic achievement subtests and the attitudes toward mathematics of the prospective elementary teachers, and their academic specialization selected. Since the academic specialization variable was composed of seven sub-variables, it was necessary to analyze more completely, each component for purposes of discussion. Prospective elementary teachers selecting Mathematics as an academic specialization, attained the highest mean scores on each of the three arithmetic subtests, total achievement, and attitudes toward mathematics. Prospective elementary teachers selecting Art as an academic specialization reported the lowest mean scores on each of the tests mentioned previously. There was no significant relationship found between the experienced elementary teachers' arithmetic achievement and attitude scores and their academic specialization.

Significant relationships were reported between all of the arithmetic subtests (except computation skills for the prospective elementary teachers) and age, and the size of high school graduating class for the prospective and experienced elementary teachers, and between all of the arithmetic subtests and the number of mathematics classes taught each day for the experienced elementary teachers. Younger experienced elementary teachers were more competent in arithmetic achievement, than the older experienced elementary teachers. In addition, those respondents that had graduated from larger high school senior classes and those teaching the larger number of mathematics classes each, were the more competent experienced elementary teachers. Similar results were reported by Orleans and Wandt (1953) in 1951. It was their conclusion that teachers of mathematics and arithmetic demonstrated a slightly better understanding of arithmetic than did the group of teachers that did not teach mathematics or arithmetic.

Arithmetic computations, concepts, and total achievement, were significantly related to the grade level teaching preference of prospective elementary teachers. Prospective elementary teachers selecting grades 4-6 as a teaching preference reported higher scores on arithmetic achievement than their counterparts selecting grades K-3 as their teaching preference. The remaining variables (sex, size of high school graduating class, and the number of mathematics methods courses completed) were not significantly related to arithmetic computational skills for prospective elementary teachers.

Prospective elementary teachers' arithmetic application scores were significantly related to their sex and size of high school graduating class. Male prospective elementary teachers and graduates from large high school graduating classes, reported higher scores than the female prospective elementary teachers and graduates from small high school graduating classes. In addition, there was no significant relationship recorded between age, number of mathematics methods courses completed, grade level teaching preference, and arithmetic application skills.

Total arithmetic achievement was significantly related to the size of high school graduating class of prospective elementary teachers. Graduates from large high school graduating classes, were the more competent in total arithmetic achievement.

Prospective and experienced elementary teachers' attitude toward mathematics was found to be significantly related to sex and the grade level teaching assignment . Prospective and experienced elementary teachers that possessed a more positive attitude toward mathematics were males planning to teach in grades 4-6. Kane (1968) reported that there was a clear difference between the attitudes of students preferring to teach in grades K-3 and those wanting to teach in grades 4-6. Prospective elementary teachers in the 4-6 grade groups reported higher attitude scores than did those in the K-3 group. It was also reported that prospective elementary teachers possessing unfavorable attitudes toward mathematics, preferred teaching assignments in the primary grades while teachers with positive attitudes toward mathematics, preferred the intermediate grades. Attitudes toward mathematics of prospective and experienced elementary teachers were found not to be significantly related to age and the size of high school graduating class.

The level of professional training of experienced elementary teachers was found to be not significantly to their arithmetic achievement. Arithmetic computations, concepts, and total achievement were significantly related to the number of years of teaching experience, grade level teaching assignment, and number of years since completing a course in mathematics content or methods. Those same variables were not significantly related to arithmetic applications.

The number of methods courses completed by experienced elementary teachers, unlike the prospective elementary teacher sample, was significantly related to all areas of arithmetic achievement except the concept skills. As previously discussed, this may have been the result of some experienced elementary teachers having completed mathematics methods courses at the graduate level.

Experienced elementary teachers' attitudes toward mathematics was significantly related to the number of mathematics methods courses completed and the number of classes in mathematics taught each day, however, there were no significant relationships found between the experienced elementary teachers' attitudes toward mathematics, age, size of high school graduating class, academic specialization, level of professional training, number of years teaching experience, and the number of years since completing a course in mathematics content or methods. Prospective elementary teachers' attitudes toward mathematics were not significantly related to age, size of high school graduating class, and the number of mathematics methods courses completed. These results are similar to those reported by Stright (1960). Stright concluded that the teachers' educational background, recent training, years of teaching experience, and age, seemed to make no significant difference in his attitude toward the teaching of arithmetic.

In order to check for significant difference between the arithmetic achievement and attitudes toward mathematics of prospective and experienced elementary teachers, the t test was used to test the difference between the means of independent samples. The .05 level of confidence was used for accepting or rejecting each null hypothesis.

An examination of Table 25 revealed that prospective elementary teachers attending privately supported colleges and universities, scored significantly higher on each of the arithmetic subtests, than the prospective elementary teachers attending state supported colleges and universities. In addition, their attitudes toward mathematics were significantly more positive.

The data revealed in Table 29, indicated that there were no significant differences between the computation, concepts, and total arithmetic achievement scores of prospective and experienced elementary teachers. Experienced elementary teachers, however, did score significantly higher in arithmetic applications than the prospective elementary sample.

Significant differences between the attitude scores of prospective and experienced elementary teachers were revealed in Table 31. Experienced elementary teachers' attitudes toward mathematics were significantly more positive than the prospective elementary teachers.

It may be concluded that experienced elementary teachers score significantly higher in arithmetic applications and have significantly more positive attitudes toward mathematics, than the prospective elementary teachers. There was no significant difference between the prospective and experienced elementary teacher scores on the arithmetic computations, concepts, and total achievement in arithmetic. In addition, prospective elementary teachers attending private institutions, have significantly more positive attitudes toward mathematics and score significantly higher on arithmetic achievement, than those prospective elementary teachers attending state supported colleges and universities. It should be pointed out that while many of the product-moment correlations were statistically significant at the .05 and .01 levels, most of the coefficients were low in size and indicate only minor or weak trends.

While there are many variables that may affect prospective and experienced elementary teachers' arithmetic achievement and attitudes toward mathematics, there are several that have more predominant influence than others. The number of high school and college mathematics courses completed appear to be the most dominant factors in determining arithmetic achievement and causing positive attitudes toward mathematics. The size of high school graduating class and grade level teaching preference appear to be other influencing factors in determining attitudes toward mathematics and arithmetic achievement.

<u>Recommendations</u>

The following recommendations are made on the basis of the conclusions of the study. As revealed in Chapter Four, there are a number of variables that play significant roles in determining prospective and experienced elementary teachers' attitudes toward mathematics and their competence in mathematics. Since the number of high school and college mathematics courses completed appear to be the best predictors of arithmetic achievement and appear to be the greatest influencing factors in shaping positive attitudes toward mathematics, the following recommendations are concerned with the mathematics curricula. Accordingly, the following reccommendations are proposed:

1. It is recommended that minimum high school mathematics requirements be established as a prerequisite for admission into elementary education programs at all state and private colleges and universities in Texas that have approved programs leading to a certificate in elementary education. In view of the conclusions reached in this

study, as well as in others, students who have studied mathematics the most, usually do better on arithmetic achievement. If high school students considering a career in teaching in the elementary grades were made aware of minimum mathematics requirements for such programs, high school graduates may be better prepared to cope with the college level mathematics requirements for elementary education majors. This may be accomplished in several ways, however, two solutions are proposed here: (a) establish a minimum required number of high school credits or units in mathematics for admission into the elementary education programs. The required mathematics courses must be selected from a list of mathematics courses recommended for college bound students; or (b) establish a minimum acceptable score on the mathematics section of the college admissions test required for all entering freshmen at Texas colleges and universities.

2. It is recommended that all state and private colleges and universities establish a minimum mathematics requirement for all prospective elementary teachers. An investigation of the general information catalogs of state and private colleges and universities, reveal that a number of institutions do not require a single college course

in mathematics for elementary education majors. It would appear that by implementing a minimum mathematics requirement for all elementary education majors, the level of mathematics competence of prospective teachers would increase significantly. In addition, it is strongly recommended that all colleges and universities place a high priority on satisfying the CUPM Level I recommendations discussed in Chapter I.

3. On the basis of the results of the study that indicated that there was a significant positive correlation between the number of mathematics methods courses completed by experienced elementary teachers and their mathematics achievement, it is recommended that state and private institutions in the State of Texas, with approved programs leading to a certificate in elementary education, offer a required mathematics methods course that must be completed by all prospective elementary teachers. The structure of the methods course should include content that not only reinforces, but supplements the material introduced in mathematics content courses designed for prospective elementary teachers. In addition, field experiences should be made an integral part of the course structure, to insure that the prospective

elementary teachers are provided with actual classroom experiences to reinforce the learning activities provided during the course of study of mathematics methods. The emphasis of the course should be on the methods of teaching elementary school arithmetic and utilizing manipulative materials, and not on the teaching of mathematics content that should have been mastered in other courses.

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APPENDICES

APPENDIX A

TEXAS COLLEGES AND UNIVERSITIES WITH APPROVED PROGRAMS IN ELEMENTARY EDUCATION AND NUMBER OF 1970 GRADUATES*

STATE COLLEGES-UNIVERSITIES		INDEPENDENT COLLEGES-UNIVERSITIES	
Angelo State U.	77	Abilene Christian College	95
East Texas State U	291	Austin College	16
Lamar University	189	Baylor University	173
Midwestern U.	58	Bishop College	40
North Texas State U.	406	Dallas Baptist College	18
Pan American College	142	Dominican College	19
Prairie View A&M	150	East Texas Baptist	24
Sam Houston State U.	238	Hardin-Simmons U.	54
Southwest Texas State U.	357	Houston Baptist College	43
Stephen F. Austin U.	355	Howard Payne College	50
Sul Ross State U.	85	Huston-Tillotson College	19
Tarleton State College	83	Incarnate Word College	86
Texas A&I U.	258	Jarvis Christian College	8
Texas A&M U.	53	McMurray College	55
Texas Southern U.	103	Mary Hardin-Baylor Col.	56
Texas Tech U.	258	Our Lady of the Lake	83
Texas Woman's U.	91	St. Edward's U.	7
U. of Texas-El Paso	207	St. Mary's U.	37
U. of Texas-Austin	458	Southern Methodist U.	190
U. of Houston	275	Southwestern U.	20
West Texas State U.	171	Texas Christian U.	99
		Texas Luthern College	30
		Texas Wesleyan College	108
		Trinity University	45
		U. of Dallas	19
		U. of St. Thomas	9
		Wayland Baptist College	21
		Wiley College	26
TOTALS	4,305		1,450

* There were 5,755 elementary education majors graduated from the 21 state supported and 28 independently supported colleges and universities during the 1969-70 academic year.

APPENDIX B

COMMITTEE ON THE UNDERGRADUATE PROGRAM
IN MATHEMATICS LEVEL I RECOMMENDATIONS

As a prerequisite for the college training of elementary-school teachers, we recommend at least two years of college preparatory mathematics, consisting of a year of algebra and a year of geometry, or the same material in integrated courses. It must also be assured that these teachers are competent in the basic techniques of arithmetic. The exact length of the training program will depend on the strength of their preparation. For their college training, it is recommended the equivalent of the following:

(a) A course or a two-course sequence devoted to the structure of the real number system and its subsystems.

(b) A course devoted to the basic concepts of algebra.

(c) A course in informal geometry.

The material in these courses might, in a sense, duplicate material studied in high school by the prospective teachers, but it is recommended that this material be covered again, this time from a more sophisticated, college-level point of view.

Whether the material suggested in (a) above can be covered in one or two courses will clearly depend upon the previous preparation of the student.

It is strongly recommended that at least 20 per cent of the Level I teachers [teachers of elementary-school mathematics] in each school have stronger preparation in mathematics, comparable to Level II [teachers of the elements of algebra and geometry] preparation, but not necessarily including calculus. Such teachers would strengthen the elementary program by their very presence within the school faculty. This additional preparation is certainly required for elementary teachers who are called upon to teach an introduction to algebra or geometry.

APPENDIX C

TEXAS COLLEGES AND UNIVERSITIES THAT COMPRISE THE POPULATION OF THE STUDY AND THE NUMBER OF PARTICIPATING PROSPECTIVE ELEMENTARY TEACHERS AT EACH INSTITUTION

STATE COLLEGES-UNIVERSITIES		INDEPENDENT COLLEGES-UNIVERSITIES	
North Texas State U.	108	Houston Baptist College	12
Prairie View A&M	38	Mary-Hardin Baylor Col.	11
South West Texas State U.	95	Our Lady of the Lake	20
Sul Ross State U.	32	Southern Methodist U.	36
Texas A&I U.	153	Southwestern U.	9
Texas A&M U.	25	Texas Wesleyan College	55
U. of Houston	130		
TOTALS BY SCHOOLS	581		143
SAMPLE TOTAL			724

APPENDIX D

PROSPECTIVE TEACHER QUESTIONNAIRE

DIRECTIONS: USING PART II OF THE ANSWER SHEET, MARK ONE OR MORE RESPONSES TO EACH OF THE FOLLOWING.

1. Sex
   1. male
   2. female

2. Age
   1. 18-24
   2. 25-34
   3. 35-44
   4. 45-54
   5. over 54

3. Mark the course(s) for which you received high school (grades 9-12) credit.
   1. Related Math I
   2. Related Math II
   3. Consumer Math
   4. Algebra I
   5. None of these

4. Continuation of 3 above.
   1. Algebra II
   2. Algebra III
   3. Algebra Iv
   4. Trigonometry
   5. None of these

5. Contination of 3-4 above.
   1. Plane Geometry
   2. Solid Geometry
   3. Aanlytical Geometry
   4. Elementary Analysis I
   5. None of these

6. Continuation of 3-5 above.
   1. Elementary Analysis II
   2. Probability & Statistics
   3. Other
   4. None of these

7. Size of high school graduating class.
   1. under 50
   2. 51-150
   3. 151-300
   4. 301-450
   5. over 450

8. I have received a Bachelor's Degree and am presently working toward certification in elementary education.
   1. Yes
   2. No

9. Please specify your academic area of specialization (minor teaching field).
   1. Language Arts
   2. Mathematics
   3. Science
   4. Social Studies
   5. None of these

10. Continuation of 9 above.
    1. Art
    2. Music
    3. Physical Education
    4. Other
    5. None of these

11. Indicate the number of Mathematics Content courses for which you have received college credit. Include courses in which you are currently enrolled.
    1. None
    2. One course
    3. Two courses
    4. Three courses
    5. More than three courses

12. Indicate the number of Mathematics Methods courses for which you have received college credit. Include courses in which you are currently enrolled.
    1. None
    2. One course
    3. Two courses
    4. Three courses
    5. More than three courses

13. Indicate the grade level you prefer to teach.
    1. Kindergarten thru grade three
    2. Grade four thru grade six

14. Which course(s) have had a positive influence on your attitude toward mathematics?
    1. Mathematics content more than mathematics methods
    2. Mathematics methods more than mathematics content
    3. Both content and methods equally
    4. None of the above

15. In your opinion, which course(s) provided you with the necessary mathematics background for teaching mathematics in the elementary school?
    1. Mathematics content more than mathematics methods
    2. Mathematics methods more than mathematics content
    3. Both content and methods equally
    4. None of the above

EXPERIENCED TEACHER QUESTIONNAIRE

DIRECTIONS: USING PART II OF THE ANSWER SHEET, MARK ONE OR MORE RESPONSES TO EACH OF THE FOLLOWING.

1. Sex
   1. Male
   2. Female

2. Age
   1. 18-24
   2. 25-34
   3. 35-44
   4. 45-54
   5. over 54

3. Size of high school graduating class
   1. Under 50
   2. 51-150
   3. 151-300
   4. 301-450
   5. over 450

4. Mark the course(s) for which you received high school (grades 9-12) credit.
   1. Related Math I
   2. Related Math II
   3. Consumer Math
   4. Algebra I
   5. None of these

5. Continuation of 4 above
   1. Algebra II
   2. Algebra III
   3. Algebra IV
   4. Trigonometry
   5. None of these

6. Continuation of 4-5 above.
   1. Plane Geometry
   2. Solid Geometry
   3. Analytical Geometry
   4. Elementary Analysis I
   5. None of these

7. Continuation of 4-6 above.
   1. Elementary Analysis II
   2. Probability & Statistics
   3. Other
   4. None of these

8. Indicate the number of Mathematics Content courses for which you have received college credit. Include courses in which you are now enrolled.
   1. None
   2. One course
   3. Two courses
   4. Three courses
   5. More than three

9. Indicate the number of Mathematics Methods courses for which you have received college credit. Include courses in which you are now enrolled.
   1. None
   2. One course
   3. Two courses
   4. Three courses
   5. More than three

10. Indicate your highest level of professional training.
    1. Two years of college or less
    2. More than two years but no degree
    3. Bachelor's Degree
    4. Master's Degree
    5. Doctorate

11. Grade level you are presently teaching.
    1. Kindergarten thru grade three
    2. Grade four thru grade six

12. Indicate the number of years teaching experience.
    1. One or less
    2. 2-5
    3. 6-10
    4. 11-20
    5. More than 20

13. Number of classes in arithmetic you teach each day.
    1. None
    2. One
    3. Two
    4. Three
    5. More than three

14. Are you certified (a valid Texas Teaching Certificate) to teach in the elementary school?
    1. Yes
    2. No

15. Indicate the number of years since your last mathematics content or methods course.
    1. One year or less
    2. 2-4
    3. 5-7
    4. 8-10
    5. More than 10

16. Specify your academic area of specialization (minor teaching field).
    1. Language Arts
    2. Mathematics
    3. Science
    4. Social Studies
    5. None of these

17. Continuation of number 16.
    1. Art
    2. Music
    3. Physical Education
    4. Other
    5. None of these

18. Which course(s) have had a positive influence on your attitude toward mathematics?
    1. Mathematics content more than mathematics methods.
    2. Mathematics methods more than mathematics content
    3. Both content and methods equally
    4. None of the above

19. In your opinion, which course(s) provided you with the necessary mathematics background for teaching mathematics in the elementary school?
    1. Mathematics content more than mathematics methods.
    2. Mathematics methods more than mathematics content.
    3. Both content and methods equally.
    4. None of the above.

APPENDIX E

UNIVERSITY OF HOUSTON
COLLEGE OF EDUCATION
CULLEN BOULEVARD
HOUSTON, TEXAS 77004

CURRICULUM AND INSTRUCTION

April 5, 1971

Registrar of Records
East Texas State University
Commerce, Texas 75429

Dear Sir:

Selected members of the Curriculum and Instruction department of the College of Education of the University of Houston are conducting a survey of Texas College and Universities that have approved undergraduate programs in Elementary Education. Would you please fill in the blank below and return this sheet in the enclosed self addressed envelope at your very earliest convenience.

Thank you very much for your immediate attention and cooperation concerning this matter.

Sincerely,

Ør. John L. Creswell
Associate Professor

This institution graduated 291 undergraduate Elementary Education majors during the 1969-1970 school year. (academic year and summer)

Enclosure

SI-81-10

APPENDIX F

RANDOM SAMPLING CATEGORIES FOR SELECTING
THE TEXAS COLLEGES AND UNIVERSITIES FOR THE STUDY

NUMBER OF 1969-70 GRADUATES	NUMBER OF STATE SUPPORTED INSTITUTIONS		NUMBER OF SCHOOLS INDEPENDENTLY SUPPORTED	
Over 301	4	(1576)	0	
201-300	6	(1527)	0	
101-200	5	(755)	3	(471)
51-100	6	(447)	7	(528)
27-50	0		6	(245)
Under 27	0		12	(206)
TOTALS	21	(4305)	28	(1450)

Numerals in parenthesis indicate the combined totals of the graduates from institutions in each category.

APPENDIX G

December 13, 1971

Dear Sir:

I am currently enrolled as a Doctoral Candidate in the College of Education at the University of Houston. I have proposed a study entitled "A Comparison of Mathematical Attitudes and Competence of Selected Prospective and Experienced Elementary Teachers in the State of Texas During the 1971-72 Academic Year." I would like to request your assistance in the research study.

It is proposed that the subjects of this study will be those elementary education majors enrolled in student teaching at your institution during the 1972 Spring Semester. Each student teacher will be given a mathematical questionnaire, attitude scale, and achievement test. The total time for administering these instruments will be slightly over one hour. I will coordinate all procedures and administer all instruments for this study.

Enclosed is a self-addressed envelope. I hope you will return the enclosed information slip and indicate your willingness to assist with this study. Upon receipt of your approval, the Director of Elementary Student Teaching at your institution will be contacted in order to discuss and coordinate the survey procedures.

I shall look forward to receiving your approval within the next few days. Thank you for your cooperation and interest in educational research concerning prospective elementary teachers in our state.

Sincerely,

Dr. John L. Creswell
Professor
Research Chairman

Danny W. Higdon
Doctoral Candidate

The following is a sample of the forms that were attached to the cover letters that were sent to the colleges and universities. The forms were to be completed and returned to the researcher.

" S A M P L E "

Check one:

The College of Education at my institution will ( ) will not ( ) participate in your study.

Please indicate below, the name of the Director of Elementary Student Teaching at your institution.

____
Name

____
Title

Name and title of person I must contact if other than the person listed above.

____
Name

____
Title

APPENDIX H

COLLEGES AND UNIVERSITIES
PARTICIPATING IN THE STUDY

STATE INSTITUTIONS		PRIVATE INSTITUTIONS	
Over 301 Graduates			
North Texas State U.	406	None	
Southwest Texas State U.	357		
	763		
201-300 Graduates			
U. of Houston	275	None	
Texas A&I	258		
	533		
101-200 Graduates			
*Pan American College	142	Southern Methodist U.	190
Prairie View A&M	150	Texas Wesleyan College	108
	292		298
51-100 Graduates			
Sul Ross State U.	85	Our Lady of the Lake	83
Texas A&M	53	Mary Hardin-Baylor Col.	56
	138		139
27-50 Graduates			
None		*Howard Payne College	50
		Houston Baptist College	43
			93
Less than 27 Graduates			
None		Southwestern U.	20
		*Dominican College	19
			39
TOTALS	1726		569

*Institutions previously agreeing to participate in the study however, certain conflicts prevented them from taking part.

APPENDIX I

December 13, 1971

Dear Sir:

I am currently enrolled as a Doctoral Candidate in the College of Education at the University of Houston. I have proposed a study entitled "A Comparison of Mathematical Attitudes and Competence of Selected Prospective and Experienced Elementary Teachers in the State of Texas During the 1971-72 Academic Year." I would like to request your assistance in this research study.

It is proposed that fifty randomly selected elementary schools (K-6) from the Greater Houston Area will comprise the population for this study. A random sample of teachers at each school will form two groups: (a) those teachers engaged in the teaching of mathematics and (b) those teachers teaching subjects other than mathematics. Each teacher will be given a mathematics questionnaire, attitude scale, and achievement test. The total time for administering these instruments will be slightly over one hour. I will coordinate and administer all instruments for this study. Questionnaire responses and attitude and achievement test scores will be kept strictly confidential.

Enclosed is a self-addressed envelope. I hope you will return the enclosed information slip and indicate your willingness to assist with this study. Upon receipt of your approval, you will be contacted in order to discuss and coordinate the survey procedures.

I shall look forward to receiving your approval within the next few days. Thank you for your cooperation and interest in educational research concerning elementary teachers in our schools.

Sincerely,

Dr. John L. Creswell
Professor
Research Chairman

Danny W. Higdon
Doctoral Candidate

The following is a sample of the forms that were attached to the cover letters that were sent to the colleges and universities. The forms were to be completed and returned to the researcher.

" S A M P L E "

Check one:

My school ( ) school district ( )

will ( ) will not ( )

participate in your proposed study.

____
Name and Title

____
School or District

APPENDIX J

PUBLIC AND PRIVATE ELEMENTARY SCHOOLS THAT COMPRISE THE POPULATION FOR THE STUDY AND THE NUMBER OF PARTICIPATING EXPERIENCED ELEMENTARY TEACHERS AT EACH INSTITUTION

ELEMENTARY SCHOOLS	NUMBER OF PARTICIPATES
ALIEF INDEPENDENT SCHOOL DISTRICT	
Alief Elementary	31
Chambers Elementary	23
	54
CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT	
Bane Elementary	22
Holbrook Elementary	31
Matzke Elementary	45
	98
NORTH FOREST INDEPENDENT SCHOOL DISTRICT	53
SPRING INDEPENDENT SCHOOL DISTRICT	
Bammel Elementary	24
Ponderosa Elementary	20
Spring Elementary	25
	69
WEST BRIAR SCHOOL	10
TOTALS	284

APPENDIX K

THE NUMBER AND PERCENTAGE OF EXPERIENCED ELEMENTARY TEACHER PARTICIPANTS WITHIN EACH SCHOOL OR DISTRICT

SCHOOL OR DISTRICT	NUMBER OF TEACHERS ON STAFF	NUMBER OF PARTICIPATES	PER CENT
Alief	67*	54	80.6
Cypress-Fairbanks	105*	98	93.3
North Forest	145*	53	36.6
Spring	82	69	84.1
West Briar	12	10	83.3
TOTALS	411	284	69.1

* These figures do not represent the entire elementary teaching staff within the district.

APPENDIX L

DIRECTIONS: Each of the statements on this opinionnaire expresses a feeling which a particular person has toward mathematics. You are to express, on a five point scale, the extent of agreement between the feeling expressed in each statement and your own personal feeling. Using Part I of the answer sheet, darken the number, which best indicates how closely you agree or disagree with the feeling expressed in each statement as IT CONCERNS YOU.

The five points are: Strongly Disagree (1), Disagree (2), Undecided (3), Agree (4), and Strongly Agree (5).

1	2	3	4	5
SD	D	U	A	SA

1. I am always under a terrible strain in a math class.
2. I do not like mathematics, and it scares me to have to take it.
3. Mathematics is very interesting to me, and I enjoy math courses.
4. Mathematics is fascinating and fun.
5. Mathematics makes me feel secure, and at the same time it is stimulating.
6. My mind goes blank, and I am unable to think clearly when working math.
7. I feel a sense of insecurity when attempting mathematics.
8. Mathematics makes me feel uncomfortable, restless, irritable, and impatient.
9. The feeling that I have toward mathematics is a good feeling.
10. Mathematics makes me feel as though I'm lost in a jungle of numbers and can't find my way out.
11. Mathematics is something which I enjoy a great deal.
12. When I hear the word math, I have a feeling of dislike.
13. I approach math with a feeling of hesitation, resulting from a fear of not being able to do math.
14. I really like mathematics.
15. Mathematics is a course in school which I have always enjoyed studying.
16. It makes me nervous to even think about having to do a math problem.
17. I have never liked math, and it is my most dreaded subject.
18. I am happier in a math class than in any other class.
19. I feel at ease in mathematics and I like it very much.
20. I feel a definite positive reaction to mathematics; it's enjoyable.

APPENDIX M

PROSPECTIVE AND EXPERIENCED ELEMENTARY TEACHERS' CONVERTED ARITHMETIC ACHIEVEMENT RAW SCORES ON THE STANFORD ACHIEVEMENT TEST, ADVANCED BATTERY, FORM X

	PROSPECTIVE TEACHERS		EXPERIENCED TEACHERS	
ARITHMETIC COMPUTATION	MEAN RAW SCORE=30.19 GRADE SCORE=10.8		MEAN RAW SCORE=30.11 GRADE SCORE=10.8	
END OF GRADE	PERCENTILE RANK	STANINE	PERCENTILE RANK	STANINE
6	98	9	98	9
7	90	8	90	8
8	72	6	72	6
9	60	6	60	6
ARITHMETIC CONCEPTS	MEAN RAW SCORE=28.50 GRADE SCORE=11.4		MEAN RAW SCORE=28.26 GRADE SCORE=11.4	
END OF GRADE	PERCENTILE RANK	STANINE	PERCENTILE RANK	STANINE
6	98	9	98	9
7	92	8	92	8
8	80	7	80	7
9	68	6	68	6
ARITHMETIC APPLICATIONS	MEAN RAW SCORE=21.51 GRADE SCORE=10.8		MEAN RAW SCORE=23.39 GRADE SCORE=11.5	
END OF GRADE	PERCENTILE RANK	STANINE	PERCENTILE RANK	STANINE
6	94	8	98	9
7	84	7	94	8
8	70	6	84	7
9	64	6	78	7

APPENDIX N

CORRELATION MATRIX
PROSPECTIVE ELEMENTARY TEACHERS SELECTING
LANGUAGE ARTS AS A SPECIALIZATION

N=225

VARIABLE	COMP.	CONC.	APPL.	TOTAL	ATT.
Computations	1.000**				
Concepts	.755**	1.000**			
Applications	.556**	.658**	1.000**		
Total	.888**	.888**	.796**	1.000**	
Attitude	-.379**	-.332**	-.229*	-.356**	1.000**

VARIABLE	MEANS	STANDARD DEVIATIONS
Computations	31.37	7.48
Concepts	29.92	5.91
Applications	22.30	5.16
Total	83.31	16.75
Attitude	56.03	17.45

* Significant at the .05 level
** Significant at the .01 level

CORRELATION MATRIX
PROSPECTIVE ELEMENTARY TEACHERS SELECTING
MATHEMATICS AS A SPECIALIZATION

N=33

VARIABLE	COMP.	CONC.	APPL.	TOTAL	ATT.
Computations	1.000**				
Concepts	.642**	1.000**			
Applications	.577**	.790**	1.000**		
Total	.830**	.901**	.913**	1.000**	
Attitude	-.024	-.329*	-.239	-.217	1.000**

VARIABLE	MEANS	STANDARD DEVIATIONS
Computations	37.97	3.92
Concepts	36.00	3.10
Applications	27.63	4.91
Totals	101.61	10.53
Attitude	35.15	13.08

* Significant at the .05 level
** Significant at the .01 level

CORRELATION MATRIX
PROSPECTIVE ELEMENTARY TEACHERS SELECTING
SCIENCE AS A SPECIALIZATION

N=22

VARIABLE	COMP.	CONC.	APPL.	TOTAL	ATT.
Computations	1.000**				
Concepts	.833**	1.000**			
Applications	.606**	.778**	1.000**		
Total	.919**	.958**	.844**	1.000**	
Attitude	-.599**	-.549**	-.619**	-.645**	1.000**

VARIABLE	MEANS	STANDARD DEVIATIONS
Computations	31.31	8.29
Concepts	29.27	6.85
Applications	21.72	5.63
Total	82.31	18.94
Attitude	46.04	16.29

** Significant at the .01 level

CORRELATION MATRIX
PROSPECTIVE ELEMENTARY TEACHERS SELECTING
SOCIAL STUDIES AS A SPECIALIZATION

N=114

VARIABLE	COMP.	CONC.	APPL.	TOTAL	ATT.
Computations	1.000**				
Concepts	.773**	1.000**			
Applications	.695**	.769**	1.000**		
Total	.917**	.932**	.882**	1.000**	
Attitude	-.323**	-.296**	-.232*	-.316**	1.000**

VARIABLE	MEANS	STANDARD DEVIATIONS
Computations	31.40	7.50
Concepts	29.36	6.84
Applications	22.92	5.51
Total	83.70	18.13
Attitude	51.31	15.73

* Significant at the .05 level
** Significant at the .01 level

CORRELATION MATRIX
PROSPECTIVE ELEMENTARY TEACHERS SELECTING
ART AS A SPECIALIZATION

N=71

VARIABLE	COMP.	CONC.	APPL.	TOTAL	ATT.
Computations	1.000**				
Concepts	.770**	1.000**			
Applications	.696**	.855**	1.000**		
Total	.914**	.943**	.903**	1.000**	
Attitude	-.271*	-.292*	-.221	-.289*	1.000**

VARIABLE	MEANS	STANDARD DEVIATIONS
Computations	23.08	9.02
Concepts	22.67	7.42
Applications	17.60	6.17
Total	63.39	20.82
Attitude	58.52	16.85

* Significant at the .05 level
** Significant at the .01 level

CORRELATION MATRIX
PROSPECTIVE ELEMENTARY TEACHERS SELECTING
MUSIC AS A SPECIALIZATION

N=23

VARIABLE	COMP.	CONC.	APPL.	TOTAL	ATT.
Computation	1.000**				
Concepts	.814**	1.000**			
Applications	.710**	.722**	1.000**		
Total	.937**	.928**	.870**	1.000**	
Attitude	-.543**	-.525**	-.419*	-.549**	1.000**

VARIABLE	MEANS	STANDARD DEVIATIONS
Computations	31.13	8.26
Concepts	29.52	6.85
Applications	23.00	5.93
Total	83.65	19.27
Attitude	55.00	16.59

* Significant at the .05 level
** Significant at the .01 level

CORRELATION MATRIX
PROSPECTIVE ELEMENTARY TEACHERS SELECTING
PHYSICAL EDUCATION AS A SPECIALIZATION

N=54

VARIABLE	COMP.	CONC.	APPL.	TOTAL	ATT.
Computations	1.000**				
Concepts	.834**	1.000**			
Applications	.685**	.676**	1.000**		
Total	.946**	.933**	.831**	1.000**	
Attitude	-.333*	-.440**	-.378**	-.417**	1.000**

VARIABLE	MEANS	STANDARD DEVIATIONS
Computations	28.05	8.42
Concepts	26.07	7.18
Applications	18.92	5.10
Total	73.05	18.91
Attitude	56.53	17.94

* Significant at the .05 level
** Significant at the .01 level

APPENDIX O

CORRELATION MATRIX
EXPERIENCED ELEMENTARY TEACHERS SELECTING
LANGUAGE ARTS AS A SPECIALIZATION

N=84

VAR.	COMP.	CONC.	APPL.	TOTAL	B.S.	M.S.	PHD	ATT.
Comp.	1.000							
Conc.	.818	1.000						
Appl.	.576	.509	1.000					
Total	.940	.898	.765	1.000				
B.S.	-.137	-.107	-.105	-.135	1.000			
M.S.	.211	.076	.163	.161	.679	1.000		
PHD	.000	.000	.000	.000	.000	.000	.000	
Att.	-.251	-.300	-.185	-.282	.039	.227	.000	1.000

VARIABLE	MEANS	STANDARD DEVIATIONS
Computations	29.40	8.87
Concepts	27.35	6.71
Applications	23.04	5.94
Total	79.81	18.92
Attitude	53.59	18.24

r = .217 is significant at the .05 level
r = .283 is significant at the .01 level

CORRELATION MATRIX
EXPERIENCED ELEMENTARY TEACHERS SELECTING
MATHEMATICS AS A SPECIALIZATION

N=10

VAR.	COMP.	CONC.	APPL.	TOTAL	B.S.	M.S.	PHD	ATT.
Comp.	1.000							
Conc.	.910	1.000						
Appl.	.778	.737	1.000					
Total	.971	.956	.869	1.000				
B.S.	.000	.000	.000	.000	.000			
M.S.	.000	.000	.000	.000	.000	.000		
PHD	.000	.000	.000	.000	.000	.000	.000	
Att.	-.413	-.165	-.249	-.303	.000	.000	.000	1.000

VARIABLE	MEANS	STANDARD DEVIATIONS
Computations	32.20	8.12
Concepts	31.90	7.23
Applications	26.30	4.96
Total	90.40	19.12
Attitude	32.50	9.46

r = .576 is significant at the .05 level
r = .708 is significant at the .01 level

CORRELATION MATRIX
EXPERIENCED ELEMENTARY TEACHERS SELECTING
SCIENCE AS A SPECIALIZATION

N=22

VAR.	COMP.	CONC.	APPL.	TOTAL	B.S.	M.S.	PHD	ATT.
Comp.	1.000							
Conc.	.789	1.000						
Appl.	.604	.508	1.000					
Total	.926	.892	.789	1.000				
B.S.	.389	.524	.287	.457	1.000			
M.S.	.054	.083	.217	.122	.661	1.000		
PHD	.000	.000	.000	.000	.000	.000	.000	
Att.	-.302	-.382	-.269	-.367	-.250	-.374	.000	1.000

VARIABLE	MEANS	STANDARD DEVIATIONS
Computations	28.45	7.62
Concepts	26.50	7.51
Applications	23.27	6.43
Total	78.22	18.92
Attitude	43.90	14.88

$r = .404$ is significant at the .05 level
$r = .515$ is significant at the .01 level

CORRELATION MATRIX
EXPERIENCED ELEMENTARY TEACHERS SELECTING
SOCIAL STUDIES AS A SPECIALIZATION

N=63

VAR.	COMP.	CONC.	APPL.	TOTAL	B.S.	M.S.	PHD	ATT.
Comp.	1.000							
Conc.	.853	1.000						
Appl.	.698	.692	1.000					
Total	.950	.936	.845	1.000				
B.S.	.106	.046	.089	.089	1.000			
M.S.	.235	.577	.314	.373	.501	1.000		
PHD	.000	.000	.000	.000	.000	.000	.000	
Att.	-.469	-.444	-.441	-.494	-.039	-.396	.000	1.000

VARIABLE	MEANS	STANDARD DEVIATIONS
Computations	29.90	8.45
Concepts	28.76	6.96
Applications	23.30	5.52
Total	81.96	19.22
Attitude	51.61	19.42

r = .250 is significant at the .05 level
r = .325 is significant at the .01 level

CORRELATION MATRIX
EXPERIENCED ELEMENTARY TEACHERS SELECTING
ART AS A SPECIALIZATION

N=28

VAR.	COMP.	CONC.	APPL.	TOTAL	B.S.	M.S.	PHD	ATT.
Comp.	1.000							
Conc.	.859	1.000						
Appl.	.730	.745	1.000					
Total	.940	.939	.890	1.000				
B.S.	-.095	-.030	.003	-.212	1.000			
M.S.	.000	.000	.000	.000	.000	.000		
PHD	.000	.000	.000	.000	.000	.000	.000	
Att.	-.273	-.387	-.275	-.336	.313	.000	.000	1.000

VARIABLE	MEANS	STANDARD DEVIATIONS
Computations	29.64	6.11
Concepts	26.14	5.45
Applications	20.96	5.49
Total	76.75	15.75
Attitude	53.14	15.74

r = .361 is significant at the .05 level
r = .463 is significant at the .01 level

CORRELATION MATRIX
EXPERIENCED ELEMENTARY TEACHERS SELECTING
MUSIC AS A SPECIALIZATION

N=17

VAR.	COMP.	CONC.	APPL.	TOTAL	B.S.	M.S.	PHD	ATT.
Comp.	1.000							
Conc.	.953	1.000						
Appl.	.842	.793	1.000					
Total	.984	.970	.902	1.000				
B.S.	.197	.095	.179	.161	1.000			
M.S.	-.554	-.445	-.519	-.516	.000	1.000		
PHD	.000	.000	.000	.000	.000	.000	.000	
Att.	-.509	-.515	-.302	-.479	.234	-.149	.000	1.000

VARIABLE	MEANS	STANDARD DEVIATIONS
Computations	28.17	9.44
Concepts	27.23	9.21
Applications	24.47	6.43
Total	79.88	24.03
Attitude	50.52	24.38

r = .456 is significant at the .05 level
r = .575 is significant at the .01 level

CORRELATION MATRIX
EXPERIENCED ELEMENTARY TEACHERS SELECTING
PHYSICAL EDUCATION AS A SPECIALIZATION

N=20

VAR.	COMP.	CONC.	APPL.	TOTAL	B.S.	M.S.	PHD	ATT.
Comp.	1.000							
Conc.	.647	1.000						
Appl.	.512	.684	1.000					
Total	.886	.889	.797	1.000				
B.S.	.069	.015	.048	.051	1.000			
M.S.	.000	.000	.000	.000	.000	.000		
PHD	.000	.000	.000	.000	.000	.000	.000	
Att.	-.488	-.569	-.387	-.565	.131	.000	.000	1.000

VARIABLE	MEANS	STANDARD DEVIATIONS
Computations	30.95	7.91
Concepts	29.55	5.80
Applications	23.40	4.60
Total	83.90	15.83
Attitude	48.70	20.39

r = .423 is significant at the .05 level
r = .537 is significant at the .01 level