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To the Graduate Council:

I am submitting herewith a dissertation written by Denver Ray Childress entitled "A Study of the Relationships Between Students' Attitudes Toward Mathematics and Their Ratings of Mathematics Courses and Mathematics Instructors." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Education, with a major in Curriculum and Instruction.

Henry Frandsen

Henry Frandsen, Major Professor

We have read this dissertation
and recommend its acceptance:

Kermit J. Blank

Earl R. Hansen

Donald J. Dessart

Accepted for the Council:

Hilton A. Smith

Vice Chancellor
Graduate Studies and Research

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A STUDY OF THE RELATIONSHIPS BETWEEN STUDENTS' ATTITUDES TOWARD MATHEMATICS AND THEIR RATINGS OF MATHEMATICS COURSES AND MATHEMATICS INSTRUCTORS

A Dissertation

Presented for the

Doctor of Education

Degree

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Denver Ray Childress

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This study is dedicated to my wife, Margaret, whose loyal support and valuable assistance assured the completion of this dissertation.

ABSTRACT

The purpose of this study was to investigate the relationships between students' attitudes toward mathematics and their ratings of mathematics courses and mathematics instructors.

Two hundred four students, enrolled in either a precalculus mathematics course or a general liberal arts mathematics course, completed a questionnaire which consisted of ninety statements for which each student indicated the extent of his agreement or disagreement on each statement. The responses to the statements were used to obtain scores for each student on enjoyment of mathematics, value of mathematics, general attitude toward mathematics, instructor rating, course rating, and combined course and instructor rating. The students completed the questionnaire in a regular class meeting during the last week of class in the Fall Semester, 1974.

Using the 0.05 level of significance, a t-test comparison of mean scores on the six variables was made for several subgroups of the sample population. Pearson product-moment coefficients of correlation were calculated for several subgroups to determine the nature of the relationships between the variables.

The major results of the study were the following:

1. Scores for males and females differed significantly only on the variable enjoyment of mathematics, with male scores more favorable.

2. Scores for pre-calculus students were significantly higher than scores for the general liberal arts students on the three variables related to attitudes toward mathematics, but there were no significant differences on ratings of courses and instructors.

3. There were no significant differences on any of the six variables for these pairs of groups: pre-calculus males and pre-calculus females; freshmen and upperclassmen; freshman males and freshman females; freshman females and upper-class females; pre-calculus males and liberal arts males; and freshman males and upper-class males.

4. There was a significant positive correlation between the variables general attitude toward mathematics and combined course and instructor rating for these groups: all students in the sample; males; females; pre-calculus students; liberal arts students, freshmen; and upperclassmen. Pearson product-moment coefficients of correlation ranged from 0.41 for females to 0.58 for pre-

calculus students, with the correlation of 0.45 for all students in the study.

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CHAPTER I

INTRODUCTION

I. INTRODUCTION

Instruction is evaluated in some way, formally or informally, by teachers, and their students, colleagues, and administrators. The results of these evaluations are often used to improve instruction or to provide information for decisions on the employment, promotion, and tenure of teachers. It is therefore imperative that the most valid and reliable information be used in evaluating instruction. This study was undertaken in an attempt to provide additional information about student ratings of instruction.

This chapter gives a general overview of the study. Included in the chapter are the statement of the problem being investigated, a discussion of the importance of the study, and an outline of the design and procedures for the study. The assumptions for the study, the scope and limitations of the study, and the definitions of terms used in the study are also given in this chapter. The chapter concludes with the organization of the study.

II. STATEMENT OF THE PROBLEM

This study investigated the relationship between student attitudes toward mathematics and student ratings of mathematics instructors and mathematics courses.

More specifically, the study investigated these questions:

1. Do college students who are taking mathematics courses which have different basic objectives possess different attitudes toward mathematics, in either their enjoyment of mathematics or their appreciation of the value of mathematics to the individual and to society?

2. Do student scores on ratings of mathematics instructors and mathematics courses reflect a positive correlation with student scores on measures of attitude toward mathematics?

3. Do scores of male students differ from those of female students on measures of attitude toward mathematics and ratings of instructors and courses?

4. Do scores of freshman students differ from those of upper-class students on measures of attitude toward mathematics and ratings of instructors and courses?

III. IMPORTANCE OF THE STUDY

Efforts to evaluate instruction have intensified in recent years. These efforts to evaluate instruction have been accompanied by efforts to ensure that the most valid and reliable information is used in these evaluations. Student ratings have remained a controversial method of evaluating instruction as research has continued to try to validate this technique. Some recent research has focused on the relationships between student ratings of instruction and characteristics of students, such as sex, grade level, grade point average, and personality factors. This research has attempted to identify factors which would tend to bias student ratings. One factor which might bias the rating is the attitude of the student toward the subject being taught.

If decisions on such important matters as faculty promotion, salary, and tenure are to be based in part on these ratings, then it is imperative that such biases be discovered and understood, so that precautions may be taken to ensure proper evaluation of instruction.

IV. PROCEDURES AND DESIGN

In this study the relevant literature was reviewed, the instruments for obtaining measures of student ratings of courses and instructors and student attitudes toward mathematics were selected, and the instruments were combined to form an opinionnaire containing ninety items.

The opinionnaire was administered to students in nine mathematics classes at Carson-Newman College in a regular class session near the end of the Fall Semester, 1974. The nine classes consisted of four classes of pre-calculus mathematics and five classes of a general liberal arts mathematics course. The responses yielded, for each student, measures of his rating of his instructor, his course, and his attitude toward mathematics.

The course and instructor evaluation instrument used in the study was a fifty-item Likert type instrument in which the respondent indicates the extent to which he agrees or disagrees with each statement. The instrument used to obtain measures of attitudes toward mathematics was a Likert type instrument consisting of forty items, twenty-one of which were used to obtain the attitude scores. The remaining nineteen items on the instrument pertained to the

interests, achievements, and biographical information.

The scores obtained from the responses to the statements related to attitudes toward mathematics and opinions of mathematics courses and mathematics teachers were analyzed for selected subgroups of the sample, using t-tests and Pearson product-moment coefficients of correlation to investigate differences between subgroups and relationships between attitudes toward mathematics and ratings of courses and instructors. The specific null hypotheses tested are given in Chapter III, where a detailed description of the procedures and design of the study is given.

V. ASSUMPTIONS FOR THE STUDY

The assumptions for this study were:

1. The subjects' responses to the statements on the instrument were honest and accurate.

2. The instruments used were valid measures of student opinions of mathematics, mathematics instruction, and mathematics courses.

VI. SCOPE AND LIMITATIONS

1. The study was limited to students enrolled in either the pre-calculus mathematics course or the general liberal arts mathematics course at Carson-Newman College, Jefferson City, Tennessee, during the Fall Semester, 1974.

2. The study was further limited to those students who attended class on the day the instrument was administered, and who correctly completed the instrument.

3. The results of the study are dependent upon the specific attitude scale and course and instructor rating form used in the study, and all conclusions must be qualified to that extent.

VII. DEFINITION OF TERMS USED IN THE STUDY

Attitude Toward Mathematics. The score determined by the subjects' weighted responses to twenty-one items on the Mathematics Attitude Scale.

Course Rating. The score determined by the subjects' weighted responses to twenty items on the Course and Instructor Evaluation form.

Enjoyment of Mathematics. The score determined by

the subjects' weighted responses to eleven items on the Mathematics Attitude Scale.

Instructor Rating. The score determined by the subjects' weighted responses to twenty-two items on the Course and Instructor Evaluation form.

Mathematics 133, Pre-Calculus Mathematics. A course designed to provide background in algebra and elementary functions for the study of calculus.

Mathematics 135, Introduction to Mathematical Thought. A course designed for the liberal arts student who wishes to gain some insight into the meaning and methods of mathematics, and who does not plan to specialize in mathematics or science.

Value of Mathematics. The score determined by the subjects' weighted responses to ten items on the Mathematics Attitude Scale.

VIII. ORGANIZATION OF THE STUDY

Chapter I gives a general overview of the study. It contains the statement of the problem, a discussion of the importance of the study, and an outline of the procedures and the design of the study. Assumptions for the study, the scope and limitations of the study, and

the definitions of terms used in the study are also given. The chapter concludes with the organization of the study.

Chapter II contains a review of the literature related to the study. Proposed and actual uses of student ratings; factors which influence student ratings of instruction, including both teacher characteristics and student characteristics; and students' attitudes toward mathematics are discussed in the chapter.

Chapter III gives the procedures and design of the study. The population and sample selections are given along with a description of the instruments used in the study. The chapter also contains the notation used in the study, the hypotheses, and the statistical techniques used to test the hypotheses. The details of the administration of the questionnaire and a description of the types of data obtained concludes the chapter.

Chapter IV contains the data and data analysis for the study. Tables of the data considered in testing the hypotheses are given, along with the decisions to reject or not reject the hypotheses for the study.

Chapter V presents a summary of the study as well as conclusions and suggestions for further research.

CHAPTER II

REVIEW OF RELATED LITERATURE

I. INTRODUCTION

Much recent research has attempted to identify factors which influence student ratings of instruction. This chapter considers the literature related to the role of student ratings in the overall evaluation of instruction. The first section covers proposed and actual uses of student ratings, with some attention given to the effects of feedback from student ratings. The next section considers literature related to teacher characteristics which influence instruction, such as personality and research productivity. Student characteristics which influence ratings are then considered, followed by a discussion of other factors which may influence ratings. The final section of the chapter deals with student attitudes toward mathematics, with a discussion of scales used in measuring attitudes, the formation and stability of attitudes toward mathematics, group differences, and the effects of attitudes on student ratings of mathematics teachers.

II. THE ROLE OF STUDENT RATINGS IN THE EVALUATION OF INSTRUCTION

Proposals for Using Student Ratings

In his treatise on the evaluation of teaching, Eble (22, p. 17) strongly favored the use of student ratings, after noting that important decisions on such matters as tenure and promotion are frequently based on uninformed guesses. Miller (40, p. 19) identified classroom teaching as the central and most important of nine criteria for evaluating overall faculty performance, and singled out student ratings as the most important component in evaluating instruction (40, p. 30). He based his strong advocacy of student ratings on several research studies which supported the reliability of student ratings.

Berquist and Phillips (11) included student evaluation of instruction in their comprehensive program of faculty development. They cautioned that using student ratings as the only method of evaluation was totally inadequate, and advised that some negative aspects of student ratings could be avoided by reserving specific diagnostic and evaluative data for the individual alone. They also cautioned that student ratings are seductive, in that they are relatively

inexpensive and easily quantified and computerized. They warned of the danger of using student ratings as a weapon rather than as an instrument to improve instruction (11, p. 190).

The plan of Smock and Crooks (53) for evaluation of teaching contained three levels of evaluative information to be supplied by students. Level I, a concise general summary, consisted of five to ten questions which apply to all courses. Level II covered specific attributes of instructors and courses, and remained separate from Level I. Level III contained open-ended questions and also included class discussions. Smock and Crooks found it surprising and disturbing that so much data can be obtained from such a large proportion of students, whether the data are appropriate for the course or not (53, p. 581).

Gaff and Wilson (25, p. 478) cited a recent survey of faculty which showed that 72 percent favored a formal procedure of evaluation. Of those who favored a formal evaluation, 82 percent said students should be involved, 76 percent wanted to involve colleagues, 73 percent wanted evaluation by department chairmen, and only 33 percent wanted to include deans in the formal evaluation

procedure. They also cited a later survey which showed that 85 percent of the faculty respondents favored formal evaluation. Gaff and Wilson (25, p. 479) concluded from their examinations of the research that student ratings constituted a valuable source of faculty evaluation.

Kerlinger (31) opposed student evaluation of instruction, contending that student ratings can lead to hostility in the instructor and the erosion of professional responsibility. He offered support for evaluation initiated and conducted by professors as an integral part of the instructional process. Bryant (13) considered student ratings invalid, citing student immaturity and teaching conditions which are not comparable. He suggested peer evaluation by department chairmen through visitation, discussion, and examination of course materials and tests. Taylor (56) contended that not all students are capable of effective evaluation. He reported on a system for obtaining student ratings by having all classes observed for one week, then evaluated, by students who are perceptive and "experientially in touch."

The references cited above illustrate the diversity of opinion regarding the use of student ratings of instruction. Student ratings are widely advocated, and

violently opposed. Wide support can be found for the opposite poles, as well as for most positions between the poles.

Uses of Student Ratings

Gustad (28, p. 269) observed a decline in the use of student ratings in comparing 1961 and 1966 surveys by the American Council on Education. He attributed the decline in use to a lack of research on the validity of the instruments used. The surveys also revealed that classroom visitations for evaluative purposes were less frequent in 1966 (28, p. 271). Kent (30, p. 333) stated that more evaluation programs have faltered due to student apathy than due to faculty opposition. She offered support for student ratings as a hopeful possibility for solving some of the current problems of evaluating teaching effectiveness and improving undergraduate education (30, p. 341). Bryan (12) reported that a survey of 307 collegiate institutions revealed that 49 percent had some form of student rating of instruction.

As noted earlier, the actual extent of the use of student ratings is difficult to determine; however, as Eble (22), Kent (30), and others continue to offer support for

student involvement in evaluation, the use of student ratings seems likely to increase, thus intensifying the need for more complete information about factors which influence student ratings.

Effects of Feedback from Student Ratings

Miller (39) used thirty-six teaching assistants in three different freshman courses to investigate the effect of feedback from student ratings. Results of student ratings taken midway through the course were supplied to the instructors and compared with end-of-course ratings. In two of the three courses, no significant changes in teacher behavior were detected. Miller attributed the lack of improvement to a lack of commitment on the part of the teaching assistants. In a similar study using teaching assistants, Carter (15) reported no significant differences between mid-course ratings and end-of-course ratings of instructors.

An interesting result was obtained in an experiment by Pambookian (46). He categorized instructors as most favorable, moderately favorable, and least favorable, based on mid-course student ratings. All instructors received feedback from mid-course ratings. The instructors rated

as moderately favorable improved significantly on end-of-course ratings on factors of skill, interaction, and rapport as compared with the instructors rated as most favorable. There were no significant differences when comparisons were made with those rated as least favorable. The student ratings of the most favorable group of instructors actually declined from mid-course to end-of-course ratings.

These studies indicate that it is much easier to administer student rating forms than it is to use them to improve instruction. One explanation of the difficulty involved in improving the student ratings of an individual instructor is provided by Sherman and Blackburn (52). In a study involving about 1500 students and 108 faculty at a small liberal arts college, they found a correlation of 0.77 between teacher personality and student-judged teaching effectiveness. Dynamic, pragmatic, amicable, and highly intellectually competent instructors received significantly higher student ratings than faculty with opposite traits. They suggested that improvement of student ratings may depend more on changing personality factors than on changing classroom procedures. Personality traits are more enduring,

hence more difficult to change, than functional classroom behaviors; however, faculty who desire improvements in their student ratings should concentrate their efforts for change on personal attributes, according to Sherman and Blackburn. A study by Turner and others (60) supported these results. They concluded that if instructors with low ratings could become more exciting, humorous, and stimulating, their ratings would improve. Recognizing that these attributes are difficult to modify, due to natural limits, they suggested that instructors concentrate on improving the clarity and depth of their presentations, and strive to keep principal points and concepts in sharp focus (60, p. 87).

Those who advocate the use of student ratings to improve instruction are generally optimistic about the results which can be obtained if feedback from student ratings is utilized. Eble (22, pp. 40-41) reported an instance in which a very reputable professor who was teaching a required senior course received very poor student ratings. Over the period of two years, the professor made such dramatic improvement that he was recognized as the "official winner of the Comeback of the Year Award" by the student guidebook which published student ratings.

One of the reasons usually given in support of student ratings is that information from the ratings will be used to improve instruction. The results of research in this area have indicated that such improvement is not automatic; indeed, improvement of instruction as defined by higher student ratings may be difficult to achieve.

III. TEACHER CHARACTERISTICS WHICH INFLUENCE STUDENT RATINGS

Attempts to validate student ratings have frequently been in the form of determining the correlation between student ratings and well-known and widely-accepted criteria for effective teaching. Aleamoni and Yimer (8), in a study involving 477 instructors, found that student ratings of instructors were not significantly related to either research productivity or academic rank of the instructor. Using data from sixteen schools and about 5000 faculty, Linsky and Straus (33) found little or no correlation between student ratings and research productivity. They found academic rank to be uncorrelated with overall student ratings but correlated with the students' rating of instructor knowledge, suggesting a halo effect associated with rank. Linsky and Straus also found that student ratings vary

with the academic field, with teachers of languages receiving the highest ratings. They also found that teachers of upper-division courses tend to get higher ratings.

A study by McDaniel and Feldhusen (35) supported the conclusion that there is no significant correlation between student ratings and research activity of an instructor. Their results indicated that the most effective teachers, as judged by student ratings, write no books and limit their roles on papers and articles to second authorship. They suggested that tight schedules and deadlines imposed upon authors have a negative effect on teaching effectiveness. They also noted that teachers of large classes tended to receive low student ratings.

In a study of students in ten first-year college courses, Sullivan and Skanes (55) concluded that teachers who were both successful and highly evaluated by students tended to be both task-oriented and interest-arousing. They found a mean correlation of 0.39 between student ratings and scores on a final, common examination. Correlations were highest for experienced, fulltime faculty and lowest for inexperienced, part-time faculty, which, they concluded, tended to validate the student ratings.

One of the most novel studies involving student ratings

of instruction was reported by Naftulin, Ware, and Donnelly (41). They hired and trained a professional actor to present phony lectures of a nonsensical nature to a group of psychiatrists, psychologists, and educators. The listeners rated both lecture and lecturer favorably, leading to the conclusion that "audience" ratings may be more influenced by style than by substance.

Ware (61) used six groups in a two-by-three factorial design to investigate the effects of varying "lecturer-seduction" or "entertainment" orientation (high-low) along with content coverage (high-medium-low) of a lecture. Using a carefully programmed professional actor, six different lectures were presented, one for each group, on videotape. Ware found that, with the content coverage of substantive teaching points held constant, the lecture rated higher in seduction received higher student ratings. Lecturer seduction was also a major factor on test performance when the students were tested on the content of the lecture. When high lecturer-seduction was held constant, student ratings were not sensitive to content coverage. Ware noted that lecture effectiveness was optimized with high content coverage and high seduction.

Grush and Costin (26) used fifty-seven graduate

assistants teaching social and behavioral science classes to about 1400 students to determine characteristics of teachers who receive high student ratings. They found that good teachers, as determined by high student ratings, are self-confident, assured, energetic, and enthusiastic about class presentations. They exhibit faith and trust in students, and are tolerant and understanding. They control classroom activity by defining and giving direction to classroom procedures. They also provide personal, informal information to students, show a sense of humor, and encourage students to express their own ideas. They concluded that the contention that students' personal attraction toward teachers contaminates student ratings appears unwarranted, somewhat in contradiction to Ware's conclusions stated above.

Touq and Feldhusen (57) used eighteen teachers of 488 students in psychology and sociology classes to compare student ratings of teachers with those of professional observers. They used Flanders Interaction Analysis and a parallel student rating on nine factors. They found significant correlations between ratings of students and professional observers in four categories of teacher behavior: accepting feelings (negative correlation), praising

or encouraging, lecturing, and initiating student talk. No significant correlation was found on ratings of accepting ideas, asking questions, giving directions, criticizing, and student talk (response). Touq and Feldhusen felt that their results offered support for the validity of student ratings, and they suggested that students be given training in rating instructors and instruction, in order to improve the validity of student ratings.

IV. STUDENT CHARACTERISTICS WHICH INFLUENCE STUDENT RATINGS

A comprehensive study by Rayder (49) involved eighty-seven instructors and about 4000 students in a College of Education. Rayder found that student ratings of instruction are not significantly related to students' sex, age, grade level, major, grade point average, or grade previously received from the instructor. The most significant characteristic among instructors was the department in which he taught, suggesting that student ratings are not comparable across departments. He also found that older teachers having more education and experience tended to receive lower ratings than younger, less experienced teachers, who were judged to be friendlier, more understanding, stimulating, and imaginative.

Rees (50) investigated several characteristics of students, to determine if they were significantly correlated with student ratings of instruction. He considered socio-economic status, race, performance on ACT tests, class level, masculine sophistication, social disposition, and emotional stability. He found that students from stable lower socio-economic class homes were likely influenced more by pre-disposition than by teacher behavior.

The notion of a favorable disposition toward instruction as a source of influence on student ratings was also investigated by Treffinger and Feldhusen (59). Using ratings of 192 undergraduate students, 70 percent of which were female, they administered a general instructor rating during the first week of class, then administered the specific instructor rating during the last week of class. They also used several cognitive, personality, and attitude measures, as well as course achievement and final grades, in a step-wise multiple regression analysis, predicting students' ratings of the course and instructor. The most significant predictor of final ratings was the generalized initial ratings, although other variables made contributions to prediction. Student variables accounted for 21 percent of the variance in student ratings

of instruction. Nevertheless, Treffinger and Feldhusen advised caution in the use and interpretation of student ratings, and suggested that perhaps a more useful index might be an indication of the extent to which each students' final rating of his course and instructor has changed from his generalized initial rating. A similar study by Feldhusen and Starks (23) found significant but low correlations between pre-course and end-of-course student ratings of courses and instructors. They concluded that student ratings of a course and instructor are primarily a function of that instructor's competence and the students' perceptions of that competence.

Grush and Costin (26) found no significant correlations with ratings of teacher skill for any of the eight student personality traits investigated, including emotional stability and cautiousness. Turner and others (60, p. 51) found that the more anxious student placed greater emphasis on personal-social instructor behavior, while the less anxious valued the task-oriented and intellectual instructor. Academically poor students preferred instructors who were controlled, relaxed, and accepting, while high scholarship students preferred stimulating, clear, and open-minded instructors. Crowe (18) found that students who agree with

the instructor about the presence and importance of organizational features of the class rate the course higher and achieve higher grades in the course. He also found a significant positive relationship between student ratings and final grade in the course.

McKeachie, Lin, and Mann (37) conducted five studies in which they attempted to validate student ratings of instruction by establishing correlations with student achievement. They found that interaction of student-teacher characteristics was a significant factor in student ratings, in that teachers who were rated high on teaching skill or structure were more effective with female students, teachers who received high ratings on rapport were more effective on measures of student thinking, and teachers who were identified as having an impact on the beliefs of students were effective in changing attitudes of students. McKeachie and his colleagues asserted that in order to determine which teachers are effective, one must consider the objectives of the instruction and the type of students who will receive the instruction. They felt that their five validity studies did not invalidate the use of student ratings, but their results were less convincing than they had hoped for.

V. OTHER FACTORS WHICH INFLUENCE STUDENT RATINGS

Several studies have given attention to other factors which influence student ratings of instruction. Among these factors are the instructions given to the students, prior to their rating their courses and instructors, as to the purpose of their ratings. In a study by Aleamoni and Hexner (7), two groups of students in an undergraduate history course were given different instructions regarding the purpose of their ratings. One group was told that the results of their evaluation would be used for consideration in the promotion and salary of their instructor. The other group of students was told only that the information would be used by the department and college for the improvement of instruction. The students who were informed that their ratings would be used for promotion and salary considerations gave their instructor significantly higher ratings on each of the six factor subscores of the rating instrument.

In a similar study by Gupta (27), three sets of instructions were given to students prior to student ratings of instruction. One group was told that the evaluations would be used by the instructor only, a second group was told that the evaluations would be used by the administration for decisions on faculty, and the third group was

told that the ratings would be made available for use by students for decisions on course and faculty selection. He found no significant differences on student ratings among the three groups; however, he found that graduate students tended to rate teachers higher than undergraduate students, that teaching assistants received higher student ratings than assistant professors and full professors, and that rating as a teacher was significantly related to rating as a person.

Touq and Feldhusen (58) investigated the relationship between students' ratings of instructors and their participation in class discussion. They used eighteen instructors teaching 488 undergraduates in psychology and sociology courses. Two trained observers visited each class two times to record student-teacher interaction, and returned a third time to administer the student evaluations. The instructors nominated the ten students who participated most and the ten students who participated least in class discussions. The results showed that participating students did not rate instructors higher than non-participating students. Touq and Feldhusen conjectured that the lack of significant difference was due to the fact that instructors did not judge well who the participants and non-participants were.

Using participation as identified by the observers using the Flanders system, they found that classes which have higher participation assign higher ratings to their instructors than classes which have lower participation on the variables: Interest in subject, Sympathetic attitudes toward students, Fairness in grading, Liberal and progressive attitudes, Presentation of subject matter, Sense of proportion and humor, Self-reliance and confidence, Personal peculiarities, and Stimulating intellectual curiosity. Touq and Feldhusen also found that instructors who were indirect in their teaching style rated significantly higher on six of the ten variables under consideration. Such instructors tended to provide for more student participation in classroom procedures.

Perry, Niemi, and Jones (47) investigated the effect of prior student ratings and lecture presentation on ratings of teacher performance. They gave half of a group of students a written biography of a lecturer, with a positive evaluation of his past teaching performance, while the remainder of the students received the written biography with a negative evaluation. Prior ratings influenced ratings on several dimensions of the evaluation instrument, with the positive evaluation group rating the professor

significantly higher. They asserted that their results illustrated the self-fulfilling prophecy aspect of student ratings, and recommended that only the most positive evaluations should be publicized. Otherwise, the negative evaluations could lead to poorer students in the professor's courses, which would result in even poorer ratings. Their data also suggested that lecture content can be a major factor in influencing students' ratings of teacher performance.

Kennedy (29) used thirty sections of a required introductory English course to investigate the relationship between grades expected and received and students' ratings of instruction. The students recorded their expected grade during the first week of class, and, when they rated the instructor at the end of the course, they were aware of the grades they had actually received throughout the course. Kennedy found significant differences on all subscales of the evaluation form, with higher grades corresponding to higher student ratings. Further, students who received grades higher than expected rated their teachers significantly higher than students who received grades lower than expected. Kennedy cautioned against using student ratings in such decisions as promotion and salary, and suggested

that student ratings are more appropriate as information for individual teachers than for administrative decisions.

In a related study, Bassin (9) found that, although course difficulty and course grade accounted for only ten percent of the variation in student ratings, this produced a considerable difference in percentile ranks when compared with other instructors.

Carrier, Howard, and Miller (14) used two large lecture groups of introductory psychology students to investigate the effect of having students rate instructors at different times. Student ratings were obtained on the last day of class and again at the time of the final examination. The ratings of students who rated instructors in both instances showed that the context of rating at the time of the final examination did not appear to have any appreciable effect on the ratings. However, students who were absent on the last day of class and rated the instructors only at the final examination period rated the instructors significantly lower than students who rated on both occasions. The investigators conjectured that students who missed the last day of class would tend to have more negative opinions about the course and instructor.

Kohlan (32) obtained student ratings of instructors

after the second class hour and again during the last week of the course. There were significant correlations between the two ratings on factors of structure, rapport, benefit, and overall instructor rating, supporting the contention that early impressions by students are maintained throughout the course. Kohlan also found that upperclass students rated courses and instructors more positively, as did females, students with higher grade point averages, and students in small classes.

Costin, Greenough, and Menges (17), after reviewing several studies on the validity, reliability, and correlates of student ratings, concluded that student ratings can provide reliable and valid information on the quality of courses and instruction, enabling departments to construct normative data to be used in the evaluation of teaching, and enabling individual teachers to improve. They cautioned, however, that student ratings fall far short of a complete assessment of the contributions made by a teacher.

VI. ATTITUDES TOWARD MATHEMATICS

Attitude Scales

Aiken (2, p. 553) described several procedures used to measure attitudes toward mathematics. The first of these,

Thurstone's method of equal-appearing intervals, has been used by Dutton (20), Early (21), and others. In Thurstone's method, a group of judges assign a scale value to each of a series of statements reflecting different degrees of positive and negative attitudes. A respondent's score is the sum or mean of the scale values of the statements which he endorses.

On a Likert attitude scale, the respondent indicates the extent of agreement or disagreement with each of a series of statements expressing positive or negative attitudes, with each response having an assigned value. On both the Thurstone and Likert scales, a higher score indicates a more positive attitude (2, p. 553).

A third method, Guttman's scalogram analysis, is used less frequently for measuring attitudes toward mathematics (2, p. 553). This technique requires that a series of items be scaled on a single factor, so that if a respondent endorses one item in the series, he will endorse all items having a lower scale value. The difficulty involved in the construction of such a scale is cited by Aiken (2, p. 554) as the reason the Guttman procedure is used infrequently.

The semantic differential technique was employed by

McCallon and Brown (34) in a study of attitude toward mathematics. A semantic differential scale consists of a set of bipolar adjectives, such as good-bad and difficult-easy, for which the respondent indicates on a scale whether his feeling toward something is closer to one pole or the other.

Formation and Stability

Aiken (2, p. 556) concluded that very definite attitudes toward mathematics begin as early as the third grade, with grades four through six reported as most influential in the development of such attitudes. Dutton (19) reported that the junior high school years are frequently the most critical point in determining attitudes toward mathematics. Poffenberger and Norton (48) concluded from a study of college freshmen that attitudes toward mathematics begin their development in the early elementary years, and that student attitudes are frequently significantly correlated with attitudes of parents toward mathematics.

The results of the research studies cited in the preceding paragraph give support to the conjecture by Roberts (51) that attitudes toward mathematics of college freshmen have largely crystallized. There is evidence, however,

that attitudes toward mathematics may change as a result of specific courses or instructional methods. Warkentin (62) found that a group of prospective elementary teachers who used manipulative models in their college mathematics course had a significant change in attitudes (more positive), while a control group which did not use manipulative models in their course did not show a significant change in attitudes. Aichele (1) found that a terminal freshman mathematics course had an unfavorable effect on the attitudes toward mathematics of students who took the course.

Group Differences

A study by Newman and others (43) sought to determine initial attitude differences among students who were characterized as successful, procrastinating, or "withdrawn-from-course" students in a personalized system of statistics instruction. They found that students who withdrew from the course showed both a lower degree of interest in doing mathematics problems and greater feelings of anonymity, when compared with the successful group. Procrastinators were also characterized as having feelings of anonymity.

Roberts (51) found that students in an engineering curriculum showed significantly more positive attitudes

toward mathematics than students enrolled in a terminal mathematics course. Roberts also found that students taking the terminal mathematics course in the evening had more favorable attitudes toward mathematics than students taking the same course during the day.

Begle (10) reported that the type of curriculum, modern or traditional, does not affect the pattern of the development of attitudes toward mathematics, which he described as generally favorable in the fourth grade, improving through the sixth grade, then beginning a decline which continues through high school.

Effects on Student Ratings of Mathematics Teachers

Aiken and Dreger (6) found that attitudes toward mathematics were positively correlated with students' ratings of former mathematics teachers, with the correlation being higher for females than for males. Aiken (2, pp. 572-573) commented on these retrospective student ratings by observing that negative attitudes toward mathematics may result in students blaming mathematics teachers for their failures. College men who disliked mathematics reported that their former mathematics teachers had been more impatient and hostile. College women who disliked mathematics claimed that former mathematics teachers were

impatient, grim, brutal, dull, severely lacking in knowledge of the subject, and not knowing anything about how to teach mathematics (2, p. 573). Poffenberger and Norton (48) also found that students with negative attitudes toward mathematics consistently rated their mathematics teachers, elementary school through high school, as poorer teachers than did students with positive attitudes toward mathematics.

CHAPTER III

DESIGN AND PROCEDURES

I. INTRODUCTION

This chapter gives the design of the study and the procedures followed in conducting the study. A discussion of the population, sample, and instruments used in the study is given, along with the notation used and the hypotheses tested. The details of the administration of the questionnaire are given, and the chapter concludes with a description of the types of data obtained and the statistical techniques used in the analysis of the data.

II. DESIGN AND PROCEDURES

The basic problem investigated in the study was the degree of relationship, if any, between attitudes of students toward mathematics and their ratings of mathematics teachers and mathematics courses.

Selection of the Population

The population for the study consisted of students who were enrolled in introductory mathematics courses at Carson-Newman College, Jefferson City, Tennessee.

Selection of the Sample

All students enrolled in the pre-calculus mathematics course or the liberal arts mathematics course during the Fall Semester, 1974 comprised the sample for the study. Students from these two courses were selected for the sample in order to provide two relatively large groups of students with different objectives in mathematics and different attitudes toward mathematics.

Description of the Courses

The course entitled Pre-Calculus Mathematics is designated as Mathematics 133 at Carson-Newman College. This course is designed to provide additional preparation for students who do not feel that their mathematical background is adequate for the study of calculus. The course covers such topics as functions and their graphs, including polynomial, rational, algebraic, exponential, logarithmic, and trigonometric functions. Seventy to 80 percent of the students who take the course usually take at least one additional mathematics course, most often an introductory calculus course.

The course entitled Introduction to Mathematical Thought is designated as Mathematics 135 at Carson-Newman College, and is referred to as the general liberal

arts course in this study. The course is designed for the liberal arts student who wishes to gain some insight into the meaning and methods of mathematics, and who does not plan to specialize in mathematics, science, or other areas which require additional mathematics courses. The course covers such topics as solving equations and inequalities, linear programming, concepts of symbolic logic, and probability. Attention is given to the interaction of mathematics with other areas of academic concern. Usually 50 to 60 percent of the students taking this course take a similar mathematics course the following semester to complete a two-semester sequence.

Number of Participants

There were four sections of pre-calculus mathematics and five sections of the general liberal arts mathematics course in the Fall Semester, 1974, and the attitude and course and instructor evaluation instruments were administered to students in these nine sections. Table 1 shows the number of students enrolled in each section at the beginning of the course and at the time the ratings took place, as well as the number of participants who successfully completed the questionnaire.

TABLE 1

NUMBER ENROLLED AND NUMBER OF PARTICIPANTS

Course	Section	Beginning Enrollment	Final Enrollment	Participants
Mathematics 133 (Pre-Calculus)	1	32	30	23
	2	33	29	17
	3	25	22	17
	4	17	17	9
Mathematics 135 (Mathematical Thought)	1	35	32	18
	2	39	37	29
	3	52	49	29
	4	64	63	34
	5	35	35	28
Total		332	314	204

A total of two hundred four students participated in the study. This number is lower than the enrollment, due to absences from class on the day the ratings were taken, and response sheets which were not completed or were incorrectly marked.

Notation for Subgroups and for Variables Investigated

The following notation for various subgroups and for the variables considered in the study was used in the study.

T: All students who participated in the study. n = 204

M: Male participants. n = 105

F: Female participants. n = 99

PC: Participants who were taking the pre-calculus course, Mathematics 133. n = 66

LA: Participants who were taking the general liberal arts mathematics course, Mathematics 135. n = 138

FR: Participants who were freshmen. n = 136

UC: Participants who were sophomore, junior, or senior students. n = 67

PCM: Male participants who were taking the pre-calculus course, Mathematics 133. n = 41

PCF: Female participants who were taking the pre-

calculus mathematics course, Mathematics 133. n = 25

FRF: Female participants who were also freshman students. n = 71

FRM: Male participants who were also freshman students. n = 65

UCF: Female participants who were also sophomore, junior, or senior students. n = 27

UCM: Male participants who were also sophomore, junior, or senior students. n = 40

LAM: Male participants who were taking the general liberal arts mathematics course, Mathematics 135. n = 64

LAF: Female participants who were taking the general liberal arts mathematics course, Mathematics 135. n = 74

E: Enjoyment of mathematics.

V: Value of mathematics.

A: General attitude toward mathematics.

C: Course rating.

I: Instructor rating.

R: Combined course and instructor rating.

Hypotheses

The following hypotheses were tested at the 0.05 level of significance.

1. There is no significant difference between the

mean scores of male (M) students and female (F) students for the six variables E, V, A, C, I, or R.

2. There is no significant difference between the mean scores of pre-calculus students (PC) and liberal arts students (LA) for the six variables E, V, A, C, I, or R.

3. There is no significant difference between the mean scores of female pre-calculus students (PCF) and male pre-calculus students (PCM) for the six variables E, V, A, C, I, or R.

4. There is no significant difference between the mean scores of freshman students (FR) and upper-class students (UC) for the six variables E, V, A, C, I, or R.

5. There is no significant difference between the mean scores of freshman female students (FRF) and freshman male students (FRM) for the six variables E, V, A, C, I, or R.

6. There is no significant difference between the mean scores of freshman female students (FRF) and upper-class female students (UCF) for the six variables E, V, A, C, I, or R.

7. There is no significant difference between the mean scores of pre-calculus male students (PCM) and

liberal arts male students (LAM) for the six variables E, V, A, C, I, or R.

8. There is no significant difference between the mean scores of freshman male students (FRM) and upper-class male students (UCM) for the six variables E, V, A, C, I, or R.

9. For all students participating in the study, there is no significant correlation between any two of the six varibales E, V, A, C, I, or R.

10. For the group of all male students participating in the study, there is no significant correlation between any two of the six variables E, V, A, C, I, or R.

11. For the group of all female students participating in the study, there is no significant correlation between any two of the variables E, V, A, C, I, or R.

12. For the group of all pre-calculus students participating in the study, there is no significant correlation between any two of the six variables E, V, A, C, I, or R.

13. For the group of all liberal arts students participating in the study, there is no significant correlation between any two of the six variables E, V, A, C, I, or R.

14. For the group of all freshman students participating in the study, there is no significant correlation between any two of the six variables E, V, A, C, I, or R.

15. For the group of all upper-class students participating in the study, there is no significant correlation between any two of the six variables E, V, A, C, I, or R.

Instruments Used in the Study

Two instruments, one a measure of attitude toward mathematics and the other a course and instructor evaluation questionnaire, were combined into a single instrument which was used to obtain the data for the study.

The Mathematics Attitude Scale is a Likert type instrument developed by Aiken (5). Each respondent indicated the extent to which he agreed or disagreed with each of forty statements. Two subsets of the statements were used to obtain scores on two dimensions of attitude toward mathematics. The eleven statements shown in Table 2 were used to assess the students' enjoyment of mathematics, that is, his liking for mathematics problems and mathematical terms, symbols, and computations. The ten statements shown in Table 3 were used to obtain a measure

TABLE 2

STATEMENTS USED TO DETERMINE ENJOYMENT OF MATHEMATICS (E) SCORES, WITH MOST FAVORABLE RESPONSE: STRONGLY AGREE (SA) OR STRONGLY DISAGREE (SD)

Statement	Most Favorable Response
1. I have never liked mathematics and it is my most dreaded subject.	SD
2. Mathematics is enjoyable and stimulating to me.	SA
3. I am interested and willing to use mathematics outside school and on the job.	SA
4. I enjoy going beyond the assigned work and trying to solve new problems in mathematics.	SA
5. Mathematics makes me feel uneasy and confused.	SD
6. Mathematics is dull and boring because it leaves no room for personal opinion.	SD
7. I am interested and willing to acquire further knowledge in mathematics.	SA
8. I would like to develop my mathematical skills and study the subject more.	SA
9. Mathematics is very interesting, and I have usually enjoyed courses in this subject.	SA

TABLE 2 (continued)

Statement	Most Favorable Response
10. Mathematics makes me feel uncomfortable and nervous.	SD
11. I have always enjoyed studying mathematics in school.	SA

TABLE 3

STATEMENTS USED TO DETERMINE VALUE OF MATHEMATICS (V) SCORES, WITH MOST FAVORABLE RESPONSE: STRONGLY AGREE (SA) OR STRONGLY DISAGREE (SD)

Statement	Most Favorable Response
1. Mathematics is not important for the advance of civilization and society.	SD
2. Mathematics is less important to people than art or literature.	SD
3. Mathematics is needed in designing practically everything.	SA
4. Mathematics is needed in order to keep the world running.	SA
5. Mathematics is a very worthwhile and necessary subject.	SA
6. An understanding of mathematics is needed by artists and writers as well as scientists.	SA
7. Mathematics helps develop a person's mind and teaches him to think.	SA
8. Mathematics is not important in everyday life.	SD
9. There is nothing creative about mathematics; it's just memorizing formulas and things.	SD
10. Mathematics has contributed greatly to science and other fields of knowledge.	SA

of each student's understanding and appreciation of the value of mathematics to himself and to society. Responses to all twenty-one items (Tables 2 and 3) determined a general attitude toward mathematics score for each student. The remaining nineteen items of the Mathematics Attitude Scale pertained to interests, achievement, and biographical information.

The responses to each item were "Strongly Agree" (SA), "Agree" (A), "Undecided" (U), "Disagree" (D), or "Strongly Disagree" (SD), having a value of 0, 1, 2, 3, or 4, with higher scores indicating a more favorable attitude toward mathematics.

Aiken (5, p. 69) used a coefficient alpha to determine the internal-consistency reliability for the enjoyment dimension and for the value dimension of the Mathematics Attitude Scale. Coefficient alpha for the E Scale (enjoyment) was 0.95, while the coefficient alpha for the V Scale (value) was 0.85. For the data in the present study, coefficients alpha were 0.94 for the E Scale, 0.74 for the V Scale, and 0.91 for the combined E and V Scales (variable A). The statements which comprised the E Scale and the V Scale pertained to the appropriate dimension under

consideration, so the instrument was assumed to have face validity.

The Course and Instructor Evaluation Questionnaire is a Likert type instrument used in the general evaluation of all faculty members at Carson-Newman College. The instrument has been used at Carson-Newman for two years, and is scheduled to be used for at least two additional years. This questionnaire has also been used in the faculty evaluation program at Cleveland State University (24, p. 159).

Each respondent indicated the extent to which he agreed or disagreed with each of fifty statements. Two subsets of these fifty statements were used to obtain a course rating and an instructor rating by each student. The twenty statements in Table 4 were used to obtain course ratings, and the twenty-two statements in Table 5 were used to obtain instructor ratings. Responses to all forty-two statements determined an overall course and instructor rating by each student.

The responses for the statements were "Strongly Agree" (SA), "Agree" (A), "Disagree" (D), and "Strongly Disagree" (SD), having a value of 1, 2, 3, or 4, with higher scores more favorable.

TABLE 4

STATEMENTS USED TO DETERMINE COURSE RATINGS (C), WITH MOST FAVORABLE RESPONSE: STRONGLY AGREE (SA) OR STRONGLY DISAGREE (SD)

Statement	Most Favorable Response
1. The objectives of this course were not clear.	SD
2. The course held my interest.	SA
3. Not much was gained by taking this course.	SD
4. The text used in this course was helpful.	SA
5. Assigned readings (other than text) were helpful.	SA
6. I did not understand this course.	SD
7. I would recommend this course to others.	SA
8. The course material seemed worthwhile.	SA
9. This was the best course I have ever taken.	SA
10. The instructional material was easy to follow.	SA
11. The course demanded too much outside reading.	SD

TABLE 4 (continued)

Statement	Most Favorable Response
12. The pace of the course was too fast.	SD
13. This course had excellent content.	SA
14. The content of the course was too elementary for me.	SD
15. The course was a very valuable one for me.	SA
16. This course was a complete waste of my time.	SD
17. Overall, the course was good.	SA
18. Information obtained before enrolling in this course was consistent with course content.	SA
19. Other courses in this general area would be of interest to me.	SA
20. This course was consistent with my overall college objectives.	SA

TABLE 5

STATEMENTS USED TO DETERMINE INSTRUCTOR RATINGS (I), WITH MOST FAVORABLE RESPONSE: STRONGLY AGREE (SA) OR STRONGLY DISAGREE (SD)

Statement	Most Favorable Response
1. The instructor stimulated my curiosity about this subject.	SA
2. The instructor encouraged alternative views.	SA
3. The instructor was receptive to the expression of student views.	SA
4. Classroom sessions were worthwhile.	SA
5. My course responsibilities were clearly defined.	SA
6. Help from the instructor outside of class was good.	SA
7. Too much work was assigned outside of class.	SD
8. Teaching appeared to be a chore or routine activity to the instructor.	SD
9. This course was poorly organized.	SD
10. The instructor held the interest of the class	SA
11. I think this course was taught poorly.	SD
12. I liked this method of instruction.	SA

TABLE 5 (continued)

Statement	Most Favorable Response
13. Ideas and concepts were developed too vaguely.	SD
14. Another method of instruction would have been more helpful.	SD
15. I would take another course that was taught in this manner.	SA
16. The teaching methods used were not appropriate for this course.	SD
17. The instructor seemed to be interested in the students as persons.	SA
18. The instructor knew the subject, but could not communicate it to the students.	SD
19. The instructor failed to synthesize, integrate, or summarize effectively.	SD
20. The instructor discouraged the development of new viewpoints and appreciations.	SD
21. Student participation was lacking in this course.	SD
22. The instructor possessed a thorough knowledge of his subject	SA

Finkbeiner, Lathrop, and Schuerger (24) carried out a factor analysis to determine the dimensions of the questionnaire. They identified factors of General Course Attitude, Attitude Toward Examinations, Attitude Toward Method, Rapport, and Work Load. These factors were basically those identified by Meredith (38) and Spencer (54) in other student rating questionnaires.

For the data in the present study, the coefficients alpha, measures of the internal-consistency reliability of the instruments, were 0.93 for the statements which gave the instructor rating, 0.87 for the statements which gave the course rating, and 0.94 for the combined course and instructor rating. The statements on the questionnaire pertained to student opinions of courses and instructors, so the instrument was assumed to have face validity.

Administration of the Questionnaire

The Mathematics Attitude Scale and the Course and Instructor Evaluation Questionnaire were combined in the form of a booklet containing one questionnaire with ninety items. A copy of the questionnaire is given in the Appendix. The participants in the study completed the questionnaire in a regular class meeting, on December 4,

1974 for classes which met on a Monday-Wednesday-Friday schedule, and on December 5, 1974 for classes on a Tuesday-Thursday schedule.

The administration of the instrument was conducted by two Carson-Newman professors, and in no case was the instructor of the class present while the questionnaires were being completed. It was not announced prior to the class meeting that the evaluations would take place. The purpose of the evaluation was described to the students as a research project designed to collect information regarding student opinions of mathematics, mathematics instructors, and mathematics courses. There was no time limit for completing the questionnaire; most students took twenty-five to thirty minutes to mark their responses.

Types of Data Obtained

Using the appropriate weights assigned to the responses to the statements on the questionnaire, six scores were obtained for each student. The Enjoyment of Mathematics (E) Score was obtained by adding the weights of the responses to the eleven statements listed in Table 2, page 45; the Value of Mathematics (V) Score was obtained by adding the weights of the responses to the ten statements

in Table 3, page 47; the General Attitude Toward Mathematics (A) Score was obtained by adding the weights of the responses to the twenty-one statements given in Table 2 or Table 3; the Course Rating (C) was obtained by adding the weights of the responses to the twenty statements given in Table 4, page 50; the Instructor Rating (I) was obtained by adding the weights of the responses to the twenty-two statements given in Table 5, page 52; and the Combined Course and Instructor Rating (R) was obtained by adding the weights of the responses to the forty-two statements given in Table 4 or Table 5.

The questionnaire response sheet for each student contained the student's sex, grade level, section, and course, and his responses to the ninety statements on the questionnaire.

Techniques of Analysis of the Data

The t-test technique was used in testing hypotheses one through eight, using both a pooled variance t (which assumes homogeneity of variances) and a separate variance t. The F-ratio for testing homogeneity of sample variances was computed for each comparison of means. Although some F-ratios were significant, no decision about any hypothesis

was affected by a difference between a pooled variance t value and a separate variance t value. The data were compiled and analyzed by computer, using the Statistical Package for the Social Sciences (SPSS) subprogram T-TEST (45).

Hypotheses nine through fifteen were tested using Pearson product-moment coefficients of correlation. The data were compiled and analyzed by computer, using the SPSS program PEARSON CORR (44).

CHAPTER IV

PRESENTATION AND ANALYSIS OF THE DATA

I. INTRODUCTION

In this chapter the data obtained in the study are presented, and the statistical analysis appropriate for the testing of the hypotheses is given. The data resulted from a questionnaire which was completed by each of two hundred four students who were enrolled in either Mathematics 133, Pre-Calculus Mathematics, or Mathematics 135, Introduction to Mathematical Thought, at Carson-Newman College during the Fall Semester, 1974.

The responses to the questionnaire determined, for each student, a score on each of six variables: Enjoyment of Mathematics (E), Value of Mathematics (V), General Attitude Toward Mathematics (A), Course Rating (C), Instructor Rating (I), and Combined Course and Instructor Rating (R). The first section contains data regarding means of scores on the six variables for fifteen subgroups of the sample population; the next section presents the data, along with the analysis, for comparison of means of scores on the six variables for selected pairs of subgroups

in the study; and the final section gives the data and the analysis for determining the degree of relationship, if any, of the six variables. Individual scores for the six variables are given in the Appendix.

II. MEAN SCORES OF SUBGROUPS ON SIX VARIABLES

Table 6 gives the mean scores on the variables E, V, and A for fifteen subgroups of the sample population. For the variable E, the mean scores range from a low of 18.53 for Group LAF, to a high of 29.84 for Group PCF. The mean score for all students participating in the study, Group T, was 22.96.

The lowest mean score on the variable V was 28.70, for Groups UCM and LAM, while the highest mean score was 43.04, for Group PCF. The mean score for Group T was 29.87.

For the variable A, General Attitude Toward Mathematics, the highest mean score, 61.88, was again attained by Group PCF, pre-calculus female students. The lowest mean score was 48.43, for Group LAF. The mean score for all students, Group T, was 52.83.

Group means on the three variables pertaining to course and instructor rating, C, I, and R, are given in Table 7. The highest mean score on variable C, Course

TABLE 6

GROUP MEANS OF SCORES ON THREE VARIABLES RELATED TO ATTITUDE TOWARD MATHEMATICS

Group	Enjoyment of Mathematics	Value of Mathematics	General Attitude Toward Mathematics
T	22.96	29.87	52.83
M	24.45	29.33	53.78
F	21.38	30.44	51.83
PC	27.39	30.97	58.36
LA	20.84	29.35	50.19
FR	23.57	30.01	53.58
UC	21.67	29.57	51.24
PCM	25.90	30.32	56.22
PCF	29.84	32.04	61.88
FRM	25.09	29.72	54.82
FRF	22.17	30.28	52.45
UCM	23.40	28.70	52.10
UCF	19.11	30.85	49.96
LAM	23.52	28.70	52.22
LAF	18.53	29.91	48.43

TABLE 7

GROUP MEANS OF SCORES ON THREE VARIABLES RELATED TO COURSE AND INSTRUCTOR RATINGS

Group	Course Rating	Instructor Rating	Overall Rating
T	55.29	68.08	123.37
M	55.99	68.13	124.12
F	54.55	68.03	122.58
PC	56.68	66.70	123.38
LA	54.62	68.75	123.37
FR	55.82	67.64	123.46
UC	54.15	68.90	123.04
PCM	56.78	66.37	123.15
PCF	56.52	67.24	123.76
LAM	55.48	69.27	124.75
LAF	53.88	68.30	122.18
FRM	56.98	67.98	124.97
FRF	54.76	67.32	122.08
UCM	54.38	68.38	122.75
UCF	53.81	69.67	123.48

Rating, was 56.78 for Group PCM; the lowest mean was 53.88 by Group LAF, and the mean for Group T was 55.29. Group UCF had the highest mean score, 69.67, on variable I, while Group PCM had the lowest mean score, 66.37. Group T had a mean score of 68.08 on variable I.

On variable R, the Combined Rating, the mean scores ranged from 122.08, for Group FRF, to 124.97, for Group FRM. The mean score for all students, Group T, was 123.37.

III. COMPARISONS OF PAIRS OF GROUP MEANS ON SIX VARIABLES

The t-test technique was used to compare mean scores of the subgroups on six variables. For each comparison an F-test of sample variances was performed to test homogeneity of variances. The value of t assuming equal variances was computed, and this value is referred to as the pooled variance t in the tables in this section. The approximation to t, sometimes called pseudo t, was also computed, and the value is given in the tables as the separate variance t. In no instance did the difference between the values of the pooled variance t and the separate variance t affect the decision about any hypothesis.

Males and Females

The mean scores on the six variables for Groups M and F are given in Table 8. The data revealed a significant difference for Groups M and F only for the variable E; thus Hypothesis 1 was rejected for the variable E, but was not rejected for the variables V, A, C, I, or R.

Pre-Calculus and Liberal Arts

The data on the six variables for Groups PC and LA are shown in Table 9. There were significant differences on the three variables related to attitude toward mathematics: E, V, and A, but not on the variables C, I, or R. Hypothesis 2 was therefore rejected for variables E, V, and A, and was not rejected for variables C, I, or R.

Pre-Calculus Males and Pre-Calculus Females

Table 10 gives the data on mean scores for Groups PCM and PCF. Although Group PCF means on variables E, V, and A were all higher, the differences were not significant at the 0.05 level. Hypothesis 3 was not rejected for all six variables E, V, A, C, I, or R.

TABLE 8

COMPARISON OF MEAN SCORES OF 105 MALE STUDENTS AND 99 FEMALE STUDENTS FOR SIX VARIABLES

Variable	Group	Mean	F Value	Pooled Variance t	Separate Variance t
E	Males	24.45	1.57*	2.17*	2.15*
	Females	21.38			
V	Males	29.33	1.09	1.67	1.67
	Females	30.44			
A	Males	53.78	1.30	1.07	1.06
	Females	51.83			
C	Males	55.99	1.31	1.24	1.24
	Females	54.55			
I	Males	68.13	1.32	0.07	0.07
	Females	68.03			
R	Males	124.12	1.29	0.65	0.65
	Females	122.58			

*Significant at 0.05 level

TABLE 9

COMPARISON OF MEAN SCORES OF 66 PRE-CALCULUS STUDENTS AND 138 LIBERAL ARTS STUDENTS FOR SIX VARIABLES

Variable	Group	Mean	F Value	Pooled Variance t	Separate Variance t
E	PC	27.39	1.03	4.50*	4.52*
	LA	20.84			
V	PC	30.97	1.01	2.29*	2.30*
	LA	29.35			
A	PC	58.36	1.09	4.35*	4.29*
	LA	50.19			
C	PC	56.68	1.15	1.66	1.70
	LA	54.62			
I	PC	66.70	1.09	1.36	1.34
	LA	68.75			
R	PC	123.38	1.05	0.00	0.00
	LA	123.37			

*Significant at 0.05 level

PC = Pre-Calculus students

LA = Liberal arts students

TABLE 10

COMPARISON OF MEAN SCORES OF 41 PRE-CALCULUS MALE STUDENTS AND 25 PRE-CALCULUS FEMALE STUDENTS FOR SIX VARIABLES

Variable	Group	Mean	F Value	Pooled Variance t	Separate Variance t
E	PCM	25.90	1.19	1.63	1.59
	PCF	29.84			
V	PCM	30.32	1.79	1.45	1.56
	PCF	32.04			
A	PCM	56.22	1.07	1.76	1.77
	PCF	61.88			
C	PCM	56.78	1.34	0.13	0.12
	PCF	56.52			
I	PCM	66.37	1.23	0.33	0.32
	PCF	67.24			
R	PCM	123.15	1.18	0.14	0.14
	PCF	123.76			

PCM = Pre-calculus males

PCF = Pre-calculus females

No F or t values are significant at the 0.05 level of significance.

Freshmen and Upperclassmen

Table 11 gives the data for Groups FR and UC; there were no significant differences on any variable, so Hypothesis 4 was not rejected for variables E, V, A, C, I, or R.

Freshman Males and Freshman Females

The data for mean scores on the six variables for Groups FRM and FRF are given in Table 12. No significant differences between the mean scores of the two groups were revealed, so Hypothesis 5 was not rejected for all variables E, V, A, C, I, or R.

Freshman Females and Upper-class Females

Table 13 gives the mean scores on six variables for Groups FRF and UCF, and shows that there were no significant differences between means for any of the six variables. Thus, Hypothesis 6 was not rejected for variables E, V, A, C, I, or R.

Pre-Calculus Males and Liberal Arts Males

Mean scores on the six variables for Groups PCM and LAM are given in Table 14; no significant differences were found. Hypothesis 7 was not rejected for variables E, V, A, C, I, or R.

TABLE 11

COMPARISON OF MEAN SCORES OF 136 FRESHMAN STUDENTS AND 67 UPPER-CLASS STUDENTS FOR SIX VARIABLES

Variable	Group	Mean	F Value	Pooled Variance t	Separate Variance t
E	FR	23.57	1.11	1.24	1.27
	UC	21.67			
V	FR	30.01	1.23	0.63	0.65
	UC	29.57			
A	FR	53.58	1.23	1.20	1.24
	UC	51.24			
C	FR	55.82	1.10	1.35	1.37
	UC	54.15			
I	FR	67.64	1.35	0.83	0.88
	UC	68.90			
R	FR	123.46	1.24	0.16	0.17
	UC	123.04			

FR = Freshman students

UC = Sophomore, junior, or senior students

No F or t values are significant at the 0.05 level of significance.

TABLE 12

COMPARISON OF MEAN SCORES OF 65 FRESHMAN MALE STUDENTS AND 71 FRESHMAN FEMALE STUDENTS FOR SIX VARIABLES

Variable	Group	Mean	F Value	Pooled Variance t	Separate Variance t
E	FRM	25.09	1.57	1.65	1.67
	FRF	22.17			
V	FRM	29.72	1.06	0.66	0.66
	FRF	30.28			
A	FRM	54.82	1.33	1.02	1.02
	FRF	52.45			
C	FRM	56.98	1.38	1.54	1.55
	FRF	54.76			
I	FRM	67.98	1.82*	0.36	0.37
	FRF	67.32			
R	FRM	124.97	1.57	0.96	0.97
	FRF	122.08			

*Significant at 0.05 level

FRM = Freshman male students

FRF = Freshman female students

TABLE 13

COMPARISON OF MEAN SCORES OF 71 FRESHMAN FEMALE STUDENTS AND 27 UPPER-CLASS FEMALE STUDENTS FOR SIX VARIABLES

Variable	Group	Mean	F Value	Pooled Variance t	Separate Variance t
E	FRF	22.17	1.07	1.21	1.22
	UCF	19.11			
V	FRF	30.28	1.92	0.54	0.62
	UCF	30.85			
A	FRF	52.45	1.22	0.78	0.82
	UCF	49.96			
C	FRF	54.76	1.07	0.47	0.48
	UCF	53.81			
I	FRF	67.32	2.92*	0.96	1.20
	UCF	69.67			
R	FRF	122.08	1.75	0.34	0.38
	UCF	123.48			

*Significant at 0.05 level

FRF = Freshman female students

UCF = Sophomore, junior, or senior female students

TABLE 14

COMPARISON OF MEAN SCORES FOR 41 PRE-CALCULUS MALE STUDENTS AND 64 LIBERAL ARTS MALE STUDENTS FOR SIX VARIABLES

Variable	Group	Mean	F Value	Pooled Variance t	Separate Variance t
E	PCM	25.90	1.12	1.34	1.32
	LAM	23.52			
V	PCM	30.32	1.24	1.68	1.64
	LAM	28.70			
A	PCM	56.22	1.23	1.65	1.61
	LAM	52.22			
C	PCM	56.78	1.12	0.84	0.85
	LAM	55.48			
I	PCM	66.37	1.26	1.55	1.51
	LAM	69.27			
R	PCM	123.15	1.08	0.50	0.50
	LAM	124.75			

PCM = Pre-calculus male students

LAM = Liberal arts male students

No F or t values are significant at the 0.05 level of significance.

Freshman Males and Upper-class Males

As revealed in Table 15, there were no significant differences on mean scores for Groups FRM and UCM, so Hypothesis 8 was not rejected for variables E, V, A, C, I, or R.

IV. GROUP CORRELATIONS FOR SIX VARIABLES

This section presents the matrix of Pearson coefficients of correlation, by groups, for all pairs of the variables E, V, A, C, I, or R. The data are presented in the order appropriate for testing Hypotheses 9 through 15.

All Students

Table 16 gives the matrix of Pearson coefficients of correlation for the group of all 204 students participating in the study. All coefficients of correlation given in the table were significant at the 0.05 level of significance. Thus, Hypothesis 9 was rejected for each pair of variables.

Males

Table 17 contains the Pearson coefficients of correlation for Group M; since all coefficients were significant

TABLE 15

COMPARISON OF MEAN SCORES OF 65 FRESHMAN MALE STUDENTS AND 40 UPPER-CLASS MALE STUDENTS FOR SIX VARIABLES

Variable	Group	Mean	F Value	Pooled Variance t	Separate Variance t
E	FRM	25.09	1.07	0.94	0.95
	UCM	23.40			
V	FRM	29.72	1.04	1.05	1.05
	UCM	28.70			
A	FRM	54.82	1.14	1.11	1.13
	UCM	52.10			
C	FRM	56.98	1.00	1.69	1.69
	UCM	54.38			
I	FRM	67.98	1.36	0.21	0.20
	UCM	68.38			
R	FRM	124.97	1.18	0.69	0.68
	UCM	122.75			

FRM = Freshman male students

UCM = Sophomore, junior, or senior male students

No F or t values are significant at the 0.05 level of significance.

TABLE 16

MATRIX OF CORRELATION COEFFICIENTS* FOR SIX VARIABLES FOR ALL STUDENTS PARTICIPATING IN THE STUDY

	E	V	A	C	I	R
E	1.00	0.46	0.95	0.53	0.21	0.39
V	0.46	1.00	0.72	0.41	0.34	0.41
A	0.95	0.72	1.00	0.57	0.29	0.45
C	0.53	0.41	0.57	1.00	0.69	0.90
I	0.21	0.34	0.29	0.69	1.00	0.94
R	0.39	0.41	0.45	0.90	0.94	1.00

*All coefficients of correlation given in the table are significant at the 0.05 level of significance.

TABLE 17

MATRIX OF CORRELATION COEFFICIENTS* FOR SIX VARIABLES FOR ALL MALE STUDENTS PARTICIPATING IN THE STUDY

	E	V	A	C	I	R
E	1.00	0.53	0.94	0.54	0.20	0.38
V	0.53	1.00	0.78	0.49	0.49	0.53
A	0.94	0.78	1.00	0.59	0.34	0.49
C	0.54	0.49	0.59	1.00	0.71	0.91
I	0.20	0.49	0.34	0.71	1.00	0.94
R	0.38	0.53	0.49	0.91	0.94	1.00

*All coefficients of correlation given in the table are significant at the 0.05 level of significance.

at the 0.05 level, Hypothesis 10 was rejected for each pair of variables.

Females

Table 18 contains the Pearson coefficients of correlation for Group F; since all coefficients were significant at the 0.05 level, Hypothesis 11 was rejected for each pair of variables.

Pre-Calculus

Table 19 contains the Pearson coefficients of correlation for Group PC; since all coefficients were significant at the 0.05 level, Hypothesis 12 was rejected for each pair of variables.

Liberal Arts

Table 20 contains the Pearson coefficients of correlation for Group LA; since all coefficients were significant at the 0.05 level, Hypothesis 13 was rejected for each pair of variables.

Freshmen

Table 21 contains the Pearson coefficients of correlation for Group FR; since all coefficients were significant

TABLE 18

MATRIX OF CORRELATION COEFFICIENTS* FOR SIX VARIABLES FOR ALL FEMALE STUDENTS PARTICIPATING IN THE STUDY

	E	V	A	C	I	R
E	1.00	0.46	0.96	0.53	0.22	0.39
V	0.46	1.00	0.70	0.36	0.21	0.30
A	0.96	0.70	1.00	0.54	0.24	0.41
C	0.53	0.36	0.54	1.00	0.68	0.90
I	0.22	0.21	0.24	0.68	1.00	0.93
R	0.39	0.30	0.41	0.90	0.93	1.00

*All coefficients of correlation given in the table are significant at the 0.05 level of significance.

TABLE 19

MATRIX OF CORRELATION COEFFICIENTS* FOR SIX VARIABLES FOR ALL PRE-CALCULUS STUDENTS PARTICIPATING IN THE STUDY

	E	V	A	C	I	R
E	1.00	0.56	0.95	0.61	0.36	0.51
V	0.56	1.00	0.78	0.51	0.46	0.53
A	0.95	0.78	1.00	0.65	0.44	0.58
C	0.61	0.51	0.65	1.00	0.67	0.89
I	0.36	0.46	0.44	0.67	1.00	0.94
R	0.51	0.53	0.58	0.89	0.94	1.00

*All coefficients of correlation given in the table are significant at the 0.05 level of significance.

TABLE 20

MATRIX OF CORRELATION COEFFICIENTS* FOR SIX VARIABLES FOR ALL GENERAL LIBERAL ARTS STUDENTS PARTICIPATING IN THE STUDY

	E	V	A	C	I	R
E	1.00	0.38	0.94	0.49	0.19	0.36
V	0.38	1.00	0.68	0.35	0.32	0.36
A	0.94	0.68	1.00	0.52	0.28	0.42
C	0.49	0.35	0.52	1.00	0.73	0.92
I	0.19	0.32	0.28	0.73	1.00	0.94
R	0.36	0.36	0.42	0.92	0.94	1.00

*All coefficients of correlation given in the table are significant at the 0.05 level of significance.

TABLE 21

MATRIX OF CORRELATION COEFFICIENTS* FOR SIX VARIABLES FOR ALL FRESHMAN STUDENTS PARTICIPATING IN THE STUDY

	E	V	A	C	I	R
E	1.00	0.50	0.95	0.48	0.22	0.36
V	0.50	1.00	0.75	0.41	0.32	0.39
A	0.95	0.75	1.00	0.52	0.28	0.42
C	0.48	0.41	0.52	1.00	0.70	0.90
I	0.22	0.32	0.28	0.70	1.00	0.94
R	0.36	0.39	0.42	0.90	0.94	1.00

*All coefficients of correlation given in the table are significant at the 0.05 level of significance.

at the 0.05 level, Hypothesis 14 was rejected for each pair of variables.

Upperclassmen

Table 22 contains the Pearson coefficients of correlation for Group UC; since all coefficients were significant at the 0.05 level, Hypothesis 15 was not rejected for any pair of variables.

TABLE 22

MATRIX OF CORRELATION COEFFICIENTS* FOR SIX VARIABLES FOR ALL UPPER-CLASS STUDENTS PARTICIPATING IN THE STUDY

	E	V	A	C	I	R
E	1.00	0.36	0.94	0.64	0.22	0.45
V	0.36	1.00	0.66	0.39	0.42	0.44
A	0.94	0.66	1.00	0.66	0.33	0.53
C	0.64	0.39	0.66	1.00	0.70	0.91
I	0.22	0.42	0.33	0.70	1.00	0.93
R	0.45	0.44	0.53	0.91	0.93	1.00

*All coefficients of correlation given in the table are significant at the 0.05 level of significance.

CHAPTER V

SUMMARY AND CONCLUSIONS

I. SUMMARY AND FINDINGS

This study investigated the relationship between students' attitudes toward mathematics and their ratings of mathematics courses and mathematics instructors. Two hundred four students who were enrolled in introductory mathematics courses at Carson-Newman College in the Fall Semester, 1974, completed questionnaires, and their responses determined scores on six variables related to attitudes toward mathematics or evaluations of courses and instructors.

Comparisons of mean scores on the six variables were made for several subgroups of the sample population, using the statistical technique known as the t-test. Pearson coefficients of correlation were calculated for several subgroups of the sample population, to determine the nature of the relationships between the variables.

The major findings of the study were the following:

1. Scores for males and females differed significantly only on the variable enjoyment of mathematics, with male scores more favorable.

2. Scores for pre-calculus students were significantly higher than scores for the general liberal arts students on the three variables related to attitudes toward mathematics, but there were no significant differences on ratings of courses and instructors.

3. There were no significant differences on any of the six variables for these pairs of groups: pre-calculus males and pre-calculus females; freshmen and upperclassmen; freshman males and freshman females; freshman females and upper-class females; pre-calculus males and liberal arts males; and freshmen males and upper-class males.

4. There was a significant positive correlation between the variables general attitude toward mathematics and combined course and instructor rating for these groups: all students in the sample; males; females; pre-calculus students; liberal arts students; freshmen; and upperclassmen. Pearson product-moment coefficients of correlation ranged from 0.41 for females to 0.58 for pre-calculus students, with the correlation of 0.45 for all students in the study.

II. DISCUSSION AND CONCLUSIONS

The finding that males had significantly more favorable attitudes toward mathematics on the variable enjoyment of mathematics, differs from the result of Aiken (5, p. 70), who found no significant difference between male scores and female scores on either enjoyment of mathematics or value of mathematics.

The results of this study showed a significant difference in attitudes toward mathematics between students who were taking the pre-calculus course and students who were taking the general liberal arts mathematics course, with the mean scores of the pre-calculus students significantly higher (more favorable) on the three variables enjoyment of mathematics, value of mathematics, and general attitude toward mathematics. This result is similar to Roberts' finding (51) that engineering students had more favorable attitudes toward mathematics than did students who were taking a terminal mathematics course.

The data revealed a relatively large correlation between students' attitudes toward mathematics and their ratings of mathematics teachers. The coefficient of correlation, 0.45, for variables general attitude toward

mathematics and combined course and instructor rating suggests that student attitudes toward mathematics account for more than 20 percent of the variance in student ratings of courses and instructors. Using Roberts' conjecture (51) that attitudes of college students toward mathematics are largely predetermined when they enter college, this variance is probably related to that identified by Treffinger and Feldhusen (59) as a general predisposition toward instruction. As Bassin (9) pointed out, even a small (10 percent) variation in ratings can produce a considerable difference in percentile rank comparisons with other instructors.

The more favorable attitudes toward mathematics for the pre-calculus students would seem to suggest more favorable course and instructor ratings by that group. Surprisingly, this was not the case in this study. There were no significant differences between pre-calculus students and liberal arts students on the variables course rating, instructor rating, and combined course and instructor rating. One explanation for this result might be that, although they were teaching students with relatively poor attitudes toward mathematics, the instructors in the general liberal arts mathematics course overcame the poor

attitudes through superior teaching. Another explanation could be that, since the pre-calculus course is a prerequisite for later courses, has a more clearly-defined syllabus, and is generally regarded as a more difficult course than the general liberal arts course, other variables counterbalanced the influence of attitudes toward mathematics. In any case, the results underscore the futility of making comparisons of student ratings of instruction for different courses. The development of departmental norms for courses having multiple sections offers a more appropriate basis for comparison.

Some research (62) has shown that significant changes in attitudes toward mathematics may occur over the duration of a college mathematics course. The high correlation between student ratings of instruction and student attitudes toward mathematics, found in this study, suggests that an instructor can achieve higher student ratings if he can contribute to improvements in students' attitudes toward mathematics. Sullivan and Skanes (55, p. 586) found correlations of 0.48, 0.34, and 0.33 between students' course achievements and their ratings of instruction in three mathematics courses having multiple sections. Thus, students' attitudes toward mathematics would seem to be as

important a factor as their achievement in the course in determining their ratings of their instructor. In ten different courses, Sullivan and Skanes found correlations between students' course achievement and instructor rating ranging from -0.28 to 0.58, with an overall correlation of 0.39.

The results of this study strengthened the opinion of the writer that student ratings of instruction should be used and interpreted with extreme caution, due to the incomplete information available as to the factors which influence student ratings.

III. SUGGESTIONS FOR FURTHER RESEARCH

The following suggestions for further research on student ratings are offered with the hope that more pertinent and complete information about student ratings can be obtained.

1. The present study should be replicated, using a different instrument for attitude measurement or a different instrument for instructor ratings.

2. More attention should be given to identifying course procedures, activities, and practices which promote favorable changes in attitudes toward mathematics.

3. Similar studies should be conducted in other academic fields, to determine if similarly high correlations exist between students' attitudes and their ratings of instruction.

4. Longitudinal studies of attitude development should be conducted in mathematics and other areas, extending through the college level.

5. Studies to investigate the long-term effects of student ratings of instruction on all segments of the academic community should be begun.

6. Studies to determine some effective technique for utilizing student ratings of instruction in the improvement of instruction, which is usually stated as the most important justification of student ratings, should be conducted.

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APPENDIX

TABLE 23

INDIVIDUAL SCORES OF PRE-CALCULUS STUDENTS ON SIX VARIABLES

Student	Class	Sex	E	V	A	C	I	R
1	14	M	20	30	50	58	66	124
2	13	M	35	37	72	62	64	126
3	13	F	39	28	67	59	65	124
4	13	F	37	36	73	63	71	134
5	13	F	30	28	58	51	59	110
6	13	M	30	35	65	55	63	118
7	16	M	30	30	60	56	70	126
8	13	M	19	24	43	58	66	124
9	14	F	26	30	56	55	62	117
10	13	F	13	26	39	56	72	128
11	13	F	39	35	74	71	63	134
12	13	M	13	33	46	50	73	123
13	13	M	10	25	35	59	73	132
14	13	F	44	38	82	56	74	130
15	13	M	30	32	62	58	69	127
16	14	M	14	30	44	57	69	126
17	13	M	35	36	71	66	76	142
18	13	F	16	28	44	46	62	108
19	13	M	18	21	39	53	53	106
20	16	M	31	30	61	59	65	124
21	13	M	25	33	58	61	62	123
22	13	F	25	31	56	66	81	147
23	13	F	41	36	77	70	85	155
24	14	F	29	34	63	61	71	132
25	13	M	41	38	79	68	80	148
26	13	F	38	30	68	67	76	143
27	13	F	29	36	65	60	78	138
28	13	M	15	25	40	52	69	121
29	13	M	40	40	80	56	65	121
30	13	M	10	27	37	46	67	113
31	13	M	15	23	38	43	50	93
32	13	M	30	29	59	61	65	126
33	13	F	37	32	69	42	57	99
34	13	F	29	26	55	41	73	114

TABLE 23 (continued)

Student	Class	Sex	E	V	A	C	I	R
35	13	F	31	34	65	65	74	139
36	15	F	12	25	37	49	63	112
37	14	F	38	30	68	63	69	132
38	13	M	10	23	33	41	49	90
39	13	M	30	30	60	60	80	140
40	15	M	26	21	47	50	52	102
41	13	M	28	31	59	59	55	114
42	13	M	32	28	60	61	66	127
43	13	M	20	31	51	54	72	126
44	13	M	40	37	77	75	87	162
45	15	F	17	32	49	48	64	112
46	13	M	27	38	65	60	66	126
47	13	M	26	27	53	58	62	120
48	13	M	31	28	59	56	53	109
49	13	M	31	24	55	49	60	109
50	13	M	37	36	73	62	68	130
51	13	M	15	36	51	57	77	134
52	13	M	32	34	66	60	74	134
53	13	M	24	31	55	56	68	124
54	14	M	29	30	59	64	82	146
55	13	M	43	34	77	68	76	144
56	13	F	28	30	58	51	42	93
57	13	M	36	33	69	61	66	127
58	13	F	35	36	71	53	66	119
59	14	M	25	37	62	56	80	136
60	13	M	28	24	52	57	64	121
61	13	F	40	38	78	65	80	145
62	13	F	42	34	76	60	72	132
63	13	M	17	27	44	53	62	115
64	14	F	15	34	49	49	66	115
65	14	M	14	25	39	33	37	70
66	13	F	16	34	50	46	36	82

TABLE 24

INDIVIDUAL SCORES OF LIBERAL ARTS STUDENTS ON SIX VARIABLES

Student	Class	Sex	E	V	A	C	I	R
1	13	F	25	27	52	60	68	128
2	13	F	13	26	39	40	54	94
3	16	F	7	28	35	45	67	112
4	13	M	28	30	58	62	73	135
5	13	F	28	29	57	55	66	121
6	13	F	21	32	53	63	77	140
7	13	F	20	23	43	58	76	134
8	13	F	12	36	48	57	67	124
9	14	M	28	34	62	65	79	144
10	13	M	29	27	56	61	68	129
11	13	M	21	26	47	57	71	128
12	13	M	21	27	48	63	77	140
13	13	M	21	27	48	61	66	127
14	13	F	23	37	60	56	77	133
15	13	F	11	35	46	68	86	154
16	13	M	32	27	59	61	73	134
17	15	M	11	29	40	47	70	117
18	13	M	32	27	59	66	77	143
19	13	F	25	29	54	48	53	101
20	13	F	31	29	60	46	33	79
21	14	M	26	30	56	51	68	119
22	13	F	13	29	42	48	57	105
23	13	M	24	35	59	58	73	131
24	13	M	14	28	42	56	72	128
25	16	F	4	28	32	40	59	99
26	14	F	13	30	43	55	75	130
27	14	F	28	30	58	57	79	136
28	13	M	31	39	70	42	67	109
29	13	F	30	33	63	67	71	138
30	16	M	12	26	38	51	71	122
31	13	F	29	30	59	66	71	137
32	14	F	43	40	83	61	66	127
33	13	F	2	21	23	32	43	75
34	13	F	1	24	25	31	36	67

TABLE 24 (continued)

Student	Class	Sex	E	V	A	C	I	R
35	13	M	18	26	44	45	68	113
36	13	F	40	39	79	68	83	151
37	13	M	19	26	45	51	63	114
38	14	M	32	31	63	61	76	137
39	14	F	15	33	48	50	71	121
40	13	M	21	36	57	63	77	140
41	14	F	40	32	72	70	86	156
42	13	F	18	28	46	51	64	115
43	15	M	33	25	58	57	64	121
44	13	M	27	26	53	46	55	101
45	15	F	22	30	52	56	72	128
46	14	F	8	27	35	54	65	119
47	14	F	12	30	42	52	67	119
48	14	F	8	31	39	48	72	120
49		F	27	31	58	59	74	133
50	14	M	30	32	62	46	50	96
51	14	M	30	29	59	58	74	132
52	14	F	5	32	37	28	51	79
53	13	F	19	28	47	57	58	115
54	13	F	20	21	41	58	72	130
55	13	F	31	31	62	55	62	117
56	13	F	31	32	63	62	62	124
57	13	M	43	33	76	66	73	139
58	13	M	33	27	60	48	53	101
59	13	F	17	27	44	48	75	123
60	13	M	31	28	59	62	78	140
61	14	M	32	32	64	58	77	135
62	13	M	29	26	55	56	70	126
63	14	M	35	36	71	58	61	119
64	14	M	3	24	27	48	75	123
65	14	F	16	34	50	61	76	137
66	13	F	14	36	50	53	55	108
67	14	M	11	23	34	60	84	144
68	13	F	6	36	42	62	73	135
69	14	M	20	24	44	55	67	122
70	14	F	31	30	61	60	71	131
71	13	F	13	37	50	49	51	100

TABLE 24 (continued)

Student	Class	Sex	E	V	A	C	I	R
72	13	M	31	33	64	67	73	140
73	14	M	13	24	37	57	63	120
74	13	F	7	34	41	44	70	114
75	15	M	12	31	43	54	67	121
76	13	M	24	26	50	53	63	116
77	15	M	27	29	56	60	78	138
78	13	M	17	30	47	57	77	134
79	13	F	24	31	55	56	63	119
80	13	F	41	36	77	56	82	138
81	14	F	16	23	39	57	66	123
82	13	F	7	34	41	55	80	135
83	13	F	0	17	17	61	81	142
84	13	F	25	32	57	58	64	122
85	13	M	17	29	46	56	66	122
86	13	M	26	34	60	53	69	122
87	13	F	20	31	51	60	67	127
88	13	F	4	30	34	52	65	117
89	13	F	21	31	52	57	77	134
90	13	M	32	35	67	71	85	156
91	13	M	18	35	53	66	86	152
92	13	F	15	33	48	66	86	152
93	16	F	19	30	49	53	71	124
94	13	M	19	28	47	72	83	155
95	13	M	14	21	35	45	53	98
96	13	F	12	31	43	48	70	118
97	15	M	13	20	33	38	54	92
98	14	M	28	33	61	59	71	130
99	13	F	18	31	49	53	75	128
100	13	F	15	24	39	44	57	101
101	14	M	26	33	59	57	83	140
102	13	F	22	26	48	56	73	129
103	13	F	21	25	46	53	71	124
104	13	M	33	30	63	58	71	129
105	15	M	33	28	61	57	64	121
106	14	F	24	38	62	64	79	143
107	13	F	21	34	55	70	85	155
108	14	M	29	24	53	52	66	118
109	13	F	8	16	24	59	78	137

TABLE 24 (continued)

Student	Class	Sex	E	V	A	C	I	R
110	14	M	26	31	57	60	66	126
111	14	M	22	20	42	40	50	90
112	14	M	4	23	27	40	59	99
113	13	M	25	28	53	41	55	96
114	13	M	13	28	41	49	61	110
115	13	M	12	26	38	51	68	119
116	13	F	32	36	68	52	61	113
117	13	F	27	27	54	55	71	126
118	13	M	3	18	21	46	55	101
119	13	F	7	23	30	52	63	115
120	13	F	29	25	54	57	71	128
121	14	M	28	33	61	51	63	114
122	14	F	25	31	56	64	75	139
123	14	F	3	29	32	44	71	115
124	14	M	36	33	69	59	74	133
125	14	F	16	27	43	51	76	127
126	13	F	21	34	55	57	74	131
127	13	F	12	29	41	48	64	112
128	14	M	14	28	42	53	73	126
129	13	F	30	33	63	49	73	122
130	13	F	17	24	41	48	70	118
131	14	M	31	34	65	63	73	136
132	14	M	24	34	58	46	78	124
133	13	F	14	26	40	30	46	76
134	13	F	2	26	28	46	67	113
135	14	F	24	35	59	58	71	129
136	14	M	28	17	45	54	59	113
137	14	M	30	33	63	71	85	156
138	14	M	20	32	52	56	72	128

DEPARTMENT OF MATHEMATICS

RESEARCH STUDY

This questionnaire is part of a research study of mathematics students. Your responses to the statements will not be identified with you in any way; do not put your name on any of the materials.

The questionnaire consists of 90 statements, for which you will indicate the extent to which you agree or disagree with each statement. You will mark your responses on the separate answer sheet which has been inserted inside this booklet.

Now remove the "General Purpose-NCS-Answer Sheet" from the booklet, and on the back of the answer sheet, indicate whether you are male or female, and for "Grade or Education," mark 13 if you are a freshman, 14 if a sophomore, 15 if a junior, or 16 if a senior. No other information is necessary; do not put your name or birth date on the sheet. Now turn to the front of the answer sheet, open the booklet, and begin marking your responses to the statements. Use answer spaces 1 through 90; make heavy black marks that fill the circle completely.

Keep your materials until they are called for.

INSTRUCTIONS

The statements on this page and the next two pages refer to your general feeling about mathematics, and not to any one course or instructor, so mark your responses accordingly. Note carefully the sample responses.

SAMPLE RESPONSES	1	2	3	4	5
If you STRONGLY AGREE mark.....	●	○	○	○	○
If you AGREE mark.....	○	●	○	○	○
If you are UNDECIDED mark.....	○	○	●	○	○
If you DISAGREE mark.....	○	○	○	●	○
If you STRONGLY DISAGREE.....	○	○	○	○	●

		1	2	3	4	5
1.	I have never liked mathematics, and it is my most dreaded subject.....	○	○	○	○	○
2.	Mathematics is enjoyable and stimulating to me....	○	○	○	○	○
3.	I like to work with numbers, protractors, compasses and other tools of mathematics.....	○	○	○	○	○
4.	Mathematics is not important for the advance of civilization and society.....	○	○	○	○	○
5.	Mathematics is less important to people than art or literature.....	○	○	○	○	○
6.	Mathematics is needed in designing practically everything.....	○	○	○	○	○
7.	Mathematics should not be required for college students.....	○	○	○	○	○
8.	My mathematics grades have usually been at least as high as my grades in other school subjects.....	○	○	○	○	○
9.	I would rather memorize a list of things than try to solve a hard problem.....	○	○	○	○	○
10.	I am interested and willing to use mathematics outside school and on the job.....	○	○	○	○	○
11.	Mathematics is needed in order to keep the world running.....	○	○	○	○	○
12.	I enjoy going beyond the assigned work and trying to solve new problems in mathematics.....	○	○	○	○	○
13.	Mathematics makes me feel uneasy and confused.....	○	○	○	○	○

SAMPLE RESPONSES	1	2	3	4	5
If you STRONGLY AGREE mark.....	●	○	○	○	○
If you AGREE mark.....	○	●	○	○	○
If you are UNDECIDED.....	○	○	●	○	○
If you DISAGREE.....	○	○	○	●	○
If you STRONGLY DISAGREE mark.....	○	○	○	○	●
	1	2	3	4	5

		1	2	3	4	5
14.	Mathematics is dull and boring because it leaves no room for personal opinion.....	○	○	○	○	○
15.	All students should be required to take mathematics	○	○	○	○	○
16.	I enjoy working geometry problems.....	○	○	○	○	○
17.	I enjoy working algebra problems.....	○	○	○	○	○
18.	I am interested and willing to acquire further knowledge in mathematics.....	○	○	○	○	○
19.	I like mathematics because there is always a correct answer.....	○	○	○	○	○
20.	Mathematics is a very worthwhile and necessary subject.....	○	○	○	○	○
21.	I would like to develop my mathematical skills and study the subject more.....	○	○	○	○	○
22.	Mathematics is very interesting, and I have usually enjoyed courses in this subject.....	○	○	○	○	○
23.	Mathematics makes me feel uncomfortable and nervous	○	○	○	○	○
24.	Word problems in mathematics have always been difficult for me.....	○	○	○	○	○
25.	An understanding of mathematics is needed by artists and writers as well as scientists.....	○	○	○	○	○
26.	Mathematics helps develop a person's mind and teaches him to think.....	○	○	○	○	○
27.	I have always enjoyed studying mathematics in school	○	○	○	○	○
28.	Mathematics is not important in everyday life.....	○	○	○	○	○
29.	I have trouble with some of the terms and symbols in mathematics.....	○	○	○	○	○
30.	There is nothing creative about mathematics; it's just memorizing formulas and things.....	○	○	○	○	○

SAMPLE RESPONSES	1	2	3	4	5
If you STRONGLY AGREE mark.....	●	○	○	○	○
If you AGREE mark.....	○	●	○	○	○
If you are UNDECIDED.....	○	○	●	○	○
If you DISAGREE.....	○	○	○	●	○
If you STRONGLY DISAGREE.....	○	○	○	○	●
	1	2	3	4	5

		1	2	3	4	5
31.	My average grade in almost all school subjects has been "B" or better.....	○	○	○	○	○
32.	I am happier in a mathematics class than in any other class.....	○	○	○	○	○
33.	Mathematics has contributed greatly to science and other fields of knowledge.....	○	○	○	○	○
34.	My father was very good in mathematics.....	○	○	○	○	○
35.	My mathematics teachers either didn't know their subject or weren't able to explain it.....	○	○	○	○	○
36.	My mother always liked mathematics.....	○	○	○	○	○
37.	My mathematics teachers have usually been impatient and demanding.....	○	○	○	○	○
38.	Mathematics has always been my favorite subject.....	○	○	○	○	○
39.	Most successful businessmen are good at mathematics.	○	○	○	○	○
40.	Mathematics is a better subject for boys to study than for girls.....	○	○	○	○	○
		1	2	3	4	5

INSTRUCTIONS

The statements on this page and the next two pages refer to this mathematics course and your present mathematics instructor, so mark your responses accordingly. Note the sample responses.

SAMPLE RESPONSES	1	2	3	4
If you STRONGLY AGREE mark.....	●	○	○	○
If you AGREE mark.....	○	●	○	○
If you DISAGREE mark.....	○	○	●	○
If you STRONGLY DISAGREE.....	○	○	○	●
	1	2	3	4

41.	The objectives of this course were not clear.....	○ 1	○ 2	○ 3	○ 4
42.	The course held my interest.....	○ 1	○ 2	○ 3	○ 4
43.	Not much was gained by taking this course.....	○ 1	○ 2	○ 3	○ 4
44.	The text used in this course was helpful.....	○ 1	○ 2	○ 3	○ 4
45.	Assigned readings (other than text) were helpful.....	○ 1	○ 2	○ 3	○ 4
46.	I did not understand this course.....	○ 1	○ 2	○ 3	○ 4
47.	I would recommend this course to others.....	○ 1	○ 2	○ 3	○ 4
48.	The course material seemed worthwhile.....	○ 1	○ 2	○ 3	○ 4
49.	This was the best course I have ever taken.....	○ 1	○ 2	○ 3	○ 4
50.	The instructional material was easy to follow.....	○ 1	○ 2	○ 3	○ 4
51.	The course demanded too much outside reading.....	○ 1	○ 2	○ 3	○ 4
52.	The pace of the course was too fast.....	○ 1	○ 2	○ 3	○ 4
53.	This course had excellent content.....	○ 1	○ 2	○ 3	○ 4
54.	The content of the course was too elementary for me..	○ 1	○ 2	○ 3	○ 4
55.	The course was a very valuable one for me.....	○ 1	○ 2	○ 3	○ 4
56.	This course was a complete waste of my time.....	○ 1	○ 2	○ 3	○ 4
57.	Overall, the course was good.....	○ 1	○ 2	○ 3	○ 4
58.	Information obtained before enrolling in this course was consistent with course content.....	○ 1	○ 2	○ 3	○ 4

SAMPLE RESPONSES	1	2	3	4
If you STRONGLY AGREE mark.....	●	○	○	○
If you AGREE mark.....	○	●	○	○
If you DISAGREE mark.....	○	○	●	○
If you STRONGLY DISAGREE mark.....	○	○	○	●
	1	2	3	4

		1	2	3	4
59.	Other courses in this general area would be of interest to me.....	○	○	○	○
60.	This course was consistent with my overall college objectives.....	○	○	○	○
61.	The instructor stimulated my curiosity about this subject.....	○	○	○	○
62.	The instructor encouraged alternative views.....	○	○	○	○
63.	The instructor was receptive to the expression of student views.....	○	○	○	○
64.	Classroom sessions were worthwhile.....	○	○	○	○
65.	My course responsibilities were clearly defined.....	○	○	○	○
66.	Help from the instructor outside of class was good.....	○	○	○	○
67.	Too much work was assigned outside of class.....	○	○	○	○
68.	Teaching appeared to be a chore or routine activity to the instructor.....	○	○	○	○
69.	This course was poorly organized.....	○	○	○	○
70.	The instructor held the interest of the class.....	○	○	○	○
71.	I think this course was taught poorly.....	○	○	○	○
72.	I liked this method of instruction.....	○	○	○	○
73.	Ideas and concepts were developed too vaguely.....	○	○	○	○
74.	Another method of instruction would have been more helpful.....	○	○	○	○
75.	I would take another course that was taught in this manner.....	○	○	○	○
76.	The teaching methods used were not appropriate for this course.....	○	○	○	○

SAMPLE RESPONSES

	1	2	3	4
If you STRONGLY AGREE mark.....	●	○	○	○
If you AGREE mark.....	○	●	○	○
If you DISAGREE mark.....	○	○	●	○
If you STRONGLY DISAGREE.....	○	○	○	●
	1	2	3	4

77. The instructor seemed to be interested in the students as persons..... ○1 ○2 ○3 ○4

78. The instructor knew the subject, but could not communicate it to the students..... ○1 ○2 ○3 ○4

79. The instructor failed to synthesize, integrate, or summarize effectively..... ○1 ○2 ○3 ○4

80. The instructor discouraged the development of new viewpoints and appreciations..... ○1 ○2 ○3 ○4

81. Student participation was lacking in this course.... ○1 ○2 ○3 ○4

82. The instructor possessed a thorough knowledge of his subject..... ○1 ○2 ○3 ○4

83. The procedure for grade assignments was fair..... ○1 ○2 ○3 ○4

84. The examinations were fair appraisals of the course content..... ○1 ○2 ○3 ○4

85. Too much emphasis was placed upon the final examination..... ○1 ○2 ○3 ○4

86. The examinations were too long for the time allotted. ○1 ○2 ○3 ○4

87. The examinations were too difficult..... ○1 ○2 ○3 ○4

88. The examinations were unfair..... ○1 ○2 ○3 ○4

89. Rate the overall effectiveness of this course as:
1-Excellent 2-Good 3-Average 4-Below average
5-Poor ..... ○1 ○2 ○3 ○4 ○5

90. Rate the overall effectiveness of this teacher as:
1-Excellent 2-Good 3-Average 4-Below average
5-Poor..... ○1 ○2 ○3 ○4 ○5

VITA

Denver Ray Childress was born in Alcoa, Tennessee on February 5, 1937, the second son of Theodore and Edna Campbell Childress. After attending elementary and secondary schools in Blount County, Tennessee, he graduated from Alcoa High School in 1955. He then enrolled at Maryville College, Maryville, Tennessee on a Hunt Foundation scholarship. In 1959, he received a Bachelor of Science degree from Maryville College, after having received the Knapp Mathematics Prize as the outstanding senior majoring in mathematics. He has done post-graduate work at Middle Tennessee State University, University of California (Santa Barbara), and the University of Tennessee, Knoxville. He received the Master of Mathematics degree in August 1964 and the Doctor of Education degree in August 1975, both from the University of Tennessee.

He has taught at Powell High School, Maryville Junior High School, Maryville High School, Walters State Community College, and the University of Tennessee. He began teaching at Carson-Newman College in 1967, where he is now an assistant professor of mathematics.

He has attended numerous institutes and short courses

sponsored by the National Science Foundation, and held a National Defense Education Act fellowship while at the University of Tennessee. Honors include selection as an Outstanding Educator of America for 1975, and selection for inclusion in the 1975-76 Bicentennial Edition of Personalities of the South. He is a member of the American Association of University Professors, Kappa Mu Epsilon, National Council of Teachers of Mathematics, Mathematics Association of America, and Tennessee Mathematics Teachers Association.

He is married to the former Margaret Anne Haynes, and they have two children, a daughter, Kim, and a son, Mark.