A STUDY OF THE RELATIONSHIP BETWEEN THE RATE OF SUBJECT MATTER PRESENTATION AND ATTITUDE AND ACHIEVEMENT OF HIGH SCHOOL GEOMETRY STUDENTS

by

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CHAPTER I

INTRODUCTION

In 1957, Sputnik I was successfully lifted into orbit by the Soviet Union. Little did anyone realize at the time the impact that it would have on education in the United States in general, and mathematics education in particular. In the early 1950's efforts by such groups as the Commission on Mathematics and the University of Illinois were underway to develop a new secondary school mathematics curriculum. Preliminary reports and materials were becoming available just prior to the launching of Sputnik but little hope was given for their future due to lack of support both financially and publicly. However, the flight of Sputnik, more than any other technological event, caused the problems of mathematics education to be thrust into the public spotlight. Much like a catalyst in a chemical reaction, Sputnik acted to free federal funds for the purpose of developing, discarding, and renovating the content of mathematics courses. The School Mathematics Study Group, Ball State, and the University of Illinois were among several curriculum groups that became the recipients of the newly released funds and within a relatively short period of time the results of their efforts in the form of modern mathematics program materials became available.

The prevailing attitude among many people was and

probably still is that the new materials would more or less take care of any problems that the students had with comprehension, retention, and other assorted learning disabilities. There can be little doubt that the federal funds released by the catalytic action of Sputnik I allowed the development of the finest mathematical materials that this nation had ever known. However, in spite of the fact that improved mathematical content is necessary, it is not, in itself, a sufficient means to achieve the mathematical literacy that our society requires now and in the future. Consequently, the area of mathematics education which demands immediate attention is that of how to teach mathematics or in other words methodology.

The Problem

There are many aspects of methodology that are open to questioning. One such part is that of the rate or pace at which subject matter is presented. This particular aspect of methodology was the object of scrutiny in a study conducted over a 24 week period in the 1971-1972 school year at Shawnee Mission Northwest High School in Shawnee Mission, Kansas. This paper is a report of that study which utilized 191 geometry students at Northwest and which was designed to measure the relationship between subject matter pacing and the attitude and achievement levels of the students.

An attitude scale developed by Lewis R. Aiken was used

to measure the attitudes toward mathematics.[1] Tests constructed through the Question Pool Management System were utilized to measure achievement. Abilities of the students were determined through the Differential Aptitude Test scores. The aforementioned scores were used to develop multiple regression equations to determine the predictiveness of attitude and achievement changes.

Definitions of Terms Used

Achievement. The mean test score for all the tests taken is the achievement of the student.

Attitude. The degree of positive or negative affect associated with some psychological object is the attitude of the student.[2] In this study mathematics is the psychological object and the degree of affect is measured by using an attitude scale.

Differential Aptitude Test (DAT) Scores. The scores from the subtests Verbal Reasoning and Numerical Ability, as well as the combined Verbal Reasoning and Numerical Ability score are referred to as the DAT scores.

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[1]Lewis R. Aiken, Jr., "Personality Correlates of Attitude Toward Mathematics," The Journal of Educational Research, 56:477, May-June, 1963.

[2]Allen L. Edwards, Techniques of Attitude Scale Construction (New York: Appleton-Century-Crofts, Inc., 1957), p. 2.

Limitations of the Study

The study focused its attention on one aspect of methodology which necessitated a change in the traditional educational approach to geometry. All the data were collected during the period of time when the change in instructional pace was being implemented. Consequently all of the problems that come with a developmental program were present during the time of the study. In addition to this primary limitation, it must be emphasized that this study is not an indictment of the value of individualized instruction. It is simply a study of the relationship of one aspect of methodology, which happens to be a means of individualizing instruction, and the attitudes and achievements of a group of high school geometry students.

CHAPTER II

REVIEW OF THE LITERATURE

Attitude

In recent years there has been increased feeling that certain attitudes toward, or beliefs about mathematics are important objectives of instruction. Similarly it is felt that positive attitude toward mathematics plays an important role in causing students to learn mathematics. Research is presently contributing information that sheds some light on the nature and importance of attitudes within the mathematics classroom.

The two chief methods for evaluating pupils' attitudes are (1) direct observation, and (2) attitude scales. Attitude scales are commonly used in research in the study of attitude change resulting from particular experiences.[3]

Personality correlates of attitude. Aiken reported that high scorers on his attitude scale with mathematical ability statistically controlled, tend to be more socially and intellectually mature, more self-controlled, and place more value on theoretical matters than low scorers on the scale. These findings suggest that attitude toward mathematics

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[3]Norman E. Gronlund, Measurement and Evaluation in Teaching (New York: The Macmillan Company, 1968), p. 354.

is related to a broad constellation of personality variables indicative of adjustment and interest.[4]

Formation of attitudes. Norton and Poffenberger suggested the idea that attitudes toward mathematics are a culminative phenomenon, with experience building upon another. They also indicated that attitudes are directly related to the expectation level of the parents and parental encouragement to take mathematics courses was also significantly related to attitudes toward mathematics.[5]

Teachers effect on attitudes. Garner in some work with first-year algebra classes stated that there was a positive relationship between teachers' attitudes toward algebra and the end-of-course attitudes of their pupils.[6] Alpert noted that during the school year attitudes of elementary school students tend to shift toward the attitudes of their teacher.[7]

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[4]Aiken, op. cit., p. 479.

[5]Donald Norton and Thomas Poffenberger, "Factors in the Formation of Attitudes Toward Mathematics," The Journal of Educational Research, 52:172-174, January, 1959.

[6]M. V. Garner, "A Study of the Educational Backgrounds and Attitudes of Teachers Toward Algebra as Related to the Attitudes and Achievements of their Anglo-American and Latin-American Pupils in First-Year Algebra Classes of Texas" (unpublished Doctoral Dissertation, North Texas State University, Denton, Texas, 1963), abstract.

[7]P. H. Dubois and R. L. Feierabend (eds.), Psychological Problems and Research Methods in Mathematics Training (St. Louis: Washington University, 1959).

Achievement

Achievement is usually measured by using teacher-made tests, standardized tests, or letter grades. Many different variables tend to affect achievement. This paper is concerned with the rate of subject matter presentation variable. However in the review of literature, other pertinent variables and their correlation to achievement will be mentioned.

Programmed instruction is probably the most common means of individualizing the rate of instruction. Brown and Abell indicated that general programmed instruction is as effective as traditional teaching.[8]

Torrance and others in working with the characteristics of mathematics teachers that affect students' learning, stated that effectiveness as measured by student learning is not influenced to any significant degree by the length of the teacher's experience in teaching mathematics, his undergraduate and graduate courses and grades, and his participation in professional mathematics organizations. They further stated that the most effective teachers produced a greater variety of ideas about indications of success and failure in their teaching, hypothesized causes of success and failure, and produced a greater variety of alternative

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[8]Theodore L. Abell and Kenneth E. Brown, "Research in the Teaching of High School Mathematics," The Mathematics Teacher, 59:53-56, January, 1966.

ways of teaching mathematical concepts.[9]

With regard to the number of students per classroom, Schunert reported that class size was not significantly associated with achievement in geometry.[10]

Attitude and Achievement

Attitude and achievement are at times involved in studies to determine the effect that they have on each other. Some of these studies are designed to resolve the dilemma of whether favorable attitude causes achievement or whether achievement causes a favorable attitude. Many of the studies reviewed here were concerned not so much with causation, but more so with the degree of correlation between attitude and achievement.

Neale stated that positive or negative attitudes toward mathematics appear to have only a slight casual influence on how much mathematics is learned, remembered, and used.[11] Ellington maintained a stronger point of view as his results indicated a significant positive relationship between attitudes toward mathematics and achievement. He

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[9]E. Paul Torrance and others, "Characteristics of Mathematics Teachers that Affect Students' Learning," Report No. CRP-1020, University of Minnesota, Minneapolis (Contract No. OEC-SAE-8993; U.S. Office of Education, 1966), pp. 93-94.

[10]Jim R. Schunert, "The Association of Mathematical Achievement with Certain Factors Resident in the Teacher, in the Teaching, in the Pupil, and in the School," Journal of Experimental Education, 19:236, March, 1956.

[11]Daniel C. Neale, "The Role of Attitudes in Learning Mathematics," The Arithmetic Teacher, 16:636, December, 1969.

also affirmed that students in college preparatory classes have somewhat more positive attitudes toward mathematics than those in the terminal or general mathematics classes.[12]

Alpert reported significant and positive correlations between student performance (sixth and seventh grade mathematics grades) and high mathematics attitudes, high self-concept, high I.Q., and high level of aspiration.[13] Anttonen arrived at somewhat similar results which indicated moderate correlations of mathematics attitude scores in eleventh and twelfth graders. Achievement was also greater for students whose attitudes had remained favorable or had become favorable since elementary school.[14]

Rosenthal and Jacobson suggest rather strongly that teachers' expectations of students' abilities not only condition the teachers' attitudes, but also affect the students' self-concept and condition their scholastic achievement.[15]

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[12]James B. Ellington, "Evaluation of Attitudes of High School Students Toward Mathematics," (unpublished Doctoral Dissertation, University of Oregon, Eugene, Oregon, 1962), abstract.

[13]R. Alpert, D. Becker, and G. Stellwagon, "Psychological Factors in Mathematics Education," School Mathematics Study Group Newsletter, 15:24, 1963.

[14]R. G. Anttonen, "An Examination into the Stability of Mathematics Attitude and its Relationship to Mathematics Achievement from Elementary to Secondary School Level," (unpublished Doctoral Dissertation, University of Michigan, Ann Arbor, Michigan, 1967), abstract.

[15]Lenore Jacobson and Robert Rosenthal, Pygmalion in the Classroom (New York: Holt, Rinehart and Winston, Inc., 1968), p. 121.

The review of literature indicated that the attitudes of students were strongly influenced by both the attitudes of parents and teachers. Expectation levels of parents and teachers also contributed to more favorable attitudes. There was also evidence to support the conclusion that achievement and attitude are significantly correlated.

CHAPTER III

METHOD

Prerequisites of the Study

In undertaking a study which required some changes in the traditional instructional approach to geometry, three prerequisites must be satisfied. First, the physical facilities must be adequate to meet the special resource needs necessitated by changes in the instructional procedures. In addition to the media center, Northwest has a staffed audio-visual materials production center and a TV studio which allows the production of videotapes for use on the Dial Access Retrieval System. Accompanying these facilities is a combination mathematics-science resource and testing center which houses the mathematics resource books as well as providing a separate area for the taking of tests.

The second requirement is that the philosophy of the school must be supportive of this type of investigative activity. As a part of the staff's commitment, the philosophy of Shawnee Mission Northwest High School states that staff members shall be professional through implementing innovations in teaching; shall create interest by developing various methods of presentations and activities; and shall gear courses individually through developing and utilizing a variety of learning materials. Any one of the preceding

statements was enough to support the efforts needed to carry out the study.

The third condition and probably the most important is that of the willingness of the faculty to participate in an investigative activity of this nature. Four staff members, totaling 25 years of teaching experience, were involved in the study. Three of the four had utilized individually paced as well as teacher paced instruction at Northwest in the previous school year. The attitudes, from the author's point of view, of the participating faculty was most excellent as they willingly carried out the varied tasks within the two instructional situations.

Description of the Study

The study was inaugurated by administering an attitude scale to all geometry students. This occurred on the first full day of classes in the 1971-1972 school year. At this juncture, after a detailed explanation, the students were given the choice of the type of subject matter pacing they wanted to experience in their instruction. The two choices were teacher paced instruction, where the rate of content presentation was controlled by the teacher, and individually paced instruction, where the rate was left entirely up to the individual student.

At the end of the first three weeks all students were given the option of either remaining in their present instructional situation or switching to the other type.

Approximately one-fifth of the students decided to exercise this option with the vast majority of them selecting the teacher paced classroom. The switching option remained in effect for the duration of the study, but was used minimally after the first three weeks. The switching by some students necessitated the creation of a third group within the framework of the study which was simply called the mixed instruction group.

At the end of 24 weeks, the attitude scale was administered for a second time. Any data collected on any student that for one reason or another failed to take both administrations of the attitude scale were deleted from the study. The end of the 24 week period also signaled the cutting off of the recording of any additional test scores. It was at this stage that the data were compiled for treatment and analysis.

Treatment of the Data

The data consisted of a group number, the initial and final attitude scores, all the unit test scores, the mean test score, and the DAT scores. This information was punched onto data processing cards and subjected to analysis using computer programs from the Funstat Package.[16]

Attitude scores for both administrations of the

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[16]John T. Roscoe, "Multiple Regression Program" (The Funstat Package, Kansas State University, Manhattan, Kansas, 1971), p. 98.

attitude scale were separated according to instructional groups and the means calculated and subsequently compared. A somewhat similar procedure was utilized with scores from the unit tests. For each group and for each unit test a mean score was computed and the results compared. The concluding portion of the treatment of the data made use of multiple regression equations to determine the degree of relationship between combinations of predictor variables and the dependent variables of attitude change and achievement.

Description of the Students in the Study

Initially all students that were enrolled in geometry at the beginning of the school year were involved in the study. Data collected on individuals that dropped out of geometry, moved in after the first of the school year, or failed to take both administrations of the attitude scale were deleted from use in the study prior to treatment and analysis of the data. Before any real significance can be attached to the analysis of the data, information was needed as to the socio-economic backgrounds, as well as the academic backgrounds of the students within the study.

Shawnee Mission Northwest is located in a rapidly growing district suburban to Kansas City, Kansas. The district has five high schools of which Northwest is the newest having opened its doors for the first time three years ago. There is a wide range of economic levels in the

district, but in general, family incomes are high. Average income in the county is the fourth highest in the nation. The educational level of the district is also rather high, serving as it does as a bedroom community for many of the business and professional people of Kansas City. However the specific area served by Northwest is not quite typical of Shawnee Mission as a whole. Economically, families in the Northwest would fall more in the middle ranges. Northwest as a school draws a fully comprehensive student body both in the range of learning abilities and socio-economic backgrounds, more so than any of the other high schools in Shawnee Mission.

Academically, these students, most of whom are sophomores, are in the regular or college bound mathematics track. This means that the individual has successfully completed algebra I in the ninth grade and by following the prescribed sequence will be enrolled in algebra II in the eleventh grade and trigonometry and analytical geometry in the twelfth grade.

Students in the accelerated track of the mathematics program completed geometry in the ninth grade and as sophomores are enrolled in algebra II. As a result this study does not include as many of the mathematically gifted individuals as it would have if the tracking did not exist. This does not mean to say that the students in this study are at best, above average in mathematical ability. Selection

for the accelerated program occurs at the completion of the sixth grade and extends partially into the seventh grade. There is a wide margin of uncertainty when trying to predict academic capabilities at this early age. Consequently, the students enrolled in geometry ran the gamut of capabilities, from the unusually bright to students who are in the terminal stages of their mathematics education.

The academic backgrounds of the students were similar to the extent that they had all successfully completed algebra I which is the prerequisite to geometry. This in itself does not reveal much in terms of the capabilities of the individuals under investigation. In order to obtain additional information concerning the abilities of the students in their respective instructional groups, scores from the Differential Aptitude Tests were secured.[17]

There are eight tests within the battery of tests known as the DAT, two of which are designed to measure the aptitudes of verbal reasoning and numerical ability. These are the only two tests within the DAT that are administered to students at Northwest in the fall of their sophomore year. Separate scores for the two test were reported as well as a combined score for verbal reasoning and numerical ability. The scores were presented in percentile form and were based on national norms.

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[17]George K. Bennett, Harold G. Seashore, and Alexander G. Wesman, Differential Aptitude Tests Manual (fourth edition; New York: The Psychological Corporation, 1966).

TABLE I

DAT PERCENTILE SCORES FOR THE THREE INSTRUCTIONAL GROUPS

Verbal Reasoning

	Range			
	Low	High	Mean	Standard Deviation
Teacher Paced	10	99	67.2	21.7
Individ Paced	10	99	70.8	21.8
Mixed Instruc	25	99	66.8	20.2

Numerical Ability

	Range			
	Low	High	Mean	Standard Deviation
Teacher Paced	10	97	61.8	22.3
Individ Paced	25	99	67.8	20.8
Mixed Instruc	5	99	63.2	25.5

Verbal Reasoning and Numerical Ability

	Range			
	Low	High	Mean	Standard Deviation
Teacher Paced	15	99	65.8	21.3
Individ Paced	15	99	71.2	20.2
Mixed Instruc	10	99	66.1	21.7

NOTE: The three instructional groups contained 91, 60, and 40 students respectively.

Description of the Instructional Groups

Teacher paced instruction. The teacher paced instruction was characterized by the flow of subject matter being entirely controlled by the teacher. The lecture-discussion method was the primary means of presenting the subject matter to the classes of 25 to 35 students. Assignments were given with the answers readily available to the students. The work for these assignments was collected on a random basis. Short unannounced quizzes were also given at irregular intervals throughout the 24 week period. Each chapter was generally broken up into two or three units. Tests over the behavioral objectives for the units were taken as a group.

The principal curriculum resource was the textbook, Modern School Mathematics Geometry.[18] Supplementary explanation sheets were also used. Programmed practice booklets were available but seldom utilized. The physical resources were limited to the ones in the classroom due to the fact that the students were not allowed to leave the classroom during the class period. They were allowed to make full usage of any materials within the media center and the mathematics-science resource center on their own time. The human resources consisted of a professional staff person and

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[18]Mary P. Dolciani, Alfred J. Donnelly, and Ray C. Jurgensen, Modern School Mathematics Geometry (Boston: Houghton Mifflin Company, 1969).

students within the classroom since the students were allowed to work in groups.

Individually paced instruction. The individually paced program was significantly different from the teacher paced program in that the responsibility for the amount of content matter covered was shifted from the teacher to the individual student. With the acceptance of this responsibility, there also came some freedom of movement away from the classroom to the media center or the mathematics-science resource center. This was a distinguishing characteristic of the individually paced approach.

The primary curriculum resource was the textbook previously mentioned. In addition to the text, each student was given a syllabus of suggested exercises as well as comments about the material. Also available were several worksheets with accompanying audio tapes which were used in conjunction with the Dial Access Retrieval System in the media center or with cassette tape recorders. Programmed practice books for geometry and algebra, teacher's editions and answer keys to the geometry textbook, and other mathematics textbooks were also on hand.

The classes ranged in size from twenty to thirty students. Within the classes, there were probably as many study approaches as there were students. In many instances the syllabus provided the general guidelines for studying a particular unit. Although the emphasis was placed on

individual problem solving, the teacher nonetheless maintained a dominant role as the source of help in the solution of a problem. Often times the teacher was found in a lecture-discussion situation, similar to that of the teacher paced instruction, but involving a much smaller number of individuals. In addition to the teacher as a human resource, students acted as valuable resources to each other.

Tests were given to the students when they felt that they had mastered a particular unit to their satisfaction. The unit tests and retake opportunities were identical to the ones used in the teacher paced classes. Although tests were taken at the discretion of the students, a fixed number of unit tests had to be completed in order to receive a full credit in geometry.

In order to insure that the subject matter was being presented or examined with the same emphasis in both the teacher paced and individually paced classes, behavioral objectives were written for each unit. These objectives were in turn passed on to the students. As a result, unit tests were designed to measure the degree to which students had achieved these objectives.

Unit tests. A Question Pool Management System was developed at Northwest that allows a number of equivalent forms of a unit test to be constructed. In essence, the system contains a comprehensive pool of evaluative questions which are stored in the district computer. A comprehensive

catalog lists all the questions that are available as well as classifying the questions according to chapter, section, and behavioral objective. A test may be generated by the computer by a wide range of controls which vary from random selection to question by question specification.

Using the Question Pool Management System, four to six tests were generated for each unit. Due to the number of equivalent forms of each unit test, students were allowed to retake a unit test any number of times. The score received on the last test taken for a particular unit was used for grading purposes. This procedure was utilized in all geometry classes regardless of the pacing of the instruction. However, for the purposes of this study, the scores used as data represent only the first attempts at the unit tests.

Attitude Scale

The attitude scale was administered twice, once at the beginning of the school year and a second time at the end of 24 weeks. The scale was one that was developed by Lewis R. Aiken, Jr.[19] Aiken's scale was constructed using the Likert method of scale construction which is also called the method of summated ratings. The purpose of the scale was to measure the degree of positive or negative affect associated with mathematics. The purpose of two

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[19]Aiken, op. cit., p. 477.

administrations of the scale was to measure the change in attitude toward mathematics that may have occurred within the 24 week period.

Twenty statements were included in the scale. Ten statements were favorable toward mathematics and ten were unfavorable. The twenty statements were arranged in a random order so as to prevent the use of response sets. The students were asked to respond to each one in terms of their own agreement or disagreement with the statements. In obtaining responses the students were permitted to use any one of five categories: strongly agree, agree, undecided, disagree, or strongly disagree. The categories of response were weighted in such a way that the response made by the individuals with the most favorable attitudes toward mathematics had the highest positive weight. For the favorable statements this was the "strongly agree" category and for the unfavorable statements it was the "strongly disagree" category. For favorable statements, the strongly agree response was given a weight of four, the agree response a weight of three, the undecided response a weight of two, the disagree response a weight of one, and the strongly disagree response a weight of zero. For unfavorable statements, the scoring system was reversed, with the strongly disagree response given the four weight and the strongly agree response the zero weight.

In order to secure a score for an attitude scale constructed using the method of summated ratings, the responses

to the statements are weighted as previously described and the weights are then summed. As a result the higher the score the more favorable the attitude toward mathematics the student would be assumed to possess. The attitude scale can be found in the Appendix.

The basic design of the study was to create two instructional groups, one with rate of instruction controlled by the teacher and the other with the rate controlled by the individual student. A third group, mixed instruction, was created out of necessity by students that switched from one primary group to the other. Ability levels of the groups were determined using the DAT scores. Initial and final mean attitude scores for the three groups were computed and compared. The same procedure was used for the scores from the unit tests to measure achievement. The mean scores for attitude and achievement in conjunction with the DAT scores were placed in multiple regression equations to determine the degree of relationship between certain predictor variables and attitude change and achievement.

CHAPTER IV

RESULTS

The results are based on data accumulated from 191 geometry students. Of the 191 students, 91 were in the teacher paced group, 60 in the individually paced program, and 40 in the mixed instruction group.

Attitude

The individually paced students as a group had the highest mean score on both administrations of the attitude scale. The teacher paced group's mean score was the lowest on the first trial, while the mixed instruction group reported the lowest mean score on the second administration. All attitude changes on the average were in a negative direction. The smallest change was experienced by the teacher paced group and the largest change was recorded by the mixed instruction group. The individually paced group's mean change was only one tenth of a point from that of the mixed instruction group. The attitude scale scores are summarized in Table II.

TABLE II

MEAN ATTITUDE SCALE SCORES FOR THE THREE INSTRUCTIONAL GROUPS

	First Admin		Second Admin		
Group	Mean	Stand Dev	Mean	Stand Dev	Change
Teacher Paced	43.6	13.3	42.5	12.8	-1.1
Individ Paced	47.6	15.1	42.6	17.1	-5.0
Mixed Instruc	46.2	15.7	41.1	15.7	-5.1

Interpretation of the Attitude Results

All three instructional groups experienced a decline in the mean of their attitude scores. The change in the mean score for the teacher paced group was the smallest of the three groups. The relative stability of this mean score may in part be attributed to the fact that the students were operating within an instructional situation that was familiar to them, that of the teacher-centered classroom. It is the author's opinion that familiarity with a particular situation reduces an individual's fear of that situation. The attitude scale was in a sense trying to measure the amount of fear associated with the situation involving mathematics.

For many students, the individually paced program was a new educational experience. The responsibility for covering the content material was transferred from the teacher to the student. It may have been that this added responsibility compounded the frustration that generally accompanies any new learning situation. Other reasons why the attitude

levels might have fallen all focus on the stark newness of the individually paced program. Many of the materials were new and being tried for the first time. Resource materials on the whole were highly dependent on reading skills. Early class rolls were inadequate which hindered the teachers in getting to know the students as well as the students getting to know each other. This was especially important because by knowing other students, an individual picked up additional sources of information and help.

The mixed instruction group consisted of those students that at one time or another in the course of the 24 week period, switched from the teacher paced program to the individually paced program or vice versa. The large majority of the individuals in the mixed instruction group switched from the individually paced to the teacher paced instruction. The primary reasons for the switch centered about the need for more structure in the pacing of the subject matter. For some this voluntary switch back to the teacher paced class may have been a confidence shattering experience because their original choice indicated they thought they could proceed on their own, whereas their switch back in a way admits for them that they could not do it on their own.

There is little doubt that studying on an individualized basis carries a certain amount of prestige with it because only certain groups of people are allowed at Northwest to be part of this type of a program. If the student felt

this way, then a switch back would have amounted to a loss of prestige to the individual. This could most definitely result in a change in attitude directed toward the object that caused the loss. In any of the previous instances, switches were made due to some form of dissatisfaction with the preceding type of instruction. It would not at all be unreasonable for this dissatisfaction to surface in the form of an attitude change in the negative direction.

Achievement

The individually paced group accounted for the highest mean test scores in nine out of the fifteen reported tests and the second highest scores on five other occasions. The teacher paced group ranked second with mean test scores that were highest for three of the tests and second highest for six other tests. Certain unit tests, as reflected in the percentile scores, had a greater degree of difficulty than other tests. This was particularly true for unit tests 5B, 7A, 9A, and 9C. These scores are summarized in Table III.

Interpretation of the Achievement Results

The individually paced group consistently scored at a higher level in comparison to the other groups. This occurred in spite of the feeling of the staff that many of the students in this group took the unit tests for the first time as pretests. This was far more common, in the opinion of the participating faculty, in the individually paced classes than in the other two groups regardless of the fact

TABLE III

TEST SCORES FOR THE THREE INSTRUCTIONAL GROUPS

	Teach Pace		Indiv Pace		Mixed Pace		
Test	Mean	St Dev	Mean	St Dev	Mean	St Dev	Unit Content
1A	71.5	12.5	75.4	12.8	66.8	15.8	Language of Sets
1B	74.9	15.6	78.2	12.0	72.2	16.0	Angles & their Measures
2A	65.9	14.8	73.2	19.0	76.5	18.3	Induction
2B	73.1	13.0	68.0	18.1	59.3	17.9	Deduction & Prin. of Logic
4	68.3	14.8	67.9	19.3	69.4	13.4	Angle Relations & Perpend. Lines
5A	67.9	13.2	71.2	15.1	71.1	14.4	Parallel Lines & Planes
5B	62.0	19.8	63.2	20.3	64.1	19.5	Apply. Parallels to Polygons
6A	75.4	14.1	75.1	14.6	71.7	16.6	Proving Triangles Congruent
6B	68.8	12.0	70.2	14.9	69.9	15.8	Apply. Congruent Triangles
7A	62.3	16.0	65.2	17.2	62.1	19.1	Quadrilaterals
7B	82.6	14.3	78.9	13.2	77.4	20.1	Inequalities
8	65.2	14.7	66.8	20.4	64.1	17.2	Similar Polygons
9A	60.8	17.7	61.4	23.3	58.3	18.9	Simil. Triangles & Pythag. Thm.
9B	69.4	16.1	78.2	17.0	78.1	17.7	Apply. Pythag. Theorem
9C	46.1	18.5	56.8	21.3	51.3	16.4	Trigonometry

NOTE: The test scores are in percentage form and represent the scores on the first attempt at the unit tests.

that all the students had the same retake opportunities. It is the author's opinion that the higher test scores are the consequence of ability levels that are greater on the average than those of the students in either the teacher paced or the mixed instruction groups. This was borne out by the DAT scores in Table I.

Multiple Correlation Coefficients

Multiple correlations were established between certain predictor variables and the dependent variables attitude change and achievement. The correlation coefficient is useful as an index of relationship between predictor and dependent variables. Highest correlations were found to exist between achievement and the DAT scores as a group, and achievement and the DAT scores individually. The lowest correlation occurred between achievement and the instructional group. Table IV summarizes the multiple correlation coefficients (Mult-R) for achievement and certain predictor variables. Table V summarizes using attitude change as the dependent variable.

Interpretation of the Multiple Correlation Coefficients

Based upon the results shown in Tables IV and V, the following conclusions were reached:

1. The type of pacing the student selected had no significant effect on achievement or on attitude change.
2. Initial attitude was not a determining factor in achievement, but it was significantly correlated to attitude change in a negative way.

TABLE IV

MULTIPLE CORRELATION COEFFICIENTS FOR ACHIEVEMENT AND PREDICTOR VARIABLES

Predictor Variable(s)	Mult-R	Significant at .01 Level
Instructional Group	.0340	No
Initial Attitude	.1600	No
Final Attitude	.3310	Yes
Attitude Change	-.2145	No
Verbal Reasoning(VR)	.4438	Yes
Numerical Ability(NA)	.6075	Yes
VR + NA	.6065	Yes
DAT Scores	.6354	Yes

TABLE V

MULTIPLE CORRELATION COEFFICIENTS FOR ATTITUDE CHANGE AND PREDICTOR VARIABLES

Predictor Variable(s)	Mult-R	Significant at .01 Level
Instructional Group	.1814	No
Initial Attitude	.3889	Yes
Final Attitude	-.4323	Yes
Achievement	-.2145	No
Verbal Reasoning(VR)	.0622	No
Numerical Ability(NA)	.0788	No
VR + NA	.0896	No
DAT Scores	.1113	No

3. The best single predictor of achievement was the Numerical Ability score from the DAT.

4. The best combined group of predictors of achievement was the 3 DAT scores.

5. There was a significant correlation between achievement and the final attitude score. This was also true for attitude change and the final attitude.

In summary, the analysis of the data revealed that the pacing of subject matter presentation, whether it was controlled by the student or the teacher, had no significant effect on achievement and/or attitude change. In addition to this, the DAT scores as a unit acted as the best predictors of achievement. There was also a significant relationship between achievement and the final attitude score. In conclusion, the analysis demonstrated that the initial attitude was not a significant factor in predicting achievement.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

It was the purpose of this study to determine the relationship between the rate of instruction and the attitudes and achievement of geometry students at Shawnee Mission Northwest High School in Shawnee Mission, Kansas. The study utilized two types of instructional pacing. The two groups, teacher paced and individually paced, differed in that the pacing was controlled by the teacher in the former and the student in the latter. A third group was formed, mixed instruction, which consisted of the students that had switched from one of the primary groups to the other.

The ability levels of the three groups were determined by using the DAT scores. Attitudes were measured by administering an attitude scale at the beginning and at the end of the 24 week period of the study. Mean scores were calculated for all three groups and the results compared. Achievement was measured using equivalent forms of unit tests. Mean scores for each test and each group were computed and compared. Multiple regression equations were used to determine the degree of correlation between certain predictor variables and the dependent variables attitude change and achievement.

Scores from the DAT, the attitude scale, and the unit tests were punched onto data processing cards. Analysis of the data took place at Kansas State University, Manhattan, Kansas using programs from the Funstat Package.

The analysis revealed that the mean scores for attitude declined for all three instructional groups with the teacher paced group having the smallest drop. For achievement, the individually paced group consistently scored higher than the other two groups. The multiple correlation coefficients indicated that the type of pacing the student selected had no significant effect on achievement or on attitude change; that final attitude was significantly correlated to achievement; and that the best single predictor of achievement was the Numerical Ability score from the DAT.

Conclusions

The mean attitude scores declined in all of the instructional groups. The drop was relatively small for the teacher paced group which may indicate that any improvements in students' attitudes will depend largely on the teachers' abilities to make geometry interesting. The larger falls in attitudes experienced by the other two groups probably reflects on the newness of the individual pacing program and the uncertainties and instructional materials problems that accompanied this new instructional method at Northwest.

The analysis indicated that the type of pacing was not significantly related to achievement. Consequently this

seems to reinforce the notion that achievement was largely due to ability. The multiple regression analysis affirmed this belief by reporting that the best single predictor of achievement was the Numerical Ability score from the DAT. The analysis also confirmed that final attitude and achievement are significantly correlated, which was stated as a result in some of the literature under review.

Recommendations

The analysis of the data implied that pacing affected attitude negatively and that it had no significant relationship to achievement. In canvessing the staff involved in this study it was felt that the chances of affecting attitude and achievement positively through the offering of different rates of instruction would be increased if the following recommendations were implemented:

1. All students should be in a teacher paced instructional setting for the first three weeks, after which the students may select with a little better knowledge of the situation the type of pacing they want in their instruction.
2. Parental permission should be obtained in order to proceed with individually paced instruction.
3. Greater efforts need to be made to learn the names and faces of the students early in the school year.
4. More time needs to be invested by the staff in the area of student motivation.
5. Improved resources should be developed, especially in the nonverbal category.

The recommendations are presently being prepared for installation in the coming school year. The preparations

are being made through the efforts of a summer geometry workshop. Particular attention is being given to the construction of resource materials consistent with the wide range of abilities in the geometry program.

BIBLIOGRAPHY

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BOOKS

Bennett, George K., Harold G. Seashore, and Alexander G. Wesman. Differential Aptitude Tests Manual. Fourth edition. New York: The Psychological Corporation, 1966.

Dolciani, Mary P., Alfred J. Donnelly, and Ray C. Jurgensen. Modern School Mathematics Geometry. Boston: Houghton Mifflin Company, 1969.

Dubois, P. H., and R. L. Feierabend (eds.). Psychological Problems and Research Methods in Mathematics Training. St. Louis: Washington University, 1959.

Edwards, Allen L. Techniques of Attitude Scale Construction. New York: Appleton-Century-Crofts, Incorporated, 1957.

Gronlund, Norman E. Measurement and Evaluation in Teaching. New York: The Macmillan Company, 1968.

Jacobson, Lenore, and Robert Rosenthal. Pygmalion in the Classroom. New York: Holt, Rinehart and Winston, Inc., 1968.

McIntosh, Jerry H. (ed.). Perspectives on Secondary Mathematics Education. New Jersey: Prentice-Hall, Inc., 1971.

Roscoe, John T. Fundamental Research Statistics. New York: Holt, Rinehart and Winston, Inc., 1969.

PUBLICATIONS OF THE GOVERNMENT, LEARNED SOCIETIES, AND OTHER ORGANIZATIONS

Torrance, E. Paul, and others. "Characteristics of Mathematics Teachers that Affect Students' Learning," Report No. CRP - 1020, University of Minnesota, Minneapolis, Contract No. OEC - SAE - 8993: U.S. Office of Education, 1966.

PERIODICALS

Abell, Theodore L., and Kenneth E. Brown. "Research in the Teaching of High School Mathematics," The Mathematics Teacher, 59:53-56, January, 1966.

Aiken, Lewis R., Jr. "Personality Correlates of Attitude Toward Mathematics," The Journal of Educational Research, 56:476-479, May-June, 1963.

Alpert, R., D. Becker, and G. Stellwagon. "Psychological Factors in Mathematics Education," School Mathematics Study Group Newsletter, 15:17-24, 1963.

Blum, Martha Perkins, and Wilbur H. Dutton. "The Measurement of Attitudes Toward Arithmetic with a Likert-Type Test," The Elementary School Journal, 68:259-264, February, 1968.

Neale, Daniel C. "The Role of Attitudes in Learning Mathematics," The Arithmetic Teacher, 16:631-640, December, 1969.

Norton, Donald, and Thomas Poffenberger. "Factors in the Formation of Attitudes Toward Mathematics," The Journal of Educational Research, 52:171-176, January, 1959.

Schunert, Jim R. "The Association of Mathematical Achievement with Certain Factors Resident in the Teacher, in the Teaching, in the Pupil, and in the School," Journal of Experimental Education, 19:219-236, March, 1951.

UNPUBLISHED MATERIALS

Anttonen, R. G. "An Examination into the Stability of Mathematics Attitude and its Relationship to Mathematics Achievement from Elementary to Secondary Level," Unpublished Doctoral Dissertation, University of Michigan, Ann Arbor, Michigan, 1967.

Ellington, James B. "Evaluation of Attitudes of High School Students Toward Mathematics," Unpublished Doctoral Dissertation, University of Oregon, Eugene, Oregon, 1962.

Garner, M. V. "A Study of the Educational Backgrounds and Attitudes of Teachers Toward Algebra as Related to the Attitudes and Achievements of their Anglo-American and Latin-American Pupils in First-Year Algebra Classes of Texas," Unpublished Doctoral Dissertation, North Texas State University, Denton, Texas, 1963.

Roscoe, John T. "Multiple Regression Program." The Funstat Package, Kansas State University, Manhattan, Kansas, 1971.

APPENDIX

APPENDIX

LEWIS R. AIKEN'S REVISED MATHEMATICS ATTITUDE SCALE

Directions: Please write your name in the upper right hand corner. Each of the statements on this opionnaire expresses a feeling which a particular person has toward mathematics. You are to express, on a five-point scale, the extent of agreement between the feeling expressed in each statement and your own personal feeling. The five points are: Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), Strongly Agree (SA). You are to encircle the letter(s) which best indicates how closely you agree or disagree with the feeling expressed in each statement AS IT CONCERNS YOU.

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

12.	When I hear the word math, I have a feeling of dislike.	SD	D	U	A	SA
13.	I approach math with a feeling of hesitation, resulting from a fear of not being able to do math.	SD	D	U	A	SA
14.	I really like mathematics.	SD	D	U	A	SA
15.	Mathematics is a course in school which I have always enjoyed studying.	SD	D	U	A	SA
16.	It makes me nervous to even think about having to do a math problem.	SD	D	U	A	SA
17.	I have never liked math, and it is my most dreaded subject.	SD	D	U	A	SA
18.	I am happier in a math class than in any other class.	SD	D	U	A	SA
19.	I feel at ease in mathematics, and I like it very much.	SD	D	U	A	SA
20.	I feel a definite positive reaction to mathematics; its enjoyable.	SD	D	U	A	SA

A STUDY OF THE RELATIONSHIP BETWEEN THE RATE OF SUBJECT MATTER PRESENTATION AND ATTITUDE AND ACHIEVEMENT OF HIGH SCHOOL GEOMETRY STUDENTS

by

VAN LORENS ROSE

B.S., Kansas State University, 1968

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

College of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1972

This paper is a report of a study involving 191 geometry students at Shawnee Mission Northwest High School in Shawnee Mission, Kansas. The study, which was conducted over a 24 week period, was designed to measure the relationship between the rate of subject matter presentation and attitude and achievement. The students by choice were divided into two groups. In the teacher paced group, the rate of presentation of the subject matter was controlled by the teacher. In the individually paced group, the rate was governed by the student. Students that could not function optimally in one group were allowed to switch to the other group. Individuals that switched were categorized as the mixed instruction group.

An attitude scale was administered at the beginning of the school year and again at the end of the 24 week period. The scores from the scale were separated according to instructional groups. The mean scores were computed and the changes noted. It was found that the mean scores dropped for the individually paced and mixed instruction groups, and remained nearly the same for the teacher paced group. The drop was attributed to the newness of the individually paced program and the difficulties with the instructional materials that are inherent in newly initiated educational programs.

The second part of the study involved the measure of achievement. This was accomplished by constructing several forms of the same unit tests. The test scores for the three groups were accumulated and the mean scores calculated. The

individually paced program had the highest mean score in nine of the 15 tests and the second highest in five other tests. The fact that they consistently achieved higher than the other two groups was accounted for by their capabilities which according to the Differential Aptitude Test scores, on the average, surpassed those in the other two groups.

The concluding portion of the study used multiple regression equations to determine the correlation between other variables and attitude or achievement. The results indicated that the instructional group had no significant effect on achievement and a negative effect on attitude change; that the best predictor of achievement was the DAT scores; and that achievement and the final attitude was significantly related.

In conclusion, the report noted that the individualized pacing of instruction was of merit provided some modifications were implemented. These recommendations were formulated on the basis of the data and the author's knowledge of the program and its problems. All students should be retained in the teacher paced environment for three weeks before they are given the option of instruction on an individually paced basis. The second recommendation of major importance involved the construction of better resource materials that are not highly dependent on reading skills.