DOCUMENT RESUME

ED 030 203 EA 002 323

By-Hagan, Anastasia M.

An Analysis of the Relationship of Scheduled Class Time and Achievement under Two Methods of Instruction.

Abington High School, Pa. North Campus.
Spons Agency-Office of Education (DHEW), Washington, D.C. Bureau of Elementary and Secondary Education.
Report No-DPSC-67-4194, ESEA-Title-3
Pub Date Jun 67
Note-46p.
EDRS Price MF-$0.25 HC-$2.40
Descriptors-*Academic Achievement, Bibliographies, Grade 9, *Independent Study, Intelligence Quotient, Mathematics, Post Testing, Pretesting, *Programed Texts, Questionnaires, *Schedule Modules, Statistical Analysis, *Student Attitudes

The purpose of this Title III study was to compare the achievement and attitudes of ninth-grade algebra students who used programed texts with those of students who used conventional texts when the students were given a choice of varying degrees of classroom contact with the teacher. Following pre-unit tests of achievement and of attitudes toward independent study, programed texts, and mathematics, 42 students were divided into three sections taking 10, six, and three modules of class per week, respectively. Each section was then halved, one half using a programed text and the other using a conventional text. Tests were given again at the end of the unit. The results indicated that achievement may be inversely related to the amount of scheduled class time and bears no relation to type of text used. A decrease in preference for independence was noted both when the group was divided according to time and when divided according to type of text used, a similar change in attitude toward programed materials was observed. Attitude toward mathematics seemed to remain unchanged. Because of the small sample size the results of the study are somewhat inconclusive. A larger study conducted over a longer period of time is urged. (DE)

AN ANALYSIS OF THE RELATIONSHIP OF SCHEDULED CLASS TIME AND ACHIEVEMENT UNDER TWO METHODS OF INSTRUCTION

by

Anastasia M. Hagan

ABINGTON HIGH SCHOOL NORTH CAMPUS

Abington, Pennsylvania

June, 1967

ACKNOWLEDGMENT

The writer wishes to express appreciation to Dr. Joseph E. Ferderbar for his assistance in the development of this project and for permission to use the attitude inventories which he constructed for his doctoral study.

In addition, sincere thanks are offered to Dayton Kreider for his permission to conduct this research with three mathematics classes and for his cooperation in administering the pre-tests and post-tests to his class so that they could participate as a control group.

And finally, the writer is grateful to Barbara Flexer for her able help in the computation of the statistical data collected as part of the study.

TABLE OF CONTENTS

LIST OF TABLES

THE PROBLEM

Educators who are currently involved in designing innovative programs have suggested the use of both independent study and programed instruction at the secondary level.[1] Independently, both learning techniques are founded in an educationally-sound philosophy and can be supported by favorable research. At the same time, both are relatively new to American education and therefore present a number of unexplored possibilities for use in the secondary school. It seems, for example, that a program in which independent study and programed instruction complement each other may provide an efficient technique for teaching a structured subject such as mathematics.

Focusing on mathematics as an example of a structured subject, a review of completed research studies indicates that few studies have considered a program involving independent study and programed instruction. At the college level, Bartz and Darby conducted a scientific study of Supervised and Non-supervised Programed Instruction in the University Setting and later studied The Effects of a Programed Textbook on Achievement Under Three Techniques of Instruction.[2] In the first, results indicated that students who worked

---

[1] J. Lloyd Trump and Lois S. Karasik, Focus on the Individual - A Leadership Responsibility. (Washington, D. C.: National Association of Secondary School Principals, National Education Association, 1965).

[2] Wayne H. Bartz and Charles L. Darby, "The Effects of a Programed Textbook on Achievement Under Three Techniques of Instruction," The Journal of Experimental Education, XXXIV (Spring, 1966), 46-52.

independently of classroom supervision on a programed text did not perform as well on achievement tests as students supervised in their study of programed text. Again, in the second study, the post-test mean of the students using programed texts in full-time independent study was the lowest of all six groups (three techniques, two types of texts). In the same study, it was also noted that a large proportion of all students in independent study failed. Those students, however, on programed texts and attending all classes, required the least amount of extra help.

With respect to attitudes, the results showed that the students using programed materials in class were most favorable, while students using programed materials in independent study were the least favorable. Of those using the non-programed text, the highest percentage of favorable responses came from the students attending all classes while the least favorable came from those studying independently who were required to meet with the instructor once a week.

The authors of the study propose the following possible reasons for the project's results: (1) The course was the lowest-level mathematics offered at the university and the students in the course tend to be less able, mathematically as well as emotionally, for the independent approach; and (2) the authors of the programed texts had suggested a periodic testing to check progress, but the testing during this program was limited to a pre-test and a post-test.

At the secondary level, a plan for Independent Mathematics Study was devised and tested in 1960 at Urbana High School, Urbana, Illinois.[3] The program provided for releasing the more capable students from the structured class situation in order to work at individual paces. The student had to maintain an "A" average in order to continue to be eligible for participation in the program. He also had the option of returning to the regular class at any time. Programed materials, however, were not part of either the in-class or out-of-class study program.

Evaluation of the plan was done solely by teacher opinion which indicated that the successful pupils possessed certain characteristics in addition to the necessary ability and that few of these successful students ever elected to return to the regular class.

An Independent Classroom Experiment Using Teaching Machine Programed Material was tried in 1962 at the Moline Senior High School, Moline, Illinois.[4] Impetus for the program came from the expanding range of individual differences which presented a difficult teaching situation by March 1 of the school year. It was then decided that a six-week period would be devoted to learning by using programed materials. During this time, extra help would be available for the

---

[3] M. J. Brannon, "Individual Mathematics Study Plan," The Mathematics Teacher, LV (January, 1962), 52-56.

[4] George L. Henderson, "An Independent Classroom Experiment Using Teaching Machine Programed Materials," The Mathematics Teacher, LVI (April, 1963), 248-251.

slower learner and the better students would have an opportunity to advance.

Evaluation of the program was accomplished through the use of student essays and periodic testing. Although student reaction, as indicated by the essays, was varied, the periodic testing showed an increase in ability to factor, to read and comprehend skills and to use the mathematical nomenclature.

In reporting the results, the author expressed both positive and negative reactions toward programed instruction. He felt that, while programed instruction can be an effective teaching aid to supplement conventional classroom teaching and to provide one plan for remedial work, self study and tutoring, it cannot be used full time or replace the standard features in the public schools.

Consideration of these studies reveals that there is value in individualizing instruction in mathematics. However, it can also be noted that not all students were successful in an independent program or in a programed instruction program. In proposing further study of the use of independent study and programed materials in the mathematics curriculum, I recommend that the student be prepared to study independently and that his position in a class be determined by his own preference for independence and for programed materials.

The purpose of this study, then, is to determine the achievement of ninth-grade students studying algebra through the use of programed materials or through the conventional method of teacher

instruction when these students are given the option to have varying degrees of in-class contact with the teacher. The following hypotheses will be tested:

1. There are no significant differences among the achievement scores of students attending class three, six or ten modules per week.
2. There is no significant difference between the achievement scores of students using programed texts and students using conventional texts.
3. There are no significant differences in attitudes toward independence of students attending class three, six or ten modules per week.
4. There is no significant difference in attitude toward the use of programed materials of students using programed texts and students using conventional texts.
5. There is no significant difference in attitude toward mathematics as a result of the unit.

METHODOLOGY

During the third quarter of the 1966-67 school year, forty-two ninth-grade algebra students were divided into three sections. One section was scheduled for ten modules (twenty-three minutes each) of class per week; a second section was scheduled for six modules of class per week; and a third section was scheduled for three modules of class per week. In addition, each of these sections was further divided into two groups; one assigned to using a conventional text and the other to using a programed text.

The students were all enrolled in the ninth-grade, first-ability level, mathematics program and had completed the S.M.S.G. First Course in Algebra, volume I, during the first semester. During the experimental unit, the course of study was the S.M.S.G. First Course in Algebra, volume II, and the S.M.S.G. Programed First Course in Algebra (Revised Form H), volume II.

Prior to the beginning of the unit, the students who were to be given the opportunity to select an amount of class time were assigned two independent study projects which were designed to help them become familiar with the mathematical resources available within the school and to orient them toward the use of non-scheduled class time for independent study. Both of the projects allowed for released time from class since most of the students were carrying heavier than normal rosters. (See appendix B for the specific independent study assignments and time schedules.)

At the completion of the second independent study project, questionnaires were administered to measure attitudes toward independence and toward programed materials. The scale which evaluated attitude toward independence is of the Likert-type and was developed for this study. It consists of twelve statements, with a possible range of twelve to sixty points for each student. The coefficient of reliability was .71 when the scale was tested on a sample population of 100 students.

The inventories which were used to measure attitude toward programed materials and toward mathematics were developed by Dr. Joseph E. Ferderbar in his unpublished doctoral dissertation.[5] Both are also of the Likert-type and include twelve statements with a similar point range.

On the day preceding the beginning of the unit, the students completed the questionnaire concerning attitude toward mathematics and the pre-test achievement test which was the Cooperative Algebra II - Form B - test published by Educational Testing Service.

Grouping was done on the basis of the results of the inventories concerned with attitude toward independence and with attitude toward programed materials. In a small number of cases, scheduling conflicts forced some limitations on the groups available to the

---

[5] Joseph E. Ferderbar, Changes in Selected Student Attitudes and Personality Measures and Their Relationship to Achievement, Intelligence, and Rate When Using Programed Instruction. (Unpublished Doctoral Dissertation, University of Pittsburgh, 1963), 30-32.

student. In no case was a student placed in a group which represented the extreme opposite of his choice. The control group for the project included students who continued to meet for class the scheduled ten modules and who continued to use the conventional text. These students comprised the only group which was not given the opportunity to select the amount of class time and the type of text to be used.

During the unit, each student in a programed group worked at his own pace. The student took each chapter test when he felt that he was ready for it. Teacher help was available during class and during the students' independent study modules. In addition, help was available in the school mathematics center.

Students working in the conventional text groups which met for class six modules and for three modules per week received all assignments one to two weeks ahead of time. The long-range assignment sheets enabled the students to plan their time and to arrange for any necessary extra help. Such a plan was especially essential for those students who reported to class only three modules per week and where the limited amount of class time did not allow for such operational procedures as announcing assignments. All students in the conventional text groups took the chapter achievements together on a given date.

The time schedule for the unit is given below and the teacher roster for the program follows.

December 23 - Administration of two attitude tests

January 23 - Administration of third attitude scale and pre-achievement test

January 24 - Beginning of the unit

April 4 - Completion of the unit - Administration of post achievement test and attitude scales.

DAILY SCHEDULE

Module	Monday	Tuesday	Wednesday	Thursday	Friday
A	T_{10}	T_{10}	T_{10}	T_{10}	T_{10}
B	T_{10}	T_{10}	T_{10}	T_{10}	T_{10}
C	P_3, P_{10}	P_{10}	P_3, P_{10}	P_{10}	P_3, P_{10}
D	P_{10}	P_{10}	P_{10}	P_{10}	P_{10}
E	T_3	T_6, P_6	T_6, P_6	T_6, P_6	T_3
F	T_6, P_6	P_6	T_3	T_6	T_6, P_6

P_3 - Programed text, three modules

P_6 - Programed text, six modules

P_{10} - Programed text, ten modules

T_3 - Conventional text, three modules

T_6 - Conventional text, six modules

T_{10} - Conventional text, ten modules

In analyzing the final scores on both the achievement test and the attitude questionnaires, an analysis of covariance takes into account differences among the pre-test scores and therefore, where a significant difference is noted, it can reasonably be attributed to the treatment rather than initial differences or sampling fluctuations. Evaluation of the unit, therefore, was designed to include analyses of covariance which would indicate the acceptance or rejection of each of the null hypotheses by statistically testing for: (1) differences between achievement scores of students using programed texts and of students using conventional texts, (2) differences among achievement scores of students using ten, six or three modules per week of scheduled class time, (3) differences in attitude toward independence of students attending class ten, six or three modules per week, (4) differences in attitude toward the use of programed materials of students using programed and students using conventional text books, (5) differences in attitude toward mathematics of students using programed texts and students using the conventional texts, and (6) differences in attitude toward mathematics of students attending class ten, six or three modules per week.

In addition, the evaluation will also include the computation and testing of the following correlation coefficients:

I.Q. and: pre-attitude toward independence
pre-attitude toward programed materials
pre-attitude toward mathematics

Change in attitude toward independence and:

change in attitude toward programed materials

change in attitude toward mathematics

change in achievement

Change in attitude toward programed materials and:

change in attitude toward mathematics

change in achievement

Change in attitude toward mathematics and achievement.

Since the sample size is extremely small, apparent significant results must be noted with caution. However, the study is designed to include the statistical evaluation so that any indicated favorable results may encourage replication on a broader basis.

PRESENTATION AND ANALYSIS OF DATA

The data collected during the study is presented in eight sections: Change in Achievement, Change in Attitude toward Independence, Change in Attitude toward Mathematics, Change in Attitude toward Programed Materials, Correlation of I.Q. and pre-test attitude inventories, Correlation of Change in Attitude toward Independence and selected variables, Correlation of Change in Attitude toward Mathematics and selected variables, and Correlation of Change in Attitude toward Programed Materials and selected variables.

A. Change in Achievement

Mean post-test achievement scores are given by the following matrix:

	10 mod	6 mod	3 mod	total
Programed	18.14	20.14	22.00	20.10
Text	18.71	18.57	22.50	19.80
Total	18.43	19.36	22.23	19.95

The final scores represent a mean-gain over pre-test scores of 2.4 for the 10-module students; 3.4 for the 6-module students and 5.3 for the 3-module students.

From the summary of the analysis of covariance which is presented in TABLE I, a slight significant difference among the final achievement scores of the three groups is indicated.

TABLE I

THE EFFECT OF AMOUNT OF SCHEDULED CLASS TIME ON ACHIEVEMENT
ANALYSIS OF COVARIANCE SUMMARY

	Sum of Squares		Sum of Products	Sum of Squares Residuals	Degrees of Freedom	Variance Estimate
	Σx^2	Σy^2	Σxy	$\Sigma y'^2$		
Among groups				79.35	2	39.68
Within groups	903.01	1017.87	669.97	520.80	37	14.08
Total	894.00	1109.80	675.00	600.15	39	

F = 2.82 $.10 > P > .05$

TABLE II

ACHIEVEMENT PRE-TEST MEANS OF TEN, SIX AND THREE-MODULE GROUPS
ANALYSIS OF VARIANCE SUMMARY

	Sum of Squares	Degrees of Freedom	Variance Estimate
Among groups	.79	2	.40
Within groups	1.41	3	.47

F = .85 $P > .10$

TABLE III

ACHIEVEMENT POST-TEST MEANS OF TEN, SIX AND THREE-MODULE GROUPS
ANALYSIS OF VARIANCE SUMMARY

	Sum of Squares	Degrees of Freedom	Variance Estimate
Among groups	15.89	2	7.95
Within groups	1.52	3	.51

F = 15.6 $.05 > P > .025$

A further study of the pre-test and post-test scores was done by using an analysis of variance to test the two sets of scores. TABLE II presents the summary of the statistical analysis of the pre-test scores and TABLE III lists the summarized results of the statistical test of the post-test scores. These analyses show that while the ten, six and three module groups performed alike on the pre-test, they differed significantly on the post-test.

With reference to the type of text used, the students using a programed text gained an average of 3.7 points while the students using the conventional text gained an average of 3.45 points. The results of the analysis of covariance, as presented in TABLE IV, indicates no significant difference between the two groups. Again, when measured by using an analysis of variance on the pre-test and post-test (as summarized in TABLES V and VI), no significant difference is noted between the scores of students using the conventional text and the students using the programed text either on the pre-test or on the post-test.

In summary, a change in achievement is noted as resulting from the varied amount of scheduled class time but not from the use of a certain type of text book.

TABLE IV

THE EFFECT OF TYPE OF TEXT ON ACHIEVEMENT
ANALYSIS OF COVARIANCE SUMMARY

	Sum of Squares		Sum of Products	Sum of Squares Residuals	Degrees of Freedom	Variance Estimate
	Σx^2	Σy^2	Σxy	$\Sigma y'^2$		
Among groups				24.35	1	24.35
Within groups	956.52	1109.01	714.16	575.80	38	15.15
Total	894.00	1109.80	675.00	600.15		

F = 1.61 P > .10

TABLE V

ACHIEVEMENT PRE-TEST MEANS OF PROGRAMED AND TEXT GROUPS
ANALYSIS OF VARIANCE SUMMARY

	Sum of Squares	Degrees of Freedom	Variance Estimate
Among groups	.29	1	.29
Within groups	2.01	4	.50

F = .58 P > .10

TABLE VI

ACHIEVEMENT POST-TEST MEANS OF PROGRAMED AND TEXT GROUPS
ANALYSIS OF VARIANCE SUMMARY

	Sum of Squares	Degrees of Freedom	Variance Estimate
Among groups	.03	1	.03
Within groups	17.40	4	4.35

F = .01 P > .10

B. Change in Attitude toward Independence

The following mean scores resulted from the post-unit administration of the inventory concerned with attitude toward Independence:

	10 mod	6 mod	3 mod	total
Programed	32.14	46.43	45.17	41.05
Text	44.28	44.00	43.43	43.90
Total	38.21	45.21	44.23	42.51

A definite decrease in favorability is noted as the final scores represent the mean change of -6.2 for the ten-module students, -.4 for the six-module students and -4.8 for the three-module students.

Testing the results with an analysis of covariance, the summary given in TABLE VII indicates a significant difference between the groups as a result of the treatment.

Considering the groups using programed and conventional texts, the final mean scores represent a net decrease of 4.9 for the students using programed materials and 3.0 for the students using the conventional text. An analysis of covariance, summarized in TABLE VIII, indicates that the unit resulted in a significant difference between the groups.

With respect to change in attitude toward Independence, therefore, the unit seemed to influence an unfavorable decrease in preference for independent study both within the groups as divided according to time and when divided by type of text used.

TABLE VII

THE EFFECT OF AMOUNT OF SCHEDULED CLASS TIME ON ATTITUDE TOWARD INDEPENDENCE
ANALYSIS OF COVARIANCE SUMMARY

	Sum of Squares		Sum of Products	Sum of Squares Residuals	Degrees of Freedom	Variance Estimate
	Σx^2	Σy^2	Σxy	$\Sigma y''^2$		
Among groups				289.19	2	144.60
Within groups	810.51	1676.87	720.14	1037.02	37	28.03
Total	915.66	2076.22	859.80			

F = 5.16 .025 > P > .01

TABLE VIII

THE EFFECT OF TYPE OF TEXT ON ATTITUDE TOWARD INDEPENDENCE
ANALYSIS OF COVARIANCE SUMMARY

	Sum of Squares		Sum of Products	Sum of Squares Residuals	Degrees of Freedom	Variance Estimate
	Σx^2	Σy^2	Σxy	$\Sigma y''^2$		
Among groups				19.13	1	19.13
Within groups	954.31	1992.71	808.89	1307.08	38	34.40
Total	985.66	2076.22	859.80			

F = .56 .025 > P > .01

TABLE IX

THE EFFECT OF AMOUNT OF SCHEDULED CLASS TIME ON ATTITUDE TOWARD PROGRAMED MATERIALS
ANALYSIS OF COVARIANCE SUMMARY

	Sum of Squares		Sum of Products	Sum of Squares Residuals	Degrees of Freedom	Variance Estimate
	Σx^2	Σy^2	Σxy	$\Sigma y''^2$		
Among groups				346.11	2	173.06
Within groups	3757.25	5560.52	2093.81	4393.70	37	118.75
Total	4125.93	5791.09	2082.67			

F = 1.46 P > .10

C. Change in Attitude toward Programed Materials

Final mean scores of each group with respect to Attitude toward programed materials is given below:

	10-mod	6-mod	3-mod	total
Programed	27.71	38.29	28.67	31.70
Text	30.29	29.86	29.57	29.90
Total	29.00	34.07	29.12	30.78

These scores represent a mean decrease of 9.0 for the ten-module group, .08 for the six-module group and 2.0 for the three-module group.

The analysis of covariance, which is presented in TABLE IX, indicates that there is no significant difference among the three groups as a result of the unit.

Considered as two groups divided according to type of text, the final scores represent a mean decrease of 1.7 for the group using programed texts and a mean decrease of 6.0 for the group using the conventional text.

According to the analysis of covariance which is tabulated in TABLE X, there is no significant difference between the two groups as a result of the unit.

In summary, it is apparent that no change in attitude toward the use of programed materials resulted from the unit.

TABLE X

THE EFFECT OF TYPE OF TEXT ON ATTITUDE TOWARD PROGRAMED MATERIALS
ANALYSIS OF COVARIANCE SUMMARY

	Sum of Squares		Sum of Products	Sum of Squares Residuals	Degrees of Freedom	Variance Estimate
	Σx^2	Σy^2	Σxy	$\Sigma y''^2$		
Among groups				81.82	1	81.82
Within groups	4085.56	5757.13	2119.10	4657.99	38	122.58
Total	4125.93	5791.09	2082.67			
	F = .67		P > .10			

TABLE XI

THE EFFECT OF AMOUNT OF SCHEDULED CLASS TIME ON ATTITUDE TOWARD MATHEMATICS
ANALYSIS OF COVARIANCE SUMMARY

	Sum of Squares		Sum of Products	Sum of Squares Residuals	Degrees of Freedom	Variance Estimate
	Σx^2	Σy^2	Σxy	$\Sigma y''^2$		
Among groups				89.11	2	44.56
Within groups	1783.15	2476.28	1590.34	1057.90	36	29.39
Total	2065.60	2703.80	1793.24			
	F = 1.52		P > .10			

TABLE XII

THE EFFECT OF TYPE OF TEXT ON ATTITUDE TOWARD MATHEMATICS
ANALYSIS OF COVARIANCE SUMMARY

	Sum of Squares		Sum of Products	Sum of Squares Residuals	Degrees of Freedom	Variance Estimate
	Σx^2	Σy^2	Σxy	$\Sigma y''^2$		
Among groups				22.91	1	22.91
Within groups	2065.40	2678.20	1791.60	1124.10	37	30.38
Total	2065.60	2703.80	1793.24			
	F = .75		P > .10			

D. Change in Attitude toward Mathematics

On the post-test of Attitude toward Mathematics, the groups scored the following means:

	10-mod	6-mod	3-mod	total
Programed	38.00	43.43	49.17	43.25
Text	46.43	42.14	46.17	44.85
Total	42.21	42.79	47.67	44.05

The final means show average gains of 1.5 and .83 for the six and three-module groups respectively, and an average decrease of .85 for the ten-module group.

An analysis of covariance, as summarized in TABLE XI, indicates no significant differences among the final scores of the ten, six and three-module groups.

Relative to the groups as divided by text, the final means represent a mean change of -.89 for the programed groups and +.90 for the conventional text groups.

The analysis of covariance in TABLE XII shows that there is no significant difference between the final scores of these two groups as influenced by the unit.

The variation of amount of scheduled class time and of type of text, therefore, does not affect the students' attitudes toward the subject.

E. Correlation of I.Q. and Scores on Pre-Test Inventories

When the student's total I.Q., as measured in September, 1966, by the California Test of Mental Maturity, and his scores on each of the attitude inventories administered prior to the unit were compared, the following product-moment coefficients of correlation resulted:

	Pre-Independence	Pre-Programed	Pre-Math
I.Q.	.04	.07	.09

Using Fisher's z-transformation and the Critical Ratio test, it can be noted that in a sample of 39, any $|r_{xy}| \geq .048$ will be significantly different from 0 and thus, indicate that the hypothesis that $\hat{r}_{xy} = 0$ is to be rejected. Therefore, the coefficients of .07 and .09 which were obtained in this comparison represent a significant positive correlation. However, testing the hypothesis that $\hat{r}_{xy} = 1$ results in a rejection of the null hypothesis and indicates that the obtained coefficients are so low that they are of little value.

F. Correlation of Change in Attitude toward Independence and Selected Variables

In comparing change in attitude toward Independence as a result of the unit with change in achievement, change in attitude toward programed materials and change in attitude toward mathematics, the following coefficients of correlation were obtained:

	Achievement	Programed Materials	Mathematics
Attitude toward Independence	.22	.41	.31

As was the situation in the previous test, although each of these represents a significant positive correlation, the coefficient is too small to be of value.

G. Correlation of Change in Attitude toward Programed Materials and Selected Variables

A comparison of the change in attitude toward programed materials with the change in attitude toward mathematics and with the change in achievement yields the following:

	Mathematics	Achievement
Attitude toward Programed Materials	.35	.20

Again, both coefficients of correlation indicate a significant relationship; but the possibility of a one hundred percent correlation is rejected because the values are significantly different from 1.00.

H. Correlation between Change in Attitude toward Mathematics and Change in Achievement

The product-moment coefficient of correlation which results when the change in attitude toward mathematics is compared with the change in achievement is .01. Using the z_r transformation and the Critical Ratio test, the hypothesis that $\hat{r}_{xy} = 0$ can be accepted. Therefore, there seems to be absolutely no correlation between these two variables.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The summary of the statistics resulting from the unit will be treated from two aspects: change in each of the variables and correlations between the changes in the variables.

A. Changes in Variables

With respect to achievement, a slight difference is noted among the test scores of the students attending class three, six and ten modules per week. While the type of text did not affect achievement, the amount of scheduled class time showed indications of being a potential influence.

A definite affected factor was that of attitude toward independence. When the group is divided according to scheduled time and when it is divided according to text, there are significant differences among the results. It appears, therefore, that this variable is influenced by both amount of class time and by the type of text which the student uses.

Considering change in attitude toward programed materials, the statistics indicate that neither amount of class time nor type of text effects a change in this attitude.

The variable of attitude toward mathematics seemed to remain unchanged as a result of the unit in both the students considered according to amount of scheduled class time and in the students considered according to type of text used.

B. Correlations between Changes in Variables

Although the majority of the coefficients of correlation which were computed from the data were significantly positive, their relatively small values prevent the possibility of making any decisive conclusions.

Conclusions

Any conclusion resulting from this study must be considered with caution since the project has been done on such a small scale. However, all conclusions will be treated as valid with the recommendation that the research design be revised in any manner necessary and then be tested with a larger population and over a longer period of time.

The analyses of covariance and an examination of the mean change in achievement for each group direct that achievement may be inversely related to the amount of scheduled class time, thus rejecting the first null hypothesis. Such a relationship seems to indicate that where a small amount of class time forces the student to use a significant amount of his own time for learning, he achieves more than he would in a situation where most of the learning takes place during time which is scheduled for him. It also proposes the possibility that on his own time, the student is a more active learner and thus achieves more. The value of this result, then, lies in a proposal for further study of a flexible time plan and the continued development

and use of independent study time within a high school program. There are positive indications that a student's success in studying a structured subject may be aided by a program which incorporates class time and independent study time.

The fact that there is no difference in achievement as a result of the type of text (acceptance of second null hypothesis) seems to emphasize the fact that the student can succeed by using the type of text which he prefers. It would be interesting to expand the ability range of the students participating in a study of this type and to test for a similar result. It may well be that the selection of the type of text is desirable only for the average or above-average student. However, even with this limitation, providing a choice of materials for the majority of the students may also help to develop a more positive attitude toward the subject. Within the small sample used in this study, there were two students who were able to achieve honor roll standing as a result of doing better in the mathematics program of their choice.

In addition, the varied student reaction to programed materials which was indicated by pre-test and post-test essays and by verbal remarks during the unit, tends to suggest further study of the possibility of a correlation between attitude toward programed materials and personality. Since the correlation between preference for programed materials and I.Q., preference for mathematics and preference for independence is of little significance, there may be another factor which is more closely related. The variety of types

of students who preferred the programed materials ranged from the extremely quiet to the extravert. It, therefore, seems that a factor of personality, not the overall personality, may be related to preference for learning process, and may present another insight into procedures for individualizing instruction.

The alarming decrease in favorability toward independence and toward programed materials (rejection of third and fourth null hypotheses) acts as a flashing light for any further study. Student reaction through pre-unit and post-unit essays seemed to indicate that programed materials, without a variety of learning activities, can become boring even for the best of students. With respect to the second decreasing preference, it is the teacher's observation that the students can enjoy and benefit from independent study assignments. However, when they are forced to use an excessive amount of this time to learn basic course content on their own, the satisfaction fades and the amount of learning may consequently decrease. The answer to both problems may be a "middle-of-the-road" compromise which consists of using both techniques with limitations in order to achieve maximum learning.

The unit itself did not appear to influence the student's attitude toward mathematics (acceptance of the fifth null hypothesis), thus indicating that this attitude may be based in factors other than I.Q., amount of scheduled class time and type of materials used.

With regard to relationships between the variables which were measured, in only two cases - the relationship between I.Q. and

pre-independence and the relationship between change in attitude toward mathematics and change in achievement - can the hypothesis that the correlation of the same two variables in the total population would be zero be accepted. Although the first result is highly tenable and desirable in a school whose philosophy includes independent study for all students, the second result is not in accordance with the accepted psychological relationship between attitude and achievement. At the same time, it points out the possibility that other factors may be more closely related to change in achievement. These may include teacher attitude, peer influence, etc.

The highest coefficients of correlation between the evaluated variables existed between change in attitude toward independence and change in attitude toward programed materials. Such a correlation appears to be feasible in a school where the student has occasion to relate learning basic content and the use of independent study time. A similarly significant correlation existed between change in attitude toward programed materials and change in attitude toward mathematics. In this case, the results may be trying to indicate that a student who prefers a structured subject will also prefer a structured method of instruction such as that provided by programed materials. Again, this is a comparison which needs to be considered in a broader study and which may provide further implications for designing individualized programs.

All other correlations computed from the data of the study are negligible and do not contribute to any significant results.

Recommendations

In summary, it is possible for a ninth-grade student to learn a structured subject, such as algebra, independently. In fact, he may learn better if he learns independently. However, the recommendation is not that all students learn independently; but that students be given an opportunity to work within a degree of independence which is agreeable to them. It is not the independence or the programed materials which fosters achievement, but rather the student's fitting into a learning situation which he finds comfortable and which encourages maximum learning for him.

It is, therefore, recommended that a further study be made in order to consider the design and implementation of a flexible time plan and the possible integration of both conventional and programed text books as well as the options of total use of one type within the course of study. It is also recommended that the study be expanded to include a wider range of ability levels and to consider the variable of personality as it affects pre-attitude inventory scores and as it is affected by the unit.

This study, small in itself, has aimed to measure the accomplishments and to reflect the future possibilities of individualizing instruction. It has provided an exciting challenge to the students involved and to the participating teacher, and, though its scope is narrow, it is hoped that it will pilot further studies of ways of setting the scene for learning by considering the individual student.

BIBLIOGRAPHY

Allen, Dwight. "Individualized Instruction." California Teachers Association Journal, LXI (October, 1965), 27.

Bartz, Wayne H. and Charles L. Darby. "The Effects of a Programed Textbook on Achievement Under Three Techniques of Instruction." The Journal of Experimental Education, XXXIV (Spring, 1966), 46-52.

Beggs, David W. and Edward G. Buffie, editors. Independent Study. Bloomington: Indiana University Press, 1965.

Brannon, M. J. "Individual Mathematics Study Plan." The Mathematics Teacher, LV (January, 1962), 52-56.

Briggs, L. J. and D. Angell. "Comparisons of Programed Instruction with Conventional Methods." Review of Educational Research, XXXIV (June, 1964), 357-60.

Bush, Robert and Dwight Allen. A New Design for High School Education. New York: McGraw-Hill Inc., 1964.

Congreve, William J. "Independent Learning." North Central Association Quarterly, XL (Fall, 1965), 222-228.

Cronbach, L. J. "What Research Says About Programed Instruction." N. E. A. Journal, LI (December, 1962), 45-47.

Cuony, E. R. "Developing Independent Study Habits in the Junior High School." N.A.S.S.P. Bulletin, XLIV (November, 1960), 96-100.

Ferderbar, Joseph E. Changes in Selected Student Attitudes and Personality Measures And Their Relationship to Achievement, Intelligence, and Rate When Using Programed Instruction. (Unpublished Doctoral Dissertation, University of Pittsburgh), 1963.

Gabel, K. E. "A Study of the Relative Effectiveness of Four Distributions of Weekly Instructional Time in College Freshman Mathematics." Dissertation Abstracts, XV (1955), 1560.

Geller, M. S. "Pupils' Attitude Toward Programed Learning." Science Teacher, XXX (March, 1963), 41-42.

Henderson, George L. "An Independent Classroom Experiment Using Teaching Machine Programed Materials." The Mathematics Teacher, LVI (April, 1963), 248-251.

Keller, Robert J. "Toward Differentiated Instruction." North Central Association Quarterly, XL (Fall, 1965), 206.

Neidt, C. O. and T. F. Meredith. "Changes in Attitudes of Learners When Programed Instruction Is Interpolated Between Two Conventional Instructional Experiences." Journal of Applied Psychology, L (April, 1966), 130-137.

Swenson, Gardner and Donald Keys. Providing for Flexibility in Scheduling and Instruction. Englewood Cliffs: Prentice-Hall, Inc., 1966.

Trump, J. Lloyd and Lois S. Karasik. Focus on the Individual - A Leadership Responsibility. Washington: National Association of Secondary School Principals, National Education Association, 1965.

Washburne, Carleton and Sidney P. Marland, Jr. Winnetka: The History and Significance of an Educational Experiment. Englewood Cliffs: Prentice Hall, 1963.

APPENDIX

APPENDIX A

Title: The Effect of Independent Study on Achievement and Attitude Toward Mathematics.

Problem: Can a ninth-grade student learn a structured subject by using a programed text, independent study time and a minimum of class time as well as he could by using a non-programed text, home work time and the state-suggested amount of class time?

Procedures: Orientation: (1) Planning Assignments, (2) Project I - teacher directed, (3) Project II - self-directed, (4) Administration of attitude scales.

Project:

		M	Tu	W	Th	F
Mods:	A	1,2,3	1	1	1	1
	B	1	1	1,2	1,2	1,2
	C		2	3	2	3

Evaluation:

		P	T
Groups:	1	$\overline{X}_1$	$\overline{Y}_1$
	2	$\overline{X}_2$	$\overline{Y}_2$
	3	$\overline{X}_3$	$\overline{Y}_3$

Statistical Procedures:

Analysis of Variance

Analysis of Covariance

Coefficients of Correlation

Use of Results: Future use of such a program would depend upon the types of responses to the project. However, it is hoped that some aspects will be fully usable.

APPENDIX B

PRE-TEST, POST-TEST, I.Q. DATA

Text	Mods	Achievement		Attitude Toward Independence		Attitude Toward Programed Materials		Attitude Toward Mathematics		I.Q.
		X	Y	X	Y	X	Y	X	Y	
P	10	20	18	44	30	42	35	46	41	130
		13	19	40	38	33	26	38	31	118
		21	24	32	20	30	16	47	30	128
		10	14	44	38	30	22	41	38	113
		18	15	43	32	33	31	25	24	125
		9	13	40	31	12	14	41	40	136
		20	24	40	36	32	20	40	48	141
	6	14	22	46	42	24	55	48	52	119
		17	18	46	42	32	15	43	37	127
		18	19	46	49	32	47	45	50	117
		17	15	48	48	47	46	39	36	107
		13	18	48	46	36	12	39	38	119
		7	16	50	45	43	50	40	40	116
	3	9	14	48	45	41	46	53	51	120
		24	29	49	44	16	14	55	51	129
		18	20	46	42	27	20	40	40	133
		18	20	54	48	33	31	46	47	130
		16	26	52	55	38	37	51	53	123
		16	25	49	37	43	24	53	53	136
T	10	18	16	59	36	53	18	30	30	135
		16	19	45	43	34	23	46	42	125
		19	26	48	51	31	14	59	56	141
		12	11	53	55	55	58	55	60	122
		14	15	44	40	50	22	53	42	129
		13	20	44	34	44	33	39	41	124
		20	24	46	51	51	44	43	54	143
	6	8	10	40	41	24	26	31	38	119
		13	10	50	46	46	43	40	39	114
		14	21	41	42	21	18	36	40	133
		12	24	40	39	24	26	45	40	118
		20	17	46	45	32	33	45	50	132
		22	22	49	48	47	37	48	56	145
		19	26	42	47	30	24	40	32	144
	3	15	20	45	38	29	27	44	39	146
		27	28	52	47	30	35	42	48	149
		20	24	46	42	40	24	50	50	133
		11	19	49	46	26	32	45	48	123
		18	26	50	47	25	30	34	36	141
		13	18	54	53	20	23	54	56	127

APPENDIX C

Independent Study Project I

Directions: Independent Study Project I is designed to help you become familiar with the resources which are available for mathematics projects. During this unit, you are to choose one of the suggested topics. The length and depth of your final paper will depend on the topic you have selected. If the topic has a wide range, you will have to limit your presentation to a specific viewpoint. On the other hand, if the topic can be adequately covered in this type of paper, I would expect the full coverage. During this time, you will also be able to select up to 4 mods per week of class time to work in the resource centers. In order to facilitate attendance procedures, you must sign up on Friday for these additional Independent Study mods during the following week. You will continue to be responsible for all assignments and must report to class on test days. Progress reports are due October 28 and November 4. The final paper is due by November 11.

Schedule:

October 19 - Project Center Orientation

20 - Library Orientation

21 - Select Topic

28 - First Progress Report

November 4 - Second Progress Report

11 - Final Report Due

APPENDIX C (continued)

Name _____

Suggested Topics for Independent Study Project I

Biographies

Euclid

Eratosthenes

Fibonacci

Fermat

Descartes

Pascal

Newton

Leibniz

Euler

Gauss

Boole

Dedekind

Selected Topics

Boolean Algebra

Computers

Fermat's Last Theorem

Fibonacci Numbers

Fields (Algebraic)

Four Color Problem

Golden Section

Graphs

Group Theory

Inequalities

Infinity

Large Numbers Including Googol and Googolplex

Linear Programming

Magic Squares

Mathematical Fallacies

Mobius Strips

Number Systems

Pi

Prime Numbers

Pythagorean Theorem

Rhind Papyrus

Topology - Its Unusual Applications

Truth Tables

Zeno's Paradoxes

Zero - Its Invention and Usage

Probability

Geometry and Transformations

Mathematical Induction

Logic

Continued Fractions

Numbers and Number Systems

Measurement

Modular Arithmetic

Fractional Powers

Mathematics and Music

Mathematics and Navigation

APPENDIX C (continued)

Name _____

Independent Study Project I

Topic: _____

First Progress Report: _____

_____

_____

_____

_____

Second Progress Report: _____

_____

_____

_____

_____

_____

_____

APPENDIX C (continued)

Name _____

Independent Study Project II

Directions: Independent Study Project II is designed to give you an opportunity to learn more about a topic of your choice. During this unit, you are to select a topic and to determine the method which you will use for presentation (written paper, display, speech, etc.). You may prefer to select a topic entirely different from the last one, or related to the last one or you may decide to enlarge upon your first project. In addition, you may also choose to work with one other student in either class.

Again, you will be permitted to choose <u>up to</u> 4 mods per week of class time to work in the resource centers. These mods may now be taken 1 or 2 at a time. In order to facilitate attendance procedures, you must sign up on Friday for these additional Independent Study mods during the following week. You will continue to be responsible for all assignments and must report to class on test days.

Schedule:

November 28	Project II begins
December 2	Selection of Topic and Partner (if you have one)
December 9	Progress Report
December 19	Completion of Project II

APPENDIX C (continued)

Name _____

Topic: _____

Partner: _____

Progress Report: _____

APPENDIX D

R Math. I

Name _____

Assignment Sheet

Week of 2/13

T_6

Date due	Assignment	Date Completed
2/14	Ex. 12-4b, no. 1,3	_____
2/15	no class	
2/16	Ex. 12-5a, no. 1,2,3,4,5	_____
2/17	Ex. 12-5a, no. 6-10	_____
2/20	Ex. 12-5b - prepare - all of it	_____

T_3

2/15	Ex. 12-4a, no. 3	_____
	Ex. 12-4b, no. 1	
2/17	Ex. 12-5a, no. 1,3,5,7,9	_____
2/20	Ex. 12-5b - prepare - all of it	_____

APPENDIX E

Name _____ Date _____

ATTITUDE INVENTORY

The statements below represent varying attitudes toward the use of programed textbooks or teaching machines as a means of studying a subject. Read each statement and indicate the extent to which you agree or disagree with it by circling SA (Strongly Agree), A (Agree), U (Undecided or neutral), D (Disagree), or SD (Strongly Disagree).

1. Classes in which programed materials are used are dull and uninteresting.	SA	A	U	D	SD
2. I feel that using programed materials is the most effective method of studying that I have ever used.	SA	A	U	D	SD
3. I am glad that I am not using programed materials in more classes than I am at present.	SA	A	U	D	SD
4. I do not like to work with programed materials.	SA	A	U	D	SD
5. School would be more interesting if programed materials were used in more classes.	SA	A	U	D	SD
6. I wish that I could study programed materials in my other classes.	SA	A	U	D	SD
7. Using programed materials results in too much wasted time.	SA	A	U	D	SD
8. Using programed materials is interesting because you have to keep thinking.	SA	A	U	D	SD
9. I would rather be working with a group of classmates than working alone with a programed textbook.	SA	A	U	D	SD
10. When I use programed materials I can keep interested in my work.	SA	A	U	D	SD
11. When I use programed materials I understand everything that I study.	SA	A	U	D	SD
12. I would rather have the teacher explain the subject than be left on my own with a programed text.	SA	A	U	D	SD

APPENDIX E (continued)

Name _____ Date _____

ATTITUDE INVENTORY

The statements below represent varying attitudes toward this class or this course. Read each statement and indicate the extent to which you agree or disagree with it by encircling SA (Strongly Agree), A (Agree), U (Undecided), D (Disagree), or SD (Strongly Disagree).

1. I should like to be able to come after school to do extra work for this course.	SA	A	U	D	SD
2. I am in this course only because I have to be and would never elect to take it.	SA	A	U	D	SD
3. I should like to take further work in this subject.	SA	A	U	D	SD
4. I really like to study this subject.	SA	A	U	D	SD
5. I would not care to take another course of this type.	SA	A	U	D	SD
6. The class periods for this course seem long and boring.	SA	A	U	D	SD
7. This subject is so interesting that I can hardly wait for classtime.	SA	A	U	D	SD
8. I should like to do extra work outside of class for this course.	SA	A	U	D	SD
9. I dislike this course.	SA	A	U	D	SD
10. I should like to drop this course right now.	SA	A	U	D	SD
11. In this class I am learning many things that are important and interesting.	SA	A	U	D	SD
12. Taking this course is really a waste of my time.	SA	A	U	D	SD

APPENDIX E (continued)

Name _____ Date _____

ATTITUDE INVENTORY

The statements below represent varying attitudes toward the use of independent study. Read each statement and indicate the extent to which you agree or disagree with it by encircling SA (Strongly Agree), A (Agree), U (Undecided), D (Disagree), or SD (Strongly Disagree).

1. Having independent study assignments has helped me to learn how to study.	SA	A	U	D	SD
2. If given a choice, I would prefer going to class to learning a subject on my own in independent study.	SA	A	U	D	SD
3. I make good use of my independent study time to do school work.	SA	A	U	D	SD
4. I feel that independent study projects have no value.	SA	A	U	D	SD
5. I learn more by using the independent study centers (math., social studies, English, etc.) than by using commons B or C.	SA	A	U	D	SD
6. I feel that the independent study centers are ineffective.	SA	A	U	D	SD
7. I like the feeling of teaching myself that I sometimes have in independent study activities.	SA	A	U	D	SD
8. I would prefer to be assigned to a certain study area during my independent study time.	SA	A	U	D	SD
9. I rarely use my independent study time to do assignments.	SA	A	U	D	SD
10. I often make use of library materials.	SA	A	U	D	SD
11. I frequently use the independent study centers in the subject areas.	SA	A	U	D	SD
12. I'd rather learn all the subject material in class than to discover some things myself through independent study.	SA	A	U	D	SD