A COMPARATIVE STUDY OF THE CONVENTIONAL METHOD OF INSTRUCTION AND THE INDIVIDUALIZED METHOD OF INSTRUCTION IN FIRST YEAR ALGEBRA AT FRIES HIGH SCHOOL

by

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Abstract

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The purpose of this study was to determine if a significant difference would exist in the percentages of algebra retention of students who are taught Algebra I by two different teaching approaches. The study was used to answer the following questions:

1. Will students have a higher percentage of retention in a class which is taught using a) the conventional lecture method of instruction or b) an individualized method of instruction?
2. Is it feasible to offer individualized instruction in Algebra I to as many as twenty-four students organized as a single class?

The null hypothesis tested was: There is no significant difference in the percentage of Algebra I retention of students taught by an individualized approach to instruction and students taught by the conventional lecture method of instruction.

The study was conducted at Fries High School, Fries, Virginia, during the first twenty-four weeks of the 1974-1975 school year. Two groups of students were involved in the study. Due to scheduling conflicts within the school, one group had eight students while

the other group had twenty-four students. The larger class was chosen as the experimental group by the writer because it was of interest to determine if it was feasible to individualize instruction to a class of average or above average enrollment. The students of the control group received instruction primarily by lecture provided by the teacher. The students in the experimental group received instruction primarily by the "Student Progress Book" of the kit PLAN(Program for Learning in Accordance with Needs), published by the Westinghouse Learning Corporation. Here, each student studied alone or in small groups covering material that was within his ability with each advancing at his own pace.

Both groups received the same teacher-made pretest at the beginning of the experiment to determine their comparative levels of algebra achievement. At the conclusion of the study, both groups received a teacher-made posttest to determine their comparative percentages of algebra retention with respect to the previous twenty-four weeks. On the posttest, students answered only those questions which pertained to the material they studied. For the purposes of the t test, a simple F test was used on the pretest and posttest scores to compare the variances of the two groups. In order to compare the two groups on the equality of their retention, t tests were used on the difference between the means. The conclusions were as follows:

1. No significant difference was found between the two groups with respect to the percentage of algebra retention.
2. Individualized instruction is feasible for classes containing average or above average enrollment.

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CHAPTER I

THE PROBLEM AND ITS SCOPE

The Problem

The primary purpose of this study is to determine if there is any significant difference in the percentage of algebra retention of students who are taught Algebra I by two different methods of instruction at the high school level. The study will be used to compare two groups of students, one group which will be taught by the conventional lecture method of instruction, and the other group which will be taught by an individualized approach to instruction. More specifically, the study will be used to answer the following questions:

1. Will students of average and below average academic achievement, determined through grades and test scores, have a higher percentage of retention in a class which is taught using (a) the conventional method of instruction or (b) an individualized method of instruction?
2. Is it feasible to offer individualized instruction in Algebra I to as many as twenty-four students organized as a single class?

Need for the Study

One notices a steady decline in the enrollment in mathematics classes from one grade level to another. It is possible that this decline is due to the lack of student achievement and retention in previous mathematics courses. One can readily see that a method of instruction is needed that will insure the child the greatest possible level of achievement and retention. Educators are well aware of the many individual differences in students in the classroom. It is possible that the student might gain a higher percentage of algebra retention if these individual differences are considered.

Delimitations

This study is limited to the first year algebra students at Fries High School, Fries, Virginia, during the first twenty-four weeks of the 1974-1975 school year.

Definitions

Individualized Instruction

For the purposes of this study, individualized instruction refers to the "planning and conducting, with each student, programs of study and day-to-day lessons that are tailor made to suit his learning requirements and characteristics as a learner." (1,249)*

*Throughout this study, with regard to the pair (x,y), the x refers to the corresponding reference in the Bibliography, and the y refers to the page number of that reference.

The individualized method of instruction includes one or more of the following:

1. The teacher, if necessary, gives explanations to one student or to a group of students in which the members of the group do not exceed four in number.
2. The student carefully follows the directions in the textbook and in the "Student Progress Book" of the kit Program for Learning in Accordance with Needs (PLAN).
3. A student tutors another student within the classroom on an individual basis.

Under this method of instruction, emphasis is placed upon the student being able to progress at his own pace covering material in which he is weak. Students are tested individually according to when they are ready. This method of instruction was used with the experimental group.

Conventional Method of Instruction

In this study, the conventional lecture method of instruction refers to the method of teaching in which all students progress through the required material at the same time and same rate, where all students receive instruction primarily by lecture provided by the teacher. The class works on the same assignments and takes examinations at the same time. This approach is the method of instruction used with the control group.

Programmed Instruction

For the purposes of this study, programmed instruction refers to "a progressive sequence of written materials presented in small units which a student must learn before being allowed to read the next unit, as used in teaching machines or programmed textbooks." (2,1649) Every student sequentially covers the same material and content in the same way.

Independent Study Method of Instruction

In this study, the independent study method of instruction refers to the method of teaching in which all students work alone or in small groups covering the required material with only a limited amount of help from the teacher. The teacher acts primarily as a guide and resource person.

Learning Activity Package

For the purposes of this study, the term learning package or learning activity package refers to a student guide or "lesson plan" which the student may follow in order to achieve a particular objective. The learning package includes the following:

1. A statement of the behavorial objective(the goal that is to be reached by the student).
2. Problems that the student can do to indicate that he has mastered the objective.
3. Key words which pertain to the specific topic under study.
4. Learning activities(a description of what the student must do in order to complete the objective).

5. Optional resources which include books, films, and filmstrips for the student to use that are directly related to the topic under study.

Basic Assumptions

1. It is assumed that the conventional method of instruction and the individualized method of instruction are valid and effective teaching methods with achievement and retention as the primary outcomes.
2. It is assumed that the percentage of retention could be measured through the use of teacher-made tests.

The research includes a short history of individualized instruction and a discussion of three different types of instruction with a selected number of studies which are directly related to each.

CHAPTER II

REVIEW OF THE LITERATURE

The enormous magnitude of individual differences among students of a classroom are well known to everyone who has been involved with children. Students differ in their ability to learn, in their previous academic achievement, in their ability to sustain concentration, and in their perceptual strengths and weaknesses. Many educators believe that a method of instruction is needed that will take into account the many individual differences among students in the classroom. Hence, there have been many learning programs developed that attempt to allow the student to work according to his ability. (3,31)

One of the first learning programs that was developed to individualize instruction was devised at the San Francisco State Normal School in Winnetka, Illinois. In 1912, Mary Ward, a faculty member at the school, carried out an informal experiment. Under the school's program, students began their practice teaching very early in their college career. Two such students were assigned to do their practice teaching at an elementary school attached to the Normal School. Each teacher was assigned to teach one or two

subjects to twenty students for a third of the day. Miss Ward was an arithmetic supervisor at this time. One day, one of the student teachers told Miss Ward that the lesson plans did not fit all of the students. The lesson plans were too difficult for some and too easy for others. Miss Ward told the teacher to prepare special material for slow learners and difficult material for faster learners, thus allowing each student to work at his own level. This worked for a while, but it was soon found that there existed students whose abilities did not fall into the categories slow, average, and fast. Their abilities ranged from retarded, near retarded, and slow, on up to average, above average, and superior. Thus before long, the practice teachers were preparing work for each individual child. By the end of the school year, no two students had completed the same amount of work. The slowest students had completed a years work while the fastest students had completed two years work.

Mary Ward constructed a graph showing each child's achievement. Dr. Frederick L. Burk, President of the Normal School, saw the graph and asked Miss Ward to describe what she had done at a faculty meeting. Dr. Burk proposed that every supervisor prepare "self instructional bulletins" for the students. These materials allowed each student to progress through the required subject matter at his own rate, working on material that is within his ability; thus individualizing instruction.

From then on, instruction in the elementary school was individualized with each child proceeding at his own rate doing work that is within his ability. The Winnetka Plan is still being used and is currently being modernized. (4,6-8)

Programmed learning was one of the first steps toward individualized instruction. Under this method of teaching, students are programmed into a sequence that would allow the student to progress at his own pace that is commensurate with his abilities. Every student sequentially covers the same material and content in the same way. Programmed materials are designed for mass use. They leave little or no choice as to what the pupil's individual needs or interests may be. Programmed learning is similar to individualized learning only to the point that the student works at his own rate. (3,45)

There has been much research in the area of programmed learning. In 1967 Devine conducted a comparative study of the effects of two different teaching approaches on students who were studying Algebra I. There were two schools involved in the study, the Rich Township High Schools. The experimental groups used programmed materials as the basic source of instruction and the control groups used the conventional lecture method of instruction. Each school had an experimental group and a control group. The students in

the experimental groups worked on their own while the teacher was available only to keep records and answer questions on an individual basis. The control groups were teacher centered using the usual classroom techniques. The primary purpose of the study was to determine if any significant differences would exist between the two groups of each school with regard to student achievement and student attitudes when the groups are taught by two different teaching approaches. The results of the study showed that group instruction with an average or above average teacher is better than independent study with programmed materials. However, achievements of students was higher when taught by programmed materials than achievements of students taught by inexperienced teachers. The results also indicated that the teacher is an important factor in the development of student attitudes toward mathematics. (5,535)

In 1970 Nott conducted a comparative study of two methods of teaching Algebra I. The purpose of the study was to compare test scores of students taught by two methods of instruction. To make the comparison, the students of all 12 day classes of a remedial algebra course at St. Petersburg Junior College were ranked according to their test scores on the Lankton First Year Algebra Test. The students which met at the same time were alternately assigned to either a class taught by the conventional lecture method of instruction or a class taught by programmed instruction.

At the end of the study it was concluded that students do learn as well from programmed instruction but that the time for the programmed group was longer to cover the required material. (6,4495)

Another type of student centered learning program is independent study or independent learning. Independent study refers to any program for which some part of the school day is set aside for self-directed, self-designed study. Under this method of instruction, children are "learning about vastly different self-designed areas (curriculums, spheres of interest, units or contracts)." In the independent study situation, the student has a range of alternative activities he can explore according to his interests; the teacher is available if needed to assist him in working through the sets of learning materials he chooses. (3,68)

In 1970 Taylor conducted a comparative study of the attitude and achievement of students enrolled in Algebra I under the conventional lecture method of learning and the independent study method of learning. The experiment was conducted at Crestmoor High School in San Bruno, California, during the first semester of the 1970-1971 school year. Twenty-three students were in the class taught by the class lecture method of instruction and twenty-five students were in the class taught by the independent study method of learning. The students in the independent study group studied alone or in small groups with a minimum amount of help from the teacher. The students used the conventional textbook and

progressed individually by doing assignments in a given chapter before proceeding to the following chapter. There was no class lecture by the teacher. In the conventional group, the teacher presented the material to the class as a group and conducted question and answer periods. The data were analyzed by using t tests to compare mean attitude and achievement gains. The conclusions were as follows:

> "(1) Lecture discussion instruction was not significantly different from independent study with respect to growth in achievement for Algebra I students. (2) Students were able to learn while studying independently. (3) Growth in achievement was not significantly higher for high ability students, as defined for this study, who were taught by lecture discussion than for high ability students who studied independently. (4) Low ability students, as defined for this study, who studied independently were not able to show significantly more growth in achievement than low ability students who were taught by the conventional lecture method. (5) The growth in attitude toward mathematics of students who studied independently was not significantly different from that of students who were taught by lecture discussion." (7,3877)

Individualized instruction is oriented toward the learner. Appropriate learning experiences are assigned each student. In order to determine what is appropriate for each learner, some type of diagnostic procedure is used. Once these learning experiences are identified, instruction is mainly self-directed, self-administered, and scheduled within the classroom at a time that is convenient to the learner. "Instruction that is truly individualized must be designed by the teacher who knows the student and has tested and diagnosed his various abilities. The teacher is then able to prescribe a program tailored to the youngster's abilities, weak-

nesses, learning style, interests, and degree of self-discipline. Such a prescription not only permits the student to proceed at his own pace and level, but on materials and projects that motivate and involve him." (3,45)

In 1972 Englert conducted a comparative study of the effects on achievement of high school students enrolled in Algebra I under the conventional method of instruction and the individualized method of instruction. The study was carried out at Cleveland Heights High School, Cleveland Heights, Ohio. The control group consisted of students taught by the conventional method of instruction and the experimental group consisted of students taught by the individualized method of instruction. Three different teachers were involved in the study, each of whom had a control group and an experimental group. All the students involved in the study received as pretests the Attitude Toward Mathematics Scale, the Cooperative Arithmetic Test, and the Cooperative Structure of the Number System. As posttests, all students received the Attitude Toward Mathematics Scale and the Seattle Algebra Test. The t tests were used to analyze the data collected. The conclusions were as follows:

1. No significant differences were found when using the Structure of the Number System as a pretest and the Seattle Algebra Test as a posttest.
2. The Cooperative Arithmetic Test and the Seattle Algebra Test revealed a significant difference in the groups of one teacher.
3. In combining the above results, the investigator found the results to be inconclusive.

4. No significant differences were found in changes in attitude of the two groups of any teacher. (8,76)

In 1971 Crangle conducted a comparative study of the Northwest Junior High School individualized mathematics program. The purpose of the study was to learn if individualized instruction or conventional instruction would yield any significant differences in achievement. It was also desired to learn if there would be any difference in the lengths of time needed to complete the study of selected topics between students receiving individualized instruction compared to students receiving conventional instruction. At the beginning of the study, sixty-two eighth graders were pretested to determine their comparative levels of ability and achievement. The students were divided into two groups of thirty-one students each, with one group receiving the individualized instruction and the other group receiving the conventional instruction. At the end of the study, both groups received the same posttest. The t tests were used to analyze the data collected.

At the end of the study, it was concluded that the control group did significantly better with respect to achievement over the experimental group. Also, the control group took less time to complete the required materials. (9,1774)

In 1970 Verheul conducted a comparative study of the effects of the individualized method of instruction and the conventional method of instruction on mathematics achievement of selected sixth grade students. Two groups of students were involved in the study.

One group was taught by the conventional lecture method of instruction and the other group was taught by an individualized method of instruction. Both groups received the same pretest and posttest. The conclusions were as follows:

1. There were no significant differences found between the two groups with respect to mean score gains for arithmetic concepts and arithmetic applications.
2. There was a significant difference found between mean score gains in favor of the males and females who had conventional textbook instruction on arithmetic computations. (10,4853)

In 1972 Thomas conducted an evaluative study of the effects of "Individually Prescribed Instruction" and the conventional lecture method of instruction on mathematics achievement of fifth and sixth grade students. Part of the students used the IPI(Individually Prescribed Instruction) materials and the rest were taught by the conventional lecture method of instruction. Achievement was measured by pretest and posttest scores of the Comprehensive Basic Skills Test. The conclusions were as follows:

> "The IPI method of teaching mathematics did not produce significant achievement gains over the conventional teaching method." (11,1335)

The results of the preceeding studies are far from being conclusive. In some studies one finds results favoring individualized instruction. In others one finds results favoring the conventional approach. The literature raises many questions concerning achievement. One might conclude that the success of the

method of instruction used depends, at least partially, on the particular situation at hand.

The procedures and design of the study follow in Chapter III.

CHAPTER III

METHODS AND PROCEDURES

Mathematics Program at Fries High School

Fries High School is a small school located in Grayson County, Virginia, in the town of Fries. It was founded in 1902. It is a combined school consisting of grades K through 12. The total enrollment is approximately four-hundred and seventy-five students with approximately one-hundred and seventy-five students in grades K through 7 and approximately three-hundred students in grades 8 through 12.

The following college preparatory mathematics courses are presently being taught at the high school level: two classes of Algebra I, one class of Algebra II, and one class of Algebra III and Trigonometry. Presently, it is the responsibility of the writer to teach the above mathematics courses.

This study is concerned with the above Algebra I classes. Any student who wishes to elect Algebra I may enroll, as there are no prerequisites for the course. Primarily, students select the course for the purpose of satisfying college entrance requirements.

Selection of Treatment Groups

All students enrolled in Algebra I at Fries High School

during the academic year 1974-1975 took part in the study. Preliminary estimates of the enrollment in the course required that only two sections be planned. All students who enrolled in the courses were assigned to one of the two sections by the guidance counselor during the summer of 1974. Due to conflicts in scheduling and special grouping within the school, one section of Algebra I had twenty-four students while the other section had only eight students. The class with the larger enrollment was chosen as the experimental group by the writer because it was of interest to determine if it is feasible to individualize instruction to as many as twenty-four students organized as a single class. Also, by taking the class with the larger enrollment as the experimental group, the writer felt that this study would be more valuable to anyone interested in individualizing instruction within the classroom of average or above average enrollment.

Duration of the Study

The study was limited to the first twenty-four weeks of the 1974-1975 school year.

Selection of Study Materials

The control group used the basic Algebra I test, Modern School Mathematics by Dolciani, Wooten, Beckenbach, Jurgensen, and Donnelly. This book was used as a basic text for the students to take home nightly to work on daily assignments made by the teacher.

The experimental group used a combination of the basic text Modern School Mathematics, and the kit Program for Learning in Accordance with Needs(PLAN), published by the Westinghouse Learning

Corporation. This group used the text only as a source for extra problems on the topic under study. The explanation of the material came from the kit PLAN(Program for Learning in Accordance with Needs). This kit breaks the Algebra I course down into many learning packages, each of which contains a complete explanation of the concepts and procedures under study. Each student in the experimental group had the use of the "Student Progress Book" which contains the many learning packages. These books were part of the kit PLAN. A typical learning package would begin by stating its primary objective. Some examples would follow which would act primarily as a self-test on the package. The learning activities would begin with key words pertaining to the particular topic under study, and then continue with an explanation of the concepts and procedures needed to complete the objective. The procedures which are to be used to solve problems are explained in full detail. Many examples are worked so that the procedures can be followed by the student. At the end of each package are problems which allow the student to practice that which he has learned. Included in each learning package is a list of optional resources such as films, filmstrips, and books which are directly related to the particular topic under study.

Teaching Approaches

The control group was taught by the conventional class lecture method of instruction. All the students in the group were taught the same topics at the same time through lecture by the teacher.

At the beginning of each class period, the teacher lectured to the class on procedures and concepts used in the solution of a particular type of problem. The remainder of the period was spent in supervised study on the present assignment. Each day the teacher moved through the room and checked each student's work. If a student encountered a problem, he was given special attention by the teacher. At no time was any student turned down from individual help by the teacher. All students in the control group were tested together on the same material. If any extra time was needed to review concepts and procedures used in problem solving, the class participated as a whole. If a student did not finish an assignment during the class period, it was his responsibility to have the work completed by the next class meeting. Each student was allowed to take his textbook home and work on his assignment each night.

Each student in the individualized instruction group proceeded through the course at his own pace. If he needed help, he was free to consult the teacher or one of his classmates. When the teacher was explaining a concept to a student, as many as four could join in the discussion. Each could work individually or as many as four could work together as a group. When a student, or a group of students, felt that they had mastered a particular lesson, they were allowed to take a test. If the test was completed with at least 70 percent accuracy, he was allowed to move into the next lesson. If he did not complete the test

with the desired accuracy, more work was assigned and another test was given. Instruction was carried out within the confines of the classroom. The students were not allowed to take the PLAN "Student Progress Book" home. The students were allowed, however, to take their Algebra I texts home nightly in order that they might work on problems and concepts studied that day. Whenever it became necessary for the students to review problems and concepts for a test, each student did this independently. In this method of instruction, the class period consisted of little or no lecture by the teacher.

Procedures

Tests were administered to both classes. Both the pretest and the posttest, along with all other tests given, were teacher made.

Retention was measured in terms of the percent of items answered correctly on the test. For example, if a student made a raw score(number of correct responses) of 20 out of a possible 25 questions on the test, then his score would be 80 since (20/25) x 100=80. A score of 80 would indicate that the student answered 80 percent of the items on the test correctly.

At the end of the first, second, and third 6-weeks, a test was given to both groups. The purpose of this was to determine if significant difference existed between the two groups after covering specific topics during a 6-weeks period. At the beginning and end of the study, both groups received the pretest and

posttest respectively. The primary purpose of the pretest was to determine the student's level of academic achievement in mathematics at the beginning of the study. This test was also used to diagnose the pupil's particular needs and weaknesses. It was a teacher made test containing twenty-five multiple choice items taken from the Algebra I "Placement Test" of the kit PLAN and from the Algebra I text Modern School Mathematics. The time limit on the test was one hour. The test was designed to measure the student's computational skills, his ability to solve algebraic equations and word problems whose solutions depend upon the solution of an algebraic equation, his understanding of the basic properties of the real number system, his ability to solve algebraic inequalities, and his ability to solve open sentences in two variables.

The primary purpose of the posttest was to determine the percentage of retention over the period of the study. The posttest was a teacher made test containing twenty-five multiple choice items, many of which are similar to the pretest items. Each student answered only the questions which pertained to the material he covered. The posttest was designed to measure the student's ability to solve systems of linear equations, his ability to use factoring to solve equations, his understanding of the laws of exponents, and also that which the pretest was designed to measure.

The Null Hypothesis

There is no significant difference in the percentage of Algebra I retention of students taught by an individualized approach and students taught by the conventional lecture method of instruction.

Testing the Hypothesis

To determine if any significant difference in the percentage of retention existed between the two groups, a t test was used on the difference between the means of each group on each test given. For the purposes of the t test, an F test(ratio of variances) was used on each test of both groups to compare the amount the two groups varied from their means.

All tests conducted were two-tailed since the writer did not expect one group to do better than the other. All t tests and F tests were compared with those t scores and F scores considered to be significant at the .05 level.

The results of the experiment along with the analysis of data follow in Chapter IV.

CHAPTER IV

ANALYSIS OF DATA

Analysis of Data on the Pretest

The pretest scores along with the 6-weeks tests scores and the posttest scores of the control group and experimental group are given in Tables II and III respectively.

For the purposes of the t test, a simple F test was used on the pretest to compare the variances of the two groups. The variances were compared by the formula $F=S_1^2/S_2^2$ (where S^2 is equal to the sum of the squares of the deviations from the mean divided by one less than the number in the group). These formulae were suggested by Fischer (12,280). The F test was a two-tailed test conducted at the .05 level of significance.

After conducting the F test, it was found that the group variances did not differ significantly from one another on the pretest. The results are shown in Table I.

Table I

COMPARISON OF VARIANCES ON THE PRETEST

Control Group		Experimental Group		F
n_1	S^2	n_2	S^2	
8	77.93	24	137.42	1.76

$F_{7,23,.975}=2.90$ $F_{7,23,.025}=.35$

Table II

CONTROL GROUP SCORES ON ALL TESTS

STUDENT	PRETEST	TEST I	TEST II	TEST III	POSTTEST
1	27	70	72	76	60
2	40	95	93	76	84
3	57	70	86	100	64
4	47	75	56	70	48
5	44	100	79	76	68
6	47	90	83	100	76
7	37	65	30	70	48
8	47	75	81	49	72

SCORES ARE GIVEN IN TERMS OF PERCENT CORRECT

Table III

EXPERIMENTAL GROUP SCORES ON ALL TESTS

STUDENT	PRETEST	TEST I	TEST II	TEST III	POSTTEST
1	57	85	98	91	80
2	50	85	95	64	88
3	70	85	80	97	84
4	50	80	95	82	64
5	50	95	80	100	88
6	47	70	69	48	48
7	44	80	70	73	64
8	67	95	97	94	92
9	74	95	100	100	88
10	27	60	36	15	45
11	44	75	77	85	76
12	54	100	96	94	76
13	44	80	89	82	76
14	50	90	61	46	88
15	44	70	72	91	60
16	40	45	70	61	52
17	47	95	84	88	84
18	44	70	68	82	45
19	40	70	85	70	76
20	50	85	79	66	76
21	64	80	86	88	84
22	70	90	95	100	92
23	54	90	70	58	76
24	70	90	100	91	84

SCORES ARE GIVEN IN TERMS OF PERCENT CORRECT

In order to compare the groups on the equality of their achievements, t tests were used on the differences between the means. The formula for t is $t=(x_1-x_2)/(S^2/n_1 + S^2/n_2)^{1/2}$ where x_1 and x_2 represent the means of the control group and experimental group respectively, and $S^2=((n_1-1)S_1^2 + S_2^2(n_2-1))/(n_1 + n_2 - 2)$, where S_1^2 and S_2^2 represent the variances of the control group and experimental group respectively, and n_1 and n_2 represent the number of students in the control group and experimental group respectively. The above formulae were suggested by Fischer (12,271).

The t test conducted on the pretest indicated that there was no significant difference between the two groups with respect to achievement. The t test was a two-tailed test conducted at the .05 level of significance. The t values were checked against those in Fischer (12,324). The results of the t tests are shown in Table IV.

Table IV

COMPARISON OF MEANS ON THE PRETEST

Control Group			Experimental Group			t
n_1	x_1	S_1^2	n_2	x_2	S_2^2	
8	43.25	77.93	24	52.13	137.42	1.96

$.05t_{30} = 2.04$

Analysis of Data on the 6-Weeks Tests

A test was given at the end of the first, second, and third 6-weeks to determine if there existed any significant difference in the percentage of algebra retention between the two groups with respect to each of the three 6-weeks. The means were computed for each group on each test. For the purposes of the t test, a simple F test was performed on each test. The tests were two-tailed at the .05 level of significance.

In the comparison of the variances for the groups of each test, it was found that the group variances did not differ significantly from one another on either of the 6-weeks tests. The results of the F tests are shown in Tables V, VI, and VII.

Table V

COMPARISON OF VARIANCES ON THE FIRST 6-WEEKS TEST

Control Group		Experimental Group		F
n_1	S^2	n_2	S^2	
8	171.43	24	164.49	1.04

$F_{7,23,.975}=2.90$ $F_{7,23,.025}=.35$

Table VI

COMPARISON OF VARIANCES ON THE SECOND 6-WEEKS TEST

Control Group		Experimental Group		F
n_1	S^2	n_2	S^2	
8	415.14	24	234.58	1.77

$F_{7,23,.975} = 2.90$ $F_{7,23,.025} = .35$

Table VII

COMPARISON OF VARIANCES ON THE THIRD 6-WEEKS TEST

Control Group		Experimental Group		F
n_1	S^2	n_2	S^2	
8	277.55	24	440.80	1.59

$F_{7,23,.975} = 2.90$ $F_{7,23,.025} = .35$

In Tables I, V, VI, and VII, the F values were checked against those in Fischer (12,327).

A t test on the differences between means was run on each of the 6-weeks tests to determine whether the groups were significantly different from one another on each of the tests. From the results of the F tests, it was assumed that the variances were equal. In all cases there were no significant differences between the two groups with respect to mean scores on each of the three 6-weeks tests. The test was two-tailed conducted at the .05 level of significance. The t values were checked against those in Fischer (12,324). The results are shown in Tables VIII, IX, and X.

Table VIII

COMPARISON OF MEANS ON THE FIRST 6-WEEKS TEST

Control Group			Experimental Group			t
n_1	x_1	S_1^2	n_2	x_2	S_2^2	
8	80.00	171.43	24	81.67	164.49	.32

$.05t_{30} = 2.04$

Table IX

COMPARISON OF MEANS ON THE SECOND 6-WEEKS TEST

Control Group			Experimental Group			t
n_1	x_1	S_1^2	n_2	x_2	S_2^2	
8	72.50	415.14	24	81.33	234.58	1.30

$.05t_{30} = 2.04$

Table X

COMPARISON OF MEANS ON THE THIRD 6-WEEKS TEST

Control Group			Experimental Group			t
n_1	x_1	S_1^2	n_2	x_2	S_2^2	
8	77.13	277.55	24	77.75	440.80	.08

$.05t_{30} = 2.04$

Summary of Statistical Tests Conducted with respect to the Pretest and the 6-Weeks Tests

For the purposes of the t test, in order to assume the variances equal, F tests were used on the variances of the control group and the experimental group with respect to the following:

1. Scores on the pretest
2. Scores on the first, second, and third 6-weeks tests

No significant difference was found in the variances of the two groups on each test.

A t test was conducted on the difference of the means of the two groups with respect to the following:

1. Scores on the pretest
2. Scores on the first, second, and third 6-weeks tests

No significant difference was found between the two groups. The hypothesis concerning the equality of algebra retention of the two groups could not be rejected with respect to each of the three 6-weeks.

From the results of the statistical tests on the pretest and the 6-weeks tests, one might suspect that there would be no significant difference between the two groups with respect to algebra retention on the posttest.

Analysis of Data on the Posttest

For the purposes of the t test, an F test on the variances of the two groups was conducted on the posttest. The test was two-tailed which was conducted at the .05 level of significance. The F values were compared with those in Fischer (12,327). The F test

revealed that the group variances did not differ significantly from one another. The results of the test follow in Table XI.

Table XI

COMPARISON OF VARIANCES ON THE POSTTEST

Control Group		Experimental Group		F
n_1	S^2	n_2	S^2	
8	163.43	24	222.86	1.36

$F_{7,23,.975}=2.90$ $F_{7,23,.025}=.35$

Testing the Hypothesis

In order to test the hypothesis that there is no significant difference in the percentage of algebra retention of students taught by an individualized method of instruction and students taught by the conventional lecture method of instruction, a t test was conducted on the difference between the means on the posttest. This was done in order to determine whether the groups were significantly different from one another on the posttest. As was the case with all other tests given, there was no significant difference between the two groups.

The t test was a two-tailed test conducted at the .05 level of significance. The t values were checked against those in Fischer (12,324). The results of the t test follow in Table XII.

Table XII

COMPARISON OF MEANS ON THE POSTTEST

Control Group			Experimental Group			t
n_1	x_1	S_1^2	n_2	x_2	S_2^2	
8	65.00	163.43	24	74.42	222.86	1.60

$.05t_{30} = 2.04$

From the results of the previous test on the posttest means, one can readily see that the null hypothesis certainly cannot be rejected.

Summary of the Statistical Tests on the Posttest

For the purposes of the t test, an F test was conducted on the variances of the control group and experimental group with respect to the posttest. No significant difference was found in the two groups.

The null hypothesis tested was:

There is no significant difference in the percentage of algebra retention of students taught by an individualized approach to instruction and students taught by the conventional lecture method of instruction.

A t test was conducted on the difference of the means of the two groups with respect to the posttest. This test was used to determine whether the two groups were significantly different

from one another on the basis of the posttest. No significant difference was found in the two groups. Therefore, the null hypothesis could not be rejected.

A summary of the experiment, conclusions, and suggestions for further research follow in Chapter V.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Purpose of the Study

The primary purpose of the study was to determine which of two methods of instruction would offer the child a greater percentage of academic retention in Algebra I. There were two groups of students involved in the study. One group was taught by the conventional method of teaching and the other group was taught by an individualized method of instruction. The students in the control group received instruction primarily by teacher lecture. Here, all students worked on the same topics at the same time. In the experimental group, students received instruction primarily by the "Student Progress Book" of the kit PLAN (Program for Learning in Accordance with Needs). Here, each student studied alone or in small groups covering material that was within his ability with each advancing at his own pace. Different students worked on many different topics at the same time. It was desired to answer the following questions: (1) Will students have a higher percentage of algebra retention in a class taught by (a) individualized instruction or (b) conventional lecture method of instruction? (2) Is it feasible to offer individualized instruction to as many as twenty-four students organized as a single class?

Procedure

There were thirty-two algebra students involved in the study. These students were divided into two classes. Due to scheduling conflicts within the school, one class had twenty-four students while the other class had only eight. The writer chose the larger class to be the experimental group because of his interest to determine the feasibility of individualizing instruction to a class of average or above average enrollment. Both the control group and the experimental group received the same pretest at the beginning of the experiment to determine their comparative levels of academic achievement as well as to diagnose the particular needs of each student. At the end of the first, second, and third 6-weeks, the students of both groups received tests to determine their comparative percentages of algebra retention with respect to each of the 6-weeks. This was done in order that the writer might determine how the two groups compared with each other during the study. At the conclusion of the experiment, both groups received a posttest to determine their comparative percentages of algebra retention with respect to the previous twenty-four weeks.

The null hypothesis tested was:

There is no significant difference in the percentage of Algebra I retention of students taught by an individualized approach to instruction and students taught by the conventional lecture method of instruction.

Conclusions

From the results of the statistical tests on the pretest, it was concluded, at the beginning of the study, that both the group taught by the individualized method of instruction and the group taught by the conventional lecture method of instruction were basically the same with respect to mathematics achievement. Therefore, to test the null hypothesis that there is no difference in the percentages of algebra retention of students taught by two different methods of instruction, all that was necessary was to test the difference between the means on the posttest. From the results of the statistical tests on the posttest, it was found that there was no significant difference between the two groups with respect to the percentage of algebra retention during the past twenty-four weeks of the experiment. Hence, the null hypothesis could not be rejected. The conclusions may be summarized as follows:

1. No significant difference was found between the experimental group and the control group with respect to the percentage of algebra retention.
2. Individualized instruction is feasible for classes containing as many as twenty-four students.

On the posttest, students were tested only on the material they studied, thus allowing the writer to determine if there was any significant difference in the percentage of algebra retention of the two groups. By allowing all students in both groups to take the same posttest, both groups could have been compared with respect

to their levels of algebra achievement, which would have given an indication as to how both groups compared with respect to the total amount of algebra learned.

Recommendations for Further Research

1. Studies should be conducted on the feasibility of teaching general mathematics to eighth grade students of lower than average mathematical ability by the individualized method of instruction.
2. Studies should be conducted on the feasibility of offering individualized instruction in mathematics to students in the elementary grades.

As a direct result of this study, the investigator believes that the individualized method of instruction rightfully deserves to be called an effective method of teaching, and should be among the most commonly used methods of instruction. In order to continue the improvement of the educational system, research must be supported, so that new and improved teaching techniques may be incorporated that would insure the child the greatest possible level of academic achievement and retention.

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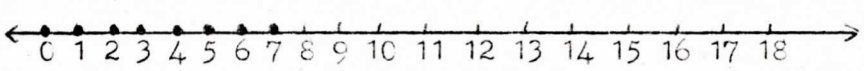
APPENDIX

ALGEBRA I PRETEST

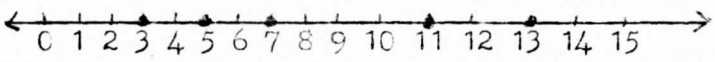
1. Which of the following is the set of all even numbers between 1 and 11?
   A. {1,2,3,4,5,6,7,8,9,10,11} B. {2,4,6,8} C. {2,4,6,8,10}
   D. None of the above

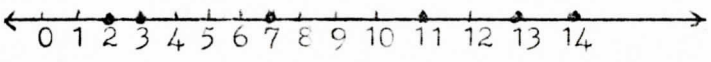
2. {M,P,S,I} may be described as:
   A. The set of all letters of the alphabet
   B. The set of all consonants
   C. The set of all letters in the word Mississippi
   D. None of the above.

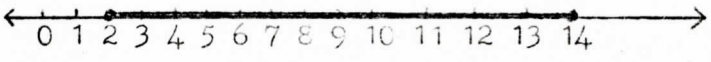
3. Which of the following is a subset of the set of all positive odd numbers?
   A. {37,39,41,42}
   B. {10801,10803,10805,10807}
   C. {279,281,-183,-185}
   D. {2,4,7,9,11}
   E. None of these

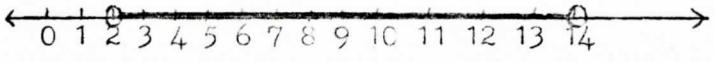
4. 

   The above graph is the graph of:
   A. The set of all integers between -1 and 8
   B. The set of all numbers between -1 and 8
   C. The set of all odd numbers between -1 and 8
   D. The set of all even numbers between -1 and 8
   E. None of the above

5. The graph of all prime numbers between 2 and 14 would be:
   A. 

   B. 

   C. 

   D. 

6. The value of $3+7\cdot2-6-2\cdot3+9-7\cdot15-5$ is
   A. 0 B. -4 C. 4 D. 69 E. None of these

7. The value of $16-2\cdot4\cdot1/2-6-2+5+8-4$ is
   A. 0 B. 3 C. 20 D. -5 E. None of these

8. Simplify: $6-3-2\cdot4-1/2+5$
   A. 1 1/2 B. -7 C. -9 D. 3 E. None of these

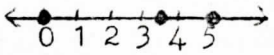
9. The value of $13x-7(x+2)/4-(x-2)$ when $x=6$ is:
   A. 56 B. 60 C. 64 D. 68 E. None of these

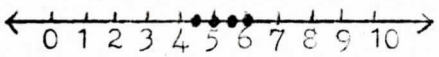
10. Evaluate $((4x+7)-(2x-5))/(x-3)$ when $x=6$ is:
A. 6 B. 14 C. 5 D. 21 E. None of these

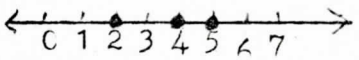
11. When $y=5$, the numerical value of the expression $2y^2-y$ is:
A. 95 B. 45 C. 5 D. 40 E. None of these

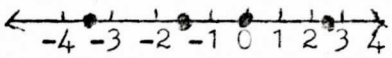
12. If $\{1,2,7\}$ is the replacement set for x in the open sentence $y=(x-7)/4$, then the truth set is:
A. $\{1/4,-5/4,3/2\}$ C. $\{0,-5/4,3/2\}$ E. None of these
B. $\{0,1/4,3/2\}$ D. $\{-3/2,-7/4,0\}$

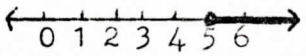
13. Given the replacement set for x in the open sentence $y=2x-4$ is $\{3,4,5\}$. The solution set is:
A. $\{2,4,6\}$ B. $\{1,3,5\}$ C. $\{1,2,3,4,5\}$ D. None of these

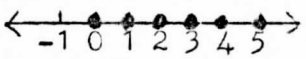
14. Given the replacement set for x in the open sentence $y-x/2=4$ is $\{1, 2, 3, 4\}$, which graph below represents the truth set?
A.


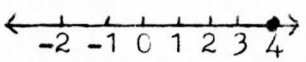
B.


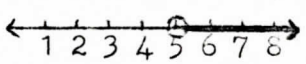
C.


D.


15. Given the replacement set $\{x:x>1\}$ for the open sentence $y=x+4$, which graph below represents the truth set?
A.


B.


C.


D.


16. Translate the following into an algebraic phrase: 4 less the sum of 2x and 5.
A. $2(x+5)-4$ B. $42x+5$ C. $4-2(x+5)$ D. $(2x+5-4)$ E. None of these

17. Translate the following sentence into an algebraic sentence: The difference of the squares of two consecutive integers is 23.
A. $(x+1)^2=23$ C. $(2x+2)^2-(2x)^2=23$ E. None of these
B. $(2x+1)^2-x^2=23$ D. $(x+1)^2-x^2=23$

18. Translate the following into an algebraic sentence: The product of x and y decreased by one-half the sum of x and y is 41.
A. $x+y-1/2x+y=41$ C. $xy-1/2(x+y)=41$ E. None of these
B. $x+y+1/2(x-y)=41$ D. $xy-1/2x+y=41$

19. Which statement concerning the positive integers is true?
A. It is closed under addition
B. It has a multiplicative inverse
C. It has an additive identity element
D. It has an additive inverse for each element
E. None of the above

20. $4\cdot(9r)=(4\cdot9)\cdot r$ is an example of what property?
A. Commutative property of addition
B. Closure property of multiplication
C. Associative property of multiplication
D. Associative property of addition
E. None of the above

21. Solve for a: $12+a=38$.
A. $a=50$ B. $a=26$ C. $a=36$ D. $a=30$ E. None of these

22. If $9x=36$, then $x=?$
A. $x=3$ B. $x=4$ C. $x=17$ D. $x=45$ E. None of these

23. Solve for x: $4x-1=15$.
A. $x=3$ B. $x=4$ C. $x=5$ D. $x=6$ E. None of these

24. If the sum of 8 times a number and 5 is 37, what is the number?
A. 5 B. 7 C. 6 D. 4 E. None of these

25. The difference between 4 times a number and 3 is 25. What is the number?
A. 6 B. 5 C. 8 D. 7 E. None of these

FIRST 6-WEEKS TEST

1. The set of days of the week written in set notation is:
   A. {1,2,3,4,5,6,7}
   B. {Monday thru Sunday}
   C. {Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday}
   D. None of the above

2. The verbal description of the set {2,4,6,8,...} is:
   A. Set of all whole numbers
   B. Set of all even positive integers
   C. Set of even positive integers less than 10
   D. None of the above

3. A subset of the set of odd numbers between 0 and 16 is:
   A. {1,3,5,7,9,11,13,15,17}
   B. {1,4,14,16,...}
   C. {2,3,6,7,...}
   D. {1,7,11}

4. The set of all whole number multiples of three that are greater than 2 and less than 17 is
   A. {3,6,9,12,15,18}
   B. {2,3,4,...}
   C. {3,6,9,12,15}
   D. None of the above

5. The set of multiples of four is:
   A. {4,6,8,10,...}
   B. {4,8,12,16,...}
   C. {1,4,14,16,...}
   D. None of the above

6. Simplify: $80-7\cdot8+4\cdot3$
   A. 24 1/3 B. 24 1/2 C. 24 1/18 D. 73 E. None of these

7. If x=8, the expression 8x-2+3x+14-x equals
   A. 92 B. 79 C. 54 D. None of these

8. If a=2, b=3, c=4, d=5, the expression (5cd)/(ac-d) equals
   A. 25 B. 16 C. 20 D. 15 E. None of these

9. Let even numbers be the replacement set. What is the truth set of x=7?
   A. {0,2,4,6,8} C. {0,1} E. None of these
   B. {2,3,4,...} D. {1}

10. Let positive integers be the replacement set of $2y+1=3$. Find the solution set.
A. $\{1,2,3,4,\ldots\}$ C. $\{0,1\}$ E. None of these
B. $\{2,3,4,\ldots\}$ D. $\{1\}$

11. The commutative property of multiplication is illustrated by
A. $a=b$ C. $a+b=b+a$
B. $ac=bc$ D. $ay=by$

12. The commutative property of addition is illustrated by
A. $a+(b+c)=(a+b)+c$ D. $a(b+c)=(b+c)a$
B. $a(b+c)=ab+ac$ E. None of these
C. $a(bc)=(ab)c$

13. Which of the following is closed under the operation?
A. $\{0,1,2\}$ addition
B. $\{1,2,3,4\}$ division
C. $\{1,3,5\}$ multiplication
D. $\{3,6,9,\ldots\}$ addition

14. Simplify: $a+3-4(a+2)-(5+6)a+10$
A. $3a+5$ C. $(-10a)/11$ E. None of these
B. $-2a+13$ D. $5-14a$

15. Simplify: $5(x+3y)+4(2x+5y)$
A. $15x+20y$ C. $11x+25y$ E. None of these
B. $13x+35y$ D. $12x+15y$

16. Solve: $a+5=7+5$
A. 5 B. 12 C. 7 D. 2 E. None of these

17. Solve: $x/5=100/5$
A. 100 B. 20 C. 10 D. 25 E. None of these

18. Solve: $3(x-6)-x=14$
A. 10 B. 16 C. 4 D. -2 E. None of these

19. Solve: $5(x+2)-4(x+1)-3=0$
A. -11 B. 3 C. -3 D. 11 E. None of these

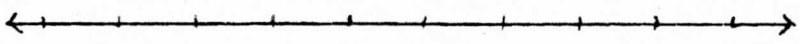
20. Chris spent a total of \$15.00 on a shirt and a pair of socks. If the total price of the shirt cost 4 times as much as the socks, how much did the shirt cost?
A. \$3.00 B. \$4.00 C. \$12.00 D. \$9.00

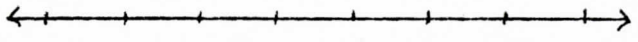
ALGEBRA I SECOND 6-WEEKS TEST

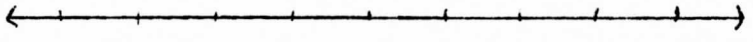
1. Solve the following:
   A. $16x=13x+45$
   B. $9-2x=5x-12$
   C. $2(2-3w)=3(3+w)+4$
   D. $(5x+9)-(3x-13)=2(11+x)$
   E. $y^2-2(y+4)-3=y^2-1/2(10+4y)$

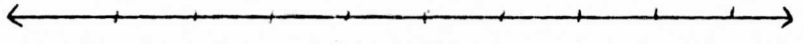
2. Let a and b be real numbers such that $a<b$.
   A. $a-1$ is _____ $b-1$ (<,=,>)
   B. $(-1)a$ is _____ $(-1)b$ (<,=,>)

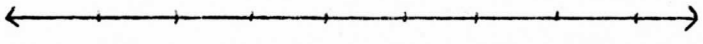
Solve and graph.

3. $3x+2\leq 5$ 

4. $x-2<-3$ or $x-3>0$ 

5. $-3<x-1<3$ 

6. $x-6\geq 4$ 

7. $x>2$ and $x<5$ 

8. Let $S=\{1,2,3,4\}$ and $T=\{4,5,6\}$
   A. $S \cup T$ =
   B. $S \cap T$ =

9. Solve: $4x+3\leq 2x-5$

10. A freight train takes 16 hours to travel the same distance that an express train travels in 12 hours. The average rate of the express train is 15 miles per hour more than that of the freight train. Find the rate at which each travels.

THIRD 6-WEEKS TEST

1. Find j and k such that $(3j,7)=(6,k+2)$.

2. Find the solution sets for the replacement sets given in the equation $x-y=4$; $x \in \{1,3,5\}$ and $y \in \{\text{positive integers}\}$.

3. If (a,b) represents an ordered pair, the abscissa is _____ and the ordinate is _____.

4. What is the ordinate of every point of the x-axis?

5. What is the abscissa of every point of the y-axis?

6. Show if the point $(6,4)$ satisfies the equation $x-y=10$.

7. Find the slope and y-intercept of the line $y-2x=1$.

8. Find the slope of the line passing through the points $(2,-3)$ and $(1,1)$.

9. Write the equation of the line with the slope of 4 and y-intercept of -1.

10. Write the equation of the line passing through the point $(-1,2)$ with slope of 3.

11. Write the equation of the line passing through the point $(2,-1)$ with the slope of $-2/3$.

12. Write the equation of the line passing through the points $(3,4)$ and $(-2,9)$.

13. What is the y-intercept of the line $2y-4x=6$?

14. On the graph paper provided, graph over the real numbers:
    a. $2x+y=8$
    b. $y=2x+1$
    c. $x+y\ 2$
    d. $2x+3y\ 6$ and $x-y\ 1$
    e. $x-2y\ 4$ or $x=4y\ 9$

ALGEBRA I POSTTEST

1. The value of $((3\cdot4)+2)\div((16-11)+2)$ is
   A. 7 B. -7 C. 9/7 D. 2 E. None of these

2. The value of $6\div3-2\cdot4\div1/2+5$ is
   A. 11/2 B. -7 C. -9 D. 3 E. None of these

3. Evaluate $(4x+7)-(2x-5)$ when $x=9$
   A. 30 B. 20 C. -30 D. -20 E. None of these

4. In the equation $y=x+1$, if the replacement set is $\{1,2,3\}$, what is the truth set?
   A. $\{2,4,6\}$ B. $\{2,3,4\}$ C. $\{1,3,5\}$ D. all real numbers

5. Solve for x: $4x-1=15$
   A. $x=7/2$ B. $x=-4$ C. $x=4$ D. $x=5$

6. If $x/5 = 4$, then $x=?$
   A. 20 B. 45 C. 4/5 D. 2 E. None of these

7. If $y=5$, then the value of the expression $2y^2- y$ is
   A. 95 B. 45 C. 5 D. 40 E. None of these

8. Which of the following illustrates the commutative property of addition?
   A. $5\cdot2=2\cdot5$ B. $2(5+2)=10+4$ C. $5+2=2+5$ D. $2(5+2)=(5+2)2$

9. Which of the following illustrates the associative property of multiplication?
   A. $2+(5+2)=(2+5)+2$
   B. $3\cdot(6\cdot4)=(3\cdot6)\cdot4$
   C. $3\cdot(6\cdot4)=(3\cdot)\cdot4$
   D. $2(4+5)=2\cdot4+2\cdot5$
   E. None of these

10. Simplify: $-7-(-3)$
    A. -4 B. 4 C. 10 D. -10 E. None of these

11. Simplify: $(12xy)\div(-3)$
    A. -4 B. 4xy C. -4xy D. None of these

12. If $4-8r=20$, then $r=?$
    A. 2 B. -2 C. 3 D. -3 E. None of these

13. If $a>b$ and $ac<bc$, then $c\underline{?}0$.
    A. < B. > C. $\leq$ D. $\geq$ E. None of the above

14. The graph  represents
A. all real numbers between -2 and 4
B. all real numbers between -2 and 4, inclusive
C. all integers between -2 and 4
D. None of the above

15. The solution set of $27-1 \leq 11$ is
A. $\{y : y \geq 5\}$ B. $\{y : y \geq 6\}$ C. $\{y : y \leq 5\}$ D. $\{y : y \leq 6\}$ E. None of these

16. If $(6,4x)=(6,12)$, then x is
A. 4 B. 6 C. -6 D. 3 E. None of these

17. The slope of the line passing through the points (1,4) and (3,-2) is
A. -3 B. 3 C. 1 D. 1/3 E. None of these

18. The slope of the line represented by the equation $y=4x-6$ is
A. 6 B. 4 C. 1 D. 0 E. No slope

19. The y-intercept of the line represented by the equation $2y=4x-6$ is
A. 4 B. -6 C. 6 D. 2 E. None of these

20. The solution to the system $\begin{cases} y=x+4 \\ y=-x+2 \end{cases}$ is
A. (-1,3) B. (1,-3) C. No solution D. Many solutions

21. The value of $(2x-2)(x-4)$ after multiplying is
A. $2x^2+8$ B. $2x^2-8$ C. $2x^2-10x+8$ D. $2x^2-8x+8$

22. The solution set to the equation $4x^2-16=0$ is
A. $x \in \{2,-2\}$ B. $\{3,-3\}$ C. $\{4,-4\}$ D. None of these

23. Simplify: $(4x^2-2x+1)(x+3)$
A. $4x^3-2x^2+x+3$ B. $4x^3+10x^2-8x+3$ C. $-4x^3-10x^2+8x+3$ D. $4x^3-3$

24. The value of y in the equation $2y^2-8y=0$ is
A. $\{0,-4\}$ B. $\{0,4\}$ C. $\{0.8\}$ D. $\{0,-8\}$

25. Simplify: $4x^2y(2x^3y-3xy^3)$
A. $8x^5y^2-12x^3y^4$
B. $6x^5y^2-7x^3y^4$
C. $6x^6y-7x^3y^3$
D. $8x^6y-12x^3y^3$
E. None of the above