To the Graduate Council:

I am submitting herewith a thesis written by Randall Keith Bassett entitled "A Study of Homogeneous and Heterogeneous Achievement Team Groupings in Geometry Mathematics Laboratories within a Classroom." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Elementary Education.

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A STUDY OF HOMOGENEOUS AND HETEROGENEOUS ACHIEVEMENT TEAM GROUPINGS IN GEOMETRY MATHEMATICS LABORATORIES WITHIN A CLASSROOM

A Thesis

Presented for the

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ABSTRACT

The purpose of the study was to discover whether third grade students would achieve significantly higher scores on geometry tests when placed in team groups with members of similar achievements or in team groups with members of different achievements; The grouping procedure was facilitated by mathematics laboratory team groups, a series of task cards, and a set of manipulative materials.

Data were collected from a class of twenty nine third grade students by means of a series of posttests that followed lesson presentations in the geometry laboratory sessions. Students were grouped according to achievement levels, and comparisons were made by comparing students placed in homogeneous achievement groups with other equally capable students who were placed in heterogeneous achievement groups.

Statitistical analysis was performed on the data by means of the t test; the confidence level was set at the .05 level. Comparisons were made at the high achievement level, average achievement level, and low achievement level, based on the data gathered from students of both forms of grouping.

The major finding of the study was that no significant difference existed in mean scores on teacher-made geometry tests as a result of the form of grouping used, at any of the three levels of achievement.

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CHAPTER I

INTRODUCTION

I. RATIONALE

Educators have frequently debated the significance of various forms of team grouping according to achievement, and how each affects the individual learners within that grouping. Many educators have advocated a policy of homogeneous achievement grouping, because the grouping of students with like achievements further facilitates the teaching of the group, assuming these students have the same needs, strengths, and weaknesses. Other educators have advocated the use of heterogeneous grouping according to achievement, saying that low achieving students benefit greatly from peer instruction, and that high achieving students benefit from helping low and average achievers. With this question in mind, this study was undertaken.

Since forms of grouping was the object of this study, an instructional technique allowing team grouping was desired. Consequently, since mathematics laboratories provide a natural setting for grouping, the mathematics laboratory was chosen as the instructional technique. Furthermore, the area of geometry was chosen because none of the students under study had been previously exposed to any geometry instruction, and thus a less biased study could be made.

II. STATEMENT OF THE PROBLEM

The purpose of this study was to investigate and compare the achievements of students with similar abilities, when exposed to two forms of team grouping: heterogeneous according to previous mathematics achievement, and homogeneous according to previous mathematics achievement. More specifically, the study was undertaken to discover whether significant differences existed between two groups of students with similar mathematics achievements, the two groups of students being one team that had been grouped with students of similar mathematics achievements, and one team that had been grouped with students whose mathematics achievements differed. Therefore, the three hypotheses of the study were:

1. There is no significant difference in the mean scores achieved on geometry posttests by high achieving students based on grouping form.

2. There is no significant difference in the mean scores achieved on geometry posttests by average achieving students based on grouping form.

3. There is no significant difference in the mean scores achieved on geometry posttests by low achieving students based on grouping form.

III. IMPORTANCE OF THE STUDY

Like most studies made of classroom instructional practices that deal with students, this study dealt specifically with team

grouping within a particular classroom atmosphere, and under the instruction of a particular teacher. It was important to note, then, that while this study had a general relevance, it was most significant to that particular teacher, and more specifically to that particular location and classroom. All expected variations in mind, this study was significant to any future grouping of students that the teacher may make.

A final significance of this study was the potential for future projection for each particular student within a classroom; that is, whether a particular student would do better in a homogeneous achievement team group or a heterogeneous achievement team group, based on his level of achievement.

IV. LIMITATIONS OF THE STUDY

The following limitations were observed during this study:

1. No attempt was made to counteract the variation in ability to adapt to an entirely new technique of instruction (geometry mathematics laboratories).

2. The grouping procedure was made according to mathematics and previous geometry achievement only, excluding similar interests, sex, age, mutual friendships, all other interpersonal factors, and other group interaction factors.

3. The fact that some students were more highly motivated by the manipulative materials than others may have had an effect on the laboratory achievements.

4. Some individuals were more highly motivated to complete the task card assignments than others.

5. Due to typical school absences and tardiness, some students occasionally missed the teacher-presented instruction, the geometry mathematics laboratory periods, or the geometry unit tests.

6. Group interaction and the sharing of materials may have been different for the groups consisting of four individuals and the group consisting of five individuals.

7. The grouping procedure by rank ordering of achievement may have been slightly imprecise since some achievement pretest scores varied by only one or two points.

8. The grouping code evaluation procedures were based on informal, non-standard, teacher-made tests.

V. ASSUMPTIONS

It was assumed that:

1. All students took the achievement pretests and the geometry posttests fairly, without cheating or insincere responses.

2. The randomly chosen questions which made up each geometry posttest reflected a true representation of acquired information for the majority of the class.

3. The order and location within the classroom of the geometry laboratory sessions had no significant influence on the productivity of the students.

4. The members within each group interacted with each other during the geometry laboratory sessions.

5. Each group worked out a method of sharing the materials and the task cards so that all students had an opportunity to work with all the manipulative materials and other geometry items.

VI. DEFINITIONS OF TERMS

High achiever. An individual who achieved at or above the 75th percentile level on a series of teacher-made, mathematics achievement pretests, administered to a class.

Average achiever. An individual who achieved between the 25th and 75th percentile levels on a series of teacher-made, mathematics achievement pretests, administered to a class.

Low achiever. An individual who achieved at or below the 25th percentile level on a series of teacher-made, mathematics achievement pretests, administered to a class.

Heterogeneous team. A selected group of four or five individuals, consisting of one high achiever, two or three average achievers, and one low achiever.

Homogeneous team of high achievers. A selected group of four individuals, each of whom achieved at or above the 75th percentile level in a class, on a series of teacher-made, mathematics achievement pretests.

Homogeneous team of average achievers. A selected group of four individuals, each of whom achieved between the 25th and 75th

percentile level in a class, on a series of teacher-made, mathematics achievement pretests.

Homogeneous team of low achievers. A selected group of four individuals, each of whom achieved at or below the 25th percentile level in a class, on a series of teacher-made, mathematics achievement pretests.

Geometry mathematics laboratory. An instructional technique consisting of a series of task cards and manipulative materials geared to the progressive instruction of geometry facts and concepts.

VII. METHODS AND PROCEDURES

The Population and Its Selection

The population used in this study was a classroom of twenty-nine third grade students attending Townsend Elementary School, Townsend, Tennessee. All students in the classroom were involved in the study, in one of the seven mathematics laboratory team groups. Due to the makeup of the class, no attempt to consider sex or age was made. This population was chosen since the teacher of the class was undertaking the study and had daily access to the students.

The Assignment of Achievement Levels

From the series of three mathematics textbooks used by the students at grade levels I, II, and III, a comprehensive mathematics test was constructed to measure mathematics achievement. According to scores made on the achievement test, a rank order of students was established; the student who scored highest on the mathematics

achievement test was designated number 1, on down to the lowest scoring student being designated number 29.

The students achieving 75 percent or above in the class percentile, students number 1 through number 8, were designated as high achievers. The students achieving between 25 percent and 75 percent in the class percentile, students number 9 through number 21, were designated as average achievers. The students achieving 25 percent or below in the class percentile, students number 22 through number 29, were designated as low achievers.

The groups were organized in this manner:

Team	Student Numbers	Description
1	1, 3, 6, 8	Homogeneous High Achievers
2	11, 14, 16, 19	Homogeneous Average Achievers, A
3	9, 12, 18, 21	Homogeneous Average Achievers, B
4	22, 24, 27, 29	Homogeneous Low Achievers
5	4, 5, 15, 25, 26	Heterogeneous Achievers, A
6	2, 13, 17, 28	Heterogeneous Achievers, B
7	7, 10, 20, 23	Heterogeneous Achievers, C

Methods of Experimentation and Gathering Data

After all the mathematics laboratory groups had been selected according to achievement, the students were instructed and allowed to work in their groups. All teacher instruction was presented to the entire class, thus making the teacher's role a constant variable. The mathematics laboratory groups operated after teacher instruction for a period of thirty minutes daily. The six geometry units lasted a week each, and the entire geometry program took place over a consecutive six-week period. A review of material, a whole class activity which included summarizing and concluding each geometry unit, took place after each unit's conclusion. A particular geometry test was given following the review and conclusion of each geometry unit. (See Appendix C.)

Each geometry test was made by the teacher and included representative items from the geometry facts and concepts that were covered by teacher instruction and the geometry laboratories.

Treatment of the Data

The scores for each student on each geometry test were recorded. From these scores a mean score was obtained for each of the following groups of students:

Homogeneous Groups	Heterogeneous Groups
High Achievers	High Achievers
Average Achievers	Average Achievers
Low Achievers	Low Achievers

In order to answer the question of whether significant difference existed between mean scores of each set of achievers, the t test was performed on each pair of mean scores. This statistical procedure was designed and chosen to contribute information establishing of any significant differences between mean scores; furthermore, this statistical procedure would indicate any significant difference as caused and effected by the two different forms of ability grouping.

VIII. ORGANIZATION OF THE STUDY

The present chapter includes the statement of the problem, the purpose of this study, limitations of the study, definitions of terms, methods and procedures used in the study, and organization of the study. Chapter II has been devoted to a review of related literature. Chapter III contains a description of the informal instruments used in the study. Chapter IV is a presentation of data and data analyses, and Chapter V consists of a summary of findings and conclusions that may be drawn from the completed study.

CHAPTER II

REVIEW OF RELATED LITERATURE

The review of related literature and research was discussed in three main categories: related literature, related research, and a summary.

I. RELATED LITERATURE

Purpose of Grouping in Pupil Teams

Various methods of grouping students in classrooms have been utilized in the past few years, and the grouping of pupils into pupil teams has been the source of much in-depth observation. However, what are the purposes of grouping. According to Austin H. Turney,

> Two questions immediately arise when one attempts to establish bases for ability grouping. The first and most fundamental is: Shall there be any grouping for learning purposes? The second is: What is the aim or purpose of ability grouping? We shall assume that some form of grouping is accepted.[1]

According to past practices, the dominating objective of the grouping of pupils has been to "improve the learning situation by bringing together 'pupils who will be alike in achievement at the

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[1]Warren W. Coxe, The Thirty-Fifth Yearbook of the National Society for the Study of Education (Bloomington, Illinois: Public School Publishing Company, 1936), p. 81.

end of a period of learning.'"[2] The major basis of team grouping, the bringing together of students with similarities to facilitate the teaching and learning practices, is of universal concern; that is, it is a common goal to strive for teachability through the use and administration of team groups.[3] It is generally an accepted fact that some form of grouping is necessary; in fact, it occurs whether planned or not.[4]

Criteria for Grouping in Pupil Teams

The two major classifications of groups into which students may be assigned are homogeneous groupings and heterogeneous groupings. Homogeneous team grouping is the pairing together of students with similarities on a particular item of value.

> Homogeneous grouping takes many forms. Students may be grouped on the basis of intelligence, reading achievement, average achievement, teacher judgment, or some combination of these.[5]

It is the general objective of homogeneous grouping to achieve some degree of uniformity. The criteria most observed as bases for grouping have been published in the Thirty-Fifth Yearbook of

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[2]David N. Aspy, "Groping or Grouping for Teachability," Contemporary Education, (May, 1970), p. 306.

[3]Ibid., p. 306.

[4]Ibid., p. 309.

[5]Robert B. Ruddell, Reading-Language Instruction: Innovative Practices (New Jersey: Prentice-Hall, Inc., 1974), p. 555.

the National Society for the Study of Education and are as follows:

1. Ordinary grade divisions, insofar as ability to learn improves with age and correlates with grade.

2. "Homogeneous" grouping, or ability groups within grade. Dividing the class into sections on the basis of ability to learn. The sections are supposed to be more homogeneous than the larger group from which they are made.

3. Special classes or institutions for gifted or bright.

4. Opportunity rooms for gifted or bright.

5. Ungraded rooms--theoretically for dull children or restoration classes.

6. Teachers' subjective grouping within a class.

7. Entrance requirements of various sorts; e.g. admit to kindergarten under five years if mental age is five or over.

8. Mutual aid groups.

9. Subject groups.

10. Grouping for specialized activities, such as physical education, music, art, etc.[6]

For most of these forms of grouping, the criteria of mental ability and achievement are fundamental. Achievement is often stressed more than ability in many groups, to allow for some degree of flexibility; consequently a pupil placed in a low section by

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[6]Coxe, op. cit., pp. 110-111.

these fundamental criterion who is doing superior work may be placed in a higher section or group.[7]

Many opponents of homogeneous grouping are quick to point out the problems caused by grouping pupils of like ability (or other similarity). A major criticism of homogeneous grouping is the negative influence it can have on the students, especially those placed in a lower section. It has been found that "a person's perception of himself influences his behavior, for better or worse, and the school's effectiveness may be governed heavily by the student's perception of himself as a learner."[8]

Wattenberg found that children who see themselves as negative had greater difficulty learning to read than children of equal ability who saw themselves in positive ways.[9] A correlated study on the psychological effect of grouping and the stigma that goes along with grouping was made on rats.

> Student experimenters were divided into two groups and were told to teach the same task to a group of rats. However, one group was told that they were getting "bright" rats, while the others were told that they were getting "dull" rats. In fact, both were random samples caged in a laboratory. The only difference in treatment involved the labels. The results indicated that the "bright" rats learned the task faster than the "dull" rats. One explanation of the difference

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[7]Ibid., p. 111.

[8]Aspy, op. cit., p. 308.

[9]Ibid., p. 308.

> is that the group of teachers working with the "bright" subjects tried harder because they felt an optimism about their work, and, additionally, ours is a culture which values brightness.[10]

Another criticism of homogeneous achievement grouping dealt with its effect on the student whose achievement is different from his ability. "The underachieving child is expected to follow the pace and instruction of the slower children, and so, because one of his reasons for underachieving in the first place was probably partly lack of motivation, he will only fall further behind."[11] Also, the child who is overachieving and is placed in a higher section than his ability would indicate, may meet a situation "destructive to his mental poise," one where the expectations and demands are obviously beyond his limitations, in which case the child may overwork, or quit trying and develop an inferiority complex.[12]

According to Sister Sheehy in the Catholic Education Review,

> Research says, (1) that homogeneity is more apparent than real, (2) that measurement techniques used for grouping are inadequate, (3) that speed is not necessarily important in learning, (4) that evidence of more effective learning in ability groups is inconclusive, and (5) that such methods may do actual harm to children's self concepts.[13]

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[10]Ibid., p. 309.

[11]Ruddell, op. cit., p. 557.

[12]Coxe, op. cit., p. 89.

[13]Aspy, op. cit., p. 308.

One obvious weakness of homogeneous grouping, according to one critic, is that once students have been lined up according to one trait, they get all out of order for a second dimension. Another opponent of homogeneous achievement and ability grouping, Milton Schwebel of New York University, wrote in School and Society, "There is a growing use of homogeneous ability grouping of children, although hardly a shred of evidence exists that children can benefit educationally from this procedure and despite evidence to the contrary."[14] One other opponent, Olson, Dean of the College of Education of the University of Michigan, found, "The fact is that the results of research on grouping tend to be small, inconsistent, complicated, and difficult to interpret. On the basis of what we know now, no one plan can be considered superior for enduring growth in achievement."[15]

By comparison, the treatment of heterogeneous ability and achievement grouping has been sketchy and imprecise. In contrast to grouping homogeneously for the purposes of uniformity, heterogeneous grouping has been said to strive for a healthy "mix" of the characteristics being measured. One review of heterogeneous grouping even went so far as to state that, due to imprecise measuring tools, homogeneous grouping is impossible for even a

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[14]Ibid., p. 308.

[15]Ibid., p. 308.

single dimension, and consequently, since all homogeneous grouping is thus impossible, all grouping is heterogeneous.[16]

Plans for Grouping of Pupils into Teams

Several plans for the grouping of pupils have been proposed. Among these are the X, Y, Z Homogeneous Plan, the A, C, D Homogeneous Plan, the Programmed Heterogeneity Plan, the Random Heterogeneity Plan, (or the Permissive Grouping Plan), the Winnetka Plan, the Dalton Laboratory Plan, the Multi-Age Grouping Plan, as listed and described in the following.

X, Y, Z Homogeneous Plan. A homogeneous plan based on achievement or intelligence; students were grouped into one of three achievement or ability groups at each grade level. The high achieving students comprised approximately 20 percent of the entire group; the average achievers comprised approximately 60 percent of the entire group, and the slow learners comprised approximately 20 percent of the entire group. Occasionally the slow learners group consisted of a group smaller than 20 percent of the entire group. Different curricula were adopted for each group.[17]

A, C, D Grouping Plan. A homogeneous plan of achievement and ability grouping. Students are grouped into six homogeneous groups, labeled AA, AC, CA, CC, DC, and DD. The first letter in the

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[16]Ibid., p. 309.

[17]Ibid., p. 307.

label refers to ability; the second letter refers to achievement. Thus, the AA students are those homogeneously grouped with high abilities and high achievements, the AC students are those with high abilities and average or low achievements. The CA students are students of average ability who have overachieved; the CC students are average achievers of average ability. The DC students are students of low ability who are overachieving; the DD students are those whose achievements and abilities are both low.[18]

Programmed Heterogeneity Plan. A plan that includes a pre-planned structure for each group (similar to the plan employed in this study). Groups usually consist of one high-achieving student, one low-achieving student, and three average-achieving students.[19]

Random Heterogeneity Plan. (Permissive Grouping Plan). A plan where all groups form at random, according to the choices and interactions of the pupils.[20]

Cambridge Plan. A plan originating in the late 1800's, allowing fast learners to complete one-third more work than slow learners, and thus finish the elementary grades in six years rather than eight.[21]

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[18]Coxe, op. cit., p. 89.

[19]Ruddell, op. cit., p. 555.

[20]Ibid., p. 555.

[21]Ibid., p. 556.

Winnetka Plan. A plan in which instruction was individualized and work was done on a contract-type basis. The student started working on a basic body of knowledge at a very simple level and progressed to higher levels on the basis of test results. Academic instruction comprised half the school day, and creative and social activities filled the rest of the day. The classroom assignments were made heterogeneously.[22]

Dalton Laboratory Plan. A plan that enabled students to complete a contract through a planned curriculum of twenty-day contracts. Students could work on subjects in whatever order and manner they chose. The curriculum was thus the same for everyone, though it allowed for individual progress.[23]

Multiage Grouping Plan. A nongraded plan in which children of various ages and grades were grouped in the same classroom. Subgroups based on individual needs were sometimes made within the multiage group.[24]

One other plan of grouping, the Joplin Plan, was an extension of the homogeneous achievement grouping that functioned cross-grade. For example, all students reading at a third grade reading level, regardless of regular grade placement would be grouped together for instruction.[25]

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[22]Ibid., p. 556.

[23]Ibid., p. 556.

[24]Ibid., p. 557.

[25]Ibid., p. 555.

II. RELATED RESEARCH

Many studies and comparisons involving grouping and pupil teams have been made, involving different content areas and different grades. In some instances the grouping of students into pupil teams was compared with other instructional techniques, such as individual or whole class instruction. In other instances, one mode of pupil grouping was contrasted with another. The results of some of these findings are listed.

1. In a study of pairing students homogeneously into high-high, high-low, and low-low pairs, there were no significant differences in achievement gains between high-high and high-low, though there was a significant difference between gains of high-high and low-low students.[26]

2. In a study comparing team groups of different sizes, 1, 2, 3, and 5 members:

   a. Groups of 3, 2, 5, and 1 retained information best, in that order.

   b. Groups of 3, 2, 1, and 5 scored highest in thinking processes, in that order.

   c. The same findings were obtained when the pupils were classified according to intelligence.[27]

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[26]J. Hartley and F. W. Hogarth, "Programmed Learning in Pairs," Educational Research, Vol. XIII (Fall, 1971), pp. 130-134.

[27]Thomas E. Culliton, Jr., "Group Size in Relation to the Discussion Tasks in Learning," Dissertation Abstracts, Vol. XXIII, No. I-A (1969), p. 282.

3. In a study of comparison between individual learning and team learning, it was found that:

   a. No significant differences were recorded for test scores of constructed-response type.

   b. Team learning was significantly superior in the immediate recall of factual knowledge.

   c. No significant difference was noted in permanent retention of knowledge for either.[28]

4. In a study of paired groups that worked independently, improvement was made by all pupils.[29]

5. In a study to measure the effectiveness of groups of 1, 3, and 5 members in grades four, five, and six:

   a. In retention, no effect was recorded.

   b. Team size of 3 was slightly favored.

   c. No significant differences were recorded for grades four and five.

   d. In grade six, the group of 1 was significantly favored.[30]

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[28]Thomas Michael Delmonaco, "Individual Versus Team Learning in Programmed Instruction in Grade Five," Dissertation Abstracts, Vol. XXXI, No.I-A (1969), p. 282.

[29]Doris Spencer, "An Evaluation of Word Study Lessons in Grade Four," Dissertation Abstracts, Vol. XIX, No. VIII (1958), p. 2034.

[30]Leonor May Rich, "The Effectiveness of Individual and Team Assignments Following Mass Presentations in Social Studies in Grades Four, Five, and Six," Dissertation Abstracts, Vol. XXIX, No. XII (1968), p. 4389.

6. In a study of grouping by intelligence on inductive and deductive learning, statistically significant gains were made by all students with an IQ of 110 or above, regardless of mode of learning.[31]

7. In a homogeneous grouping study in literature, social studies, and science:

   a. Significant improvement was noted for students with IQ's of 120 and above in all content areas; fifth grade social studies excepted.

   b. Pupils whose IQ's ranged between 95 and 119 made statistically significant gains in two of the content areas, for each grade.

   c. Pupils with IQ's below 95 in grade five made no gains; in grade six, gains were reported in two content areas.[32]

8. In a study of paired grouping, homogeneously according to three ability groups in grade six, no significant change was noted.[33]

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[31]Clare Mary Corcoran, "Inductive Versus Deductive Methods of Teaching Word Analysis in Grade Three," Dissertation Abstracts, Vol. XXII, No. XII (1961), p. 4290.

[32]John Manning, "Evaluation of Growth in the Content Areas of Literature, Social Studies, and Science in a Program of Individualized Instruction," Dissertation Abstracts, Vol. XXI, No. XI (1960), p. 3368.

[33]Annie Lee Jones, "Graded Study Guides for Sixth Grade Social Studies," Dissertation Abstracts, Vol. XIX, No. VIII, (1963), p. 2027.

9. In a study of groups equated on the bases of intelligence, reading achievement, spelling achievement and phonics knowledge:

   a. The program was found to be equally effective for children of different intelligence levels.

   b. The program was equally effective for boys and girls.[34]

10. In a study of team group progress in a program of individualization, in grades four, five, and six:

   a. Achievement gains were noted in grades five and six.

   b. Bright, average and slow children generally made achievement gains.[35]

III. SUMMARY

For the purpose of facilitating greater learning gains on the part of students, many different forms of grouping have been tried in the classroom. Some of the most common and most successful of these have included team grouping by some criterion of importance; these criteria may include age, sex, ability, achievement, interest, or some other variable. The grouping together of students with

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[34]Roselmina Indrisano, "Evaluation of a Word Analysis Program for Grade Two," Dissertation Abstracts, Vol. XXV, No. IV (1963), p. 2377.

[35]Mariam J. McSweeney, "Word Usage Techniques in Spelling," Dissertation Abstracts, Vol. XX, No. X (1959), p. 1460.

similarities in one or more aspects was in contrast to the planned grouping together of students with notable differences in one or more aspects under consideration. A random form of grouping with no criterion whatsoever emerged as the less structured counterparts of the planned grouping forms. All of the forms of grouping have both proponents and opponents, either defending or criticizing the merits of each, in relation to their values or deterrent qualities as a learning aid. Defined plans, variations of the three mentioned forms, have emerged and been implemented both experimentally and practically.

Many studies have been made dealing with forms of grouping and learning gains. Among these, it has been found generally to be the case that students do make notable gains when the team group is used; attitudes of the students have been generally favorable to the implementation of team grouping in the classroom. A group consisting of three members was generally found to be the most effective size of group. Further studies have found that while team learning resulted in greater immediate recall, there were no significant differences in permanent knowledge retention for group learning and individual learning.

The broad topic of grouping was relevant to the study at hand in several noteworthy ways. As always in the cases of the studies on grouping and grouping forms, the need for further understanding of the nature of grouping forms was stressed, as was

the case with the present study. The present study dealt with third grade mathematics and with two different forms of grouping in teams: homogeneous and heterogeneous team grouping. Other related studies dealt with size and heterogeneous grouping, paired learning and homogeneous grouping, and sex and homogeneous grouping; additional studies contrasted from the study presented also by content or the subject matter taught, the age and grade of the pupils, or forms of grouping.

Although related to the study at hand, these studies were not entirely similar to the one presented. Nonetheless, the implications that the previous studies had for the present study were threefold: first, it was implied that knowledge gains resulted from group learning; second, that grouping according to ability, either homogeneously or heterogeneously resulted in no significant changes or differences; and third, that group learning was equally effective for children of all intelligence and achievement levels.

CHAPTER III

INSTRUMENTS AND MATERIALS

The three instruments used in the study were the mathematics achievement pretests, the geometry laboratory content, and the geometry posttests. Each of these three instruments was designed specifically for the study, and each of the instruments was used according to its purposes and designs.

I. ACHIEVEMENT PRETESTS

Based on a selection of three mathematics textbooks of a series, a teacher-made mathematics achievement test was constructed. These were the mathematics textbooks used by the students in the study, in their first, second, and third grade years. The three mathematics textbooks served as models of form and style, and also as a basis of construction of the mathematics achievement pretests. They further served as guides of what mathematics content had been previously taught, and to what degree the various aspects of primary grade mathematics had been stressed to the students in the study.

The entire mathematics achievement test consisted of a group of six subtests which took approximately thirty minutes each. The tests were administered on six consecutive school days in sessions of thirty minutes each. From the scores made on the entire achievement test,

a rank ordering of the students was made; from this rank ordering of students based on mathematics achievement, geometry laboratory team assignments were made by grouping students into either homogeneous achievement groups or heterogeneous achievement groups. (For further detail, see Appendix A.)

II. GEOMETRY LABORATORY CONTENT

From a group of eight third grade mathematics textbooks, a list of concepts, problems, instructional content, and manipulative content concerning third grade geometry was made. This list included all the major topics presented in these eight third grade mathematics textbooks. An organized unit of third grade geometry was then made from all the material gathered, and from this material a step-by-step progression of concepts, facts, and problems was made. (See Appendix B.)

The geometry content was divided into six main categories: (1) points, lines, line segments, rays, and angles, (2) curves and circles, (3) triangles and their properties, (4) rectangles, squares, parallelograms, and quadrilaterals, (5) solids, (emphasizing the most common solid geometrical constructs), and (6) congruence, similarity, symmetry, and transformations. From the content organization a series of tasks was designed to teach the lessons; each series of tasks was placed on one or more task cards, each of which took approximately fifteen minutes to complete. Thus the geometry

content was presented for each unit through a series of task cards, which were made from a series of tasks geared for the instruction of particular concepts, and organized from the geometry content outline representing the general third grade geometry content, as presented in and compiled from eight third grade mathematics textbooks. (For further detail, see Appendix C.)

III. GEOMETRY POSTTESTS

From the content of the geometry laboratories and task cards, a series of six geometry posttests were constructed, one test for each unit. Each test took approximately twenty minutes to administer, and the appropriate test was presented at the conclusion of the laboratory unit at the end of the week. All geometry posttests were presented orally to the students, to which the students responded.

The geometry posttests were representative of the content covered throughout each unit. The posttests included questions which demanded short sentence answers, exact one-word or one-number answers, drawings, and explanations. (See Appendix D.)

The geometry posttests were scored according to number of correct answers, and from these scores data were gathered for each unit covered, and for the entire study.

CHAPTER IV

PRESENTATION OF DATA AND FINDINGS

I. PRESENTATION OF DATA

It was the aim of this study to compare two forms of achievement team grouping: heterogeneous achievement team grouping and homogeneous achievement team grouping. It was also the design of this study to compare the two forms of achievement grouping at three different achievement levels: high achievement levels, average achievement levels, and low achievement levels.

After instruction had taken place, scores were gathered from the geometry posttests that were administered following each of the six geometry units. Every score obtained from the entire chosen population was used in the comparisons of forms of grouping. All students in the study were classified according to achievement level and the form of grouping to which they were assigned.

Comparisons were made between the mean scores of students in the two forms of grouping, according to achievement levels. High achievers placed in a homogeneous achievement team were compared with high achievers placed in a heterogeneous achievement team. Likewise, average or low achievers placed in a homogeneous achievement team were compared with average or low achievers placed in a heterogeneous achievement team.

Statistical analyses were applied to the results for the entire population of the study and to the results when the participants were categorized by achievement levels and form of grouping. The analysis procedure used was the t test, and the confidence level was set at the .05 level. The absence or presence of significant differences between mean scores was derived from published statistical tables.[1]

The major results of the study are presented. The data are discussed for each of the three achievement levels. Tables I and II present the data and results of calculations for the high achievement students on the tests; Table III presents the data and results of the t-test administration. Tables IV and V present the data and results of calculations for the average achievement students; Table VI presents the results of the t-test administration performed on means achieved for this group of students. Tables VII and VIII present the data and calculations for the low achievement students; Table IX presents the results of the t-test analysis performed on the data for the low achievement students.

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[1]Woodrow W. Wyatt and Charles M. Bridges, Jr., Statistics for the Behavioral Sciences (Boston: D. C. Heath and Company, 1967), p. 271.

TABLE I

MEANS AND SUMS OF SQUARED DEVIATIONS OF GEOMETRY POSTTEST SCORES FOR HIGH ACHIEVING STUDENTS GROUPED IN HOMOGENEOUS ACHIEVEMENT GEOMETRY TEAMS

Unit	Number, N_1	Mean, M_1	Sum of Squared Deviations
1.	4	13.4	.2
2.	4	23.0	10.0
3.	4	8.6	4.6
4.	4	10.5	1.0
5.	4	11.8	14.6
6.	4	8.5	1.0
Total (of all tests)	24	75.8	31.4

TABLE II

MEANS AND SUMS OF SQUARED DEVIATIONS OF GEOMETRY POSTTEST SCORES FOR HIGH ACHIEVING STUDENTS GROUPED IN HETEROGENEOUS ACHIEVEMENT GEOMETRY TEAMS

Unit	Number, N_2	Mean, M_2	Sum of Squared Deviations
1.	3	12.1	16.2
2.	4	21.3	14.8
3.	4	8.1	1.8
4.	4	12.0	14.0
5.	3	13.3	29.1
6.	4	7.3	6.8
Total (of all tests)	22	74.1	82.7

TABLE III

RESULTS AND INTERPRETATIONS OF t-TEST ANALYSIS FOR HIGH ACHIEVERS

Unit	t-test Score	Interpretation
1.	.88	No Significant Difference
2.	1.18	No Significant Difference
3.	.68	No Significant Difference
4.	-1.36	No Significant Difference
5.	- .66	No Significant Difference
6.	1.48	No Significant Difference
Total (of all tests)	.58	No Significant Difference

TABLE IV

MEANS AND SUMS OF SQUARED DEVIATIONS OF GEOMETRY POSTTEST SCORES FOR AVERAGE ACHIEVING STUDENTS GROUPED IN HOMOGENEOUS ACHIEVEMENT GEOMETRY TEAMS

Unit	Number, N_1	Mean, M_1	Sum of Squared Deviations
1.	8	11.1	14.8
2.	7	19.7	13.5
3.	7	7.1	16.8
4.	8	7.8	36.7
5.	7	10.6	46.0
6.	5	6.2	11.4
Total (of all tests)	42	62.5	139.2

TABLE V

MEANS AND SUMS OF SQUARED DEVIATIONS OF GEOMETRY POSTTEST SCORES FOR AVERAGE ACHIEVING STUDENTS GROUPED IN HETEROGENEOUS ACHIEVEMENT GEOMETRY TEAMS

Unit	Number, N_2	Mean, M_2	Sum of Squared Deviations
1.	3	12.3	4.7
2.	4	20.3	11.6
3.	5	7.0	14.0
4.	5	9.4	13.4
5.	4	10.0	16.0
6.	4	5.8	10.0
Total (of all tests)	25	64.8	69.7

TABLE VI

RESULTS AND INTERPRETATIONS OF t-TEST ANALYSIS FOR AVERAGE ACHIEVERS

Unit	t-test Score	Interpretation
1.	-1.21	No Significant Difference
2.	- .57	No Significant Difference
3.	.10	No Significant Difference
4.	-1.31	No Significant Difference
5.	.36	No Significant Difference
6.	.34	No Significant Difference
Total (of all tests)	- .97	No Significant Difference

TABLE VII

MEANS AND SUMS OF SQUARED DEVIATIONS OF GEOMETRY POSTTEST SCORES FOR LOW ACHIEVING STUDENTS GROUPED IN HOMOGENEOUS ACHIEVEMENT GEOMETRY TEAMS

Unit	Number, N_1	Mean, M_1	Sum of Squared Deviations
1.	4	9.3	22.8
2.	3	19.7	4.7
3.	4	7.0	3.0
4.	4	9.3	28.8
5.	4	8.3	98.8
6.	4	5.8	4.8
Total (of all tests)	23	59.4	162.9

TABLE VIII

MEANS AND SUMS OF SQUARED DEVIATIONS OF GEOMETRY POSTTEST SCORES FOR LOW ACHIEVING STUDENTS GROUPED IN HETEROGENEOUS ACHIEVEMENT GEOMETRY TEAMS

Unit	Number, N_2	Mean, M_2	Sum of Squared Deviations
1.	4	8.3	6.8
2.	4	20.3	14.8
3.	4	5.4	17.8
4.	4	7.0	6.0
5.	4	8.8	18.7
6.	4	4.1	12.8
Total (of all tests)	24	53.9	76.9

TABLE IX

RESULTS AND INTERPRETATIONS OF t-TEST ANALYSIS FOR LOW ACHIEVERS

Unit	t-test Score	Interpretation
1.	.64	No Significant Difference
2.	-.40	No Significant Difference
3.	1.21	No Significant Difference
4.	1.35	No Significant Difference
5.	-.16	No Significant Difference
6.	1.40	No Significant Difference
Total (of all tests)	1.20	No Significant Difference

II. FINDINGS

High Achievement Levels

The comparisons between the high achieving students in homogeneous achievement teams and high achieving students in heterogeneous teams were made using the t test; the confidence level was set at the .05 level. The data were recorded in Tables I and II, and the results of the t test were recorded in Table III (pages 30, 31, and 32, respectively).

The results of the statistical analysis confirm the hypothesis that no significant difference existed in mean scores achieved on the geometry posttests between high achieving students grouped in homogeneous or heterogeneous achievement teams. Furthermore, no consistent patterns in the scores or deviations of either group were noted.

Average Achievement Levels

In comparing the scores of students of average achievement who were grouped in the two forms of achievement grouping, the t test was again used, and the confidence level remained at the .05 level. The data were presented in Tables IV (page 33) and V (page 34), respectively, and the results of the comparisons of average achieving students from the t-test administration were recorded in Table VI (page 35).

Again, this confirms the hypotheses of no significant difference existing in mean scores achieved on the geometry posttests

between the two team groups. In this comparison, also, there were no patterns of any noteworthy consistence.

Low Achievement Levels

The t test was used also in comparison of the scores of the low achieving students, comparing the scores of students in homogeneous achievement groups with the scores of students in heterogeneous achievement groups; the confidence level was again set at the .05 level. The data for the low achieving students were recorded in Tables VII (page 36) and VIII (page 37), respectively, and the results of the statistical analysis were noted in Table IX (page 38).

Once again the results of the statistical analysis confirm the hypothesis of no significant difference existing in mean scores achieved on the geometry posttests between low achieving students in homogeneous achievement teams and low achieving students in heterogeneous achievement teams. There were no consistent patterns that emerged from the comparisons of these two team groupings.

III. SUMMARY

Regardless of the form of team grouping used, either homogeneous achievement grouping or heterogeneous achievement grouping, no significant differences were found in mean scores made by the students on the geometry posttests. This held consistently true for students of high achievement levels, average achievement levels, and low achievement levels.

The three hypotheses which stated that for each of the achievement levels, no significant difference on geometry posttest mean scores would be found between students grouped in homogeneous achievement team groupings and students grouped in heterogeneous achievement team groupings were accepted.

CHAPTER V

SUMMARY, FINDINGS, AND CONCLUSIONS

I. SUMMARY

This study was designed to compare the achievements of twenty-nine third grade students at the high achievement, average achievement, and low achievement levels when exposed to two forms of team grouping: homogeneous team grouping according to mathematics achievement, and heterogeneous team grouping according to mathematics achievement. A homogeneous team consisted of four members of similar mathematics achievement, and a heterogeneous team consisted of four or five members whose mathematics achievements differed. A limitation noted was that the participating students were pretested with a teacher-made mathematics achievement pretest (see Appendix A), and based on the rank-order results of this teacher-made pretest, they were assigned to team groups, either with students of similar or different mathematics achievement levels. A high achiever was defined to be a student who scored at or above the 75th percentile on a teacher-made mathematics achievement test; an average achiever was defined to be a student who scored between the 25th and 75th percentiles on a teacher-made mathematics achievement test; a low achiever was defined to be a student who scored at or below the 25th percentile on a teacher-made mathematics achievement test. The hypotheses were that no significant differences

existed in mean scores achieved on the geometry posttests between the two differently grouped teams at (1) the high achievement level, (2) the average achievement level, and (3) the low achievement level.

The team groups were led through a series of six geometry units that were presented in mathematics laboratories that employed task cards and manipulative materials, for a period of thirty minutes daily, over a consecutive six-week period. The six geometry units consisted of (1) points, lines, line segments, rays, and angles, (2) curves and circles, (3) triangles and their properties, (4) rectangles, squares, parallelograms, and quadrilaterals, (5) solids (emphasizing the most common solid geometrical constructs), and (6) congruence, similarity, symmetry and transformations. (See Appendix B.) The six geometry posttests were administered to the participants following the geometry units, to measure achievements of the geometry laboratory experience. (See Appendix C.) The scores from the geometry posttests were then analyzed statistically to discover if any significant differences in geometry achievement had occurred as a result of the form of grouping used, at any of the levels of achievement.

A review of related literature and research suggested that the use of team grouping in the classroom for greater learning gains did result in notable gains in learning. Team groups consisting of three members were found to be most effetive, and attitudes on the parts of the members mostly remained high. Further studies

have found that while team learning resulted in greater immediate recall, there were no significant differences in permanent knowledge retention for group learning and individual learning.

II. FINDINGS

Since the purpose of the study was to compare the achievement gains of students grouped in homogeneous achievement groups with those grouped in heterogeneous achievement groups, at three levels of achievement, the t test was used to measure the absence or presence of any significant differences in each individual test and in the total of all tests. An acceptable level of significance was set at the .05 level of confidence. The results of the data were presented in Tables I (page 30), II (page 31), IV (page 33), V (page 34), VII (page 36), and VIII (page 37), respectively, and the results of the statistical analysis involving the t-test administration were presented in Tables III (page 32), VI (page 35), and IX (page 38), respectively. The significant findings of the study were as follows:

1. No significant differences were noted between students of high achievement when grouped in homogeneous achievement team groups in contrast to heterogeneous achievement groups.

2. No significant differences were noted between average achievement students grouped in homogeneous team groups and average achievement students grouped in heterogeneous team groups.

3. No significant differences between students of low achievement grouped in homogeneous achievement teams or heterogeneous achievement teams were noted.

III. CONCLUSIONS

On the basis of these findings, the following conclusions were offered:

1. There were no significant differences between the learning gains of students grouped in homogeneous achievement groups and heterogeneous achievement groups among high achieving students, average achieving students, or low achieving students.

2. No patterns of scores or analysis emerged from the study sufficient enough to justify any additional speculation.

Therefore, the three hypotheses were accepted.

IV. OBSERVATIONS AND RECOMMENDATIONS FOR FURTHER STUDY

The data gathered in this study showed no significant differences between gains of students in homogeneous or heterogeneous achievement teams, regardless of the level of achievement. Further, no pattern was established to reveal any other discoveries or relationships. However, these results and the content of the study raised some additional considerations, and recommendations for further study.

1. How would students respond to a teacher-presented class or some other teaching technique, if grouped in similar homogeneous and heterogeneous achievement groups?

2. How would student gains differ if they remained in the achievement groups but covered different content, such as language arts, reading, or physical education?

3. What results might occur in a similar study if the data were analyzed according to sex, age, interest, or some variable other than achievement levels?

The present study was inspired by some practical educational problems involving the use of achievement grouping to achieve greater learning gains on the part of the students. Although the limitations of the study were such that no broad conclusion could be derived, implications of the nature of grouping and results from homogeneous and heterogeneous achievement groupings were established. In consequence, attention should be placed on the use of achievement grouping in the classroom with the understanding brought about by this study.

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BIBLIOGRAPHY

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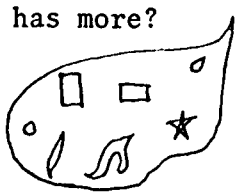
APPENDICES

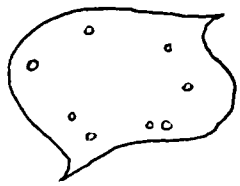
APPENDIX A

APPENDIX A

ACHIEVEMENT PRETESTS

1. Which set has more?





2. Put in the missing numeral.

3 + ☐ = 7

4 + ☐ = 9

☐ + 6 = 6

☐ + 9 = 10

☐ + 7 = 9

3 + 8 = ☐

☐ + 3 = 9

7 + 6 = ☐

7 + 9 = ☐

6 + 9 = ☐

9 + ☐ = 17

8 + ☐ = 17

6 + ☐ = 17

8 + 10 = ☐

9 + 9 = ☐

☐ + 8 = 20

3. 6 - 5 = ☐

7 - 6 = ☐

8 - 2 = ☐

10 - 10 = ☐

4. 20 - ☐ = 17

25 - ☐ = 17

17 - ☐ = 8

17 - 11 = ☐

☐ - 7 = 17

☐ - 6 = 11

☐ - 3 = 3

☐ - 9 = 19

☐ - 21 = 2

12 - ☐ = 12

5. 5 + (3 + 2) = ☐

(7 + 2) + 6 = ☐

6. $166 = 100 + \square\square + 6$

$295 = 200 + 90 + \square\square$

$562 = \square\square + 60 + 2$

$89 = \square\square + \square\square$

$1113 = 1000 + \square\square + 10 + 3$

7. $203 = 200 + \square\square + 3$

$861 = \square\square + 60 + \square\square$

$2163 = 2000 + 100 + \square\square + 3$

8. Add.

62 + 5	81 + 3	90 + 9	82 + 6
95 + 5	78 + 6	85 + 8	93 + 9
76 + 8	79 + 9	83 + 8	27 + 7

9.

283 + 21	309 + 16	821 + 19	217 + 33
112 +213	819 +918	962 +459	863 +998

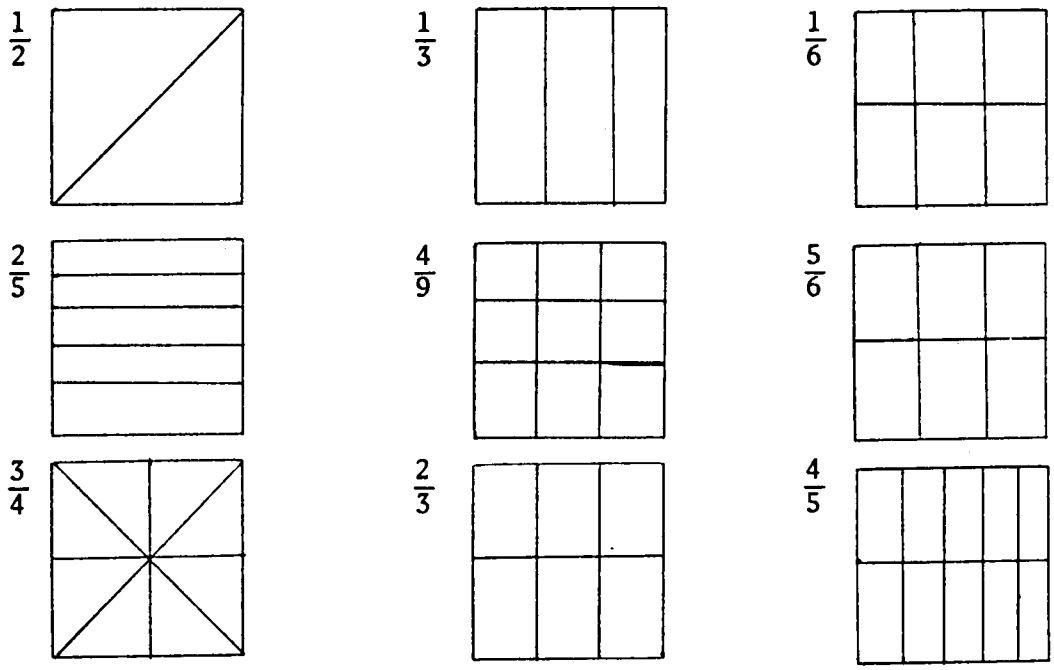
10. Subtract.

119 - 39	424 - 80	106 - 36	437 - 90
428 - 57	113 - 62	762 - 81	731 - 60

11.

901	807	683	802
-900	-716	-581	-111
999	755	281	789
-876	-307	-182	-191

12. Color in the parts:



13. Add.

12	31	86	12
38	82	97	70
25	90	88	11
95	86	45	81
59	72	55	82
62	81	65	87

14. Fill in the missing sign: $<$, $>$, or $=$.

Example: 3 $\boxed{<}$ 4

6 $\square$ 8 9 $\square$ 1 7 $\square$ 6

9 $\square$ 12 13 $\square$ 13 82 $\square$ 802

12786 $\square$ 11786 30496 $\square$ 30596

26781 $\square$ 26791 1035 $\square$ 1035

15. Example: 8 + 1 $\boxed{<}$ 10

8 + 9 $\square$ 13 6 + 3 $\square$ 8

12 + 6 $\square$ 17 9 + 5 $\square$ 16

16. Fill in the missing sign: $<$, $>$, or $=$.

Example: 10 $\boxed{>}$ 5 - 3

15 $\square$ 17 - 3 51 $\square$ 39 + 13

26 $\square$ 39 + 13 31 $\square$ 40 - 2

37 $\square$ 46 - 9 29 $\square$ 50 + 20

17. 25 - 8 $\square$ 7 + 11 63 - 5 $\square$ 61 - 0

32 + 5 $\square$ 47 - 8 57 + 8 $\square$ 73

41 + 2 $\square$ 38 + 3 42 + 11 $\square$ 39 + 14

18.

\$3.36 + .94	\$6.92 -2.86	\$5.80 +2.23
\$7.81 +7.81	\$8.56 -2.87	\$9.01 -8.12

19. Fill in the missing numerals:

10	15	20	___	___	___	___	___	50
12	16	20	___	___	___	___	___	44
16	24	32	___	___	___	___	___	80
11	16	21	___	___	___	___	___	51
18	27	36	___	___	___	___	___	90
17	27	37	___	___	___	___	___	97
114	104	94	84	___	___	___	___	34
48	46	44	___	___	___	___	___	32
425	450	475	___	___	___	___	___	625
121	141	161	___	___	___	___	___	281
111	222	333	___	___	___	___	___	999
102	203	304	___	___	___	___	___	910

20. Write the numeral that means:

6 tens, 12 ones ____

9 tens, 10 ones ____

4 thousands, 10 hundreds ____

9 tens, 15 ones ____

5 thousands, 12 hundreds _____

2 thousands, 15 hundreds, 5 tens, 2 ones _____

4 thousands, 15 hundreds, 2 ones _____

6 thousands, 5 tens, 0 ones _____

6 thousands, 20 hundreds, 6 tens, 6 ones

21. Write the numeral for these:

XX _____ IX _____

IV _____ XXII _____

VII _____ XXIX _____

XXIV _____ XVII _____

22. Write the Roman numeral for these:

1 = _____ 6 = _____

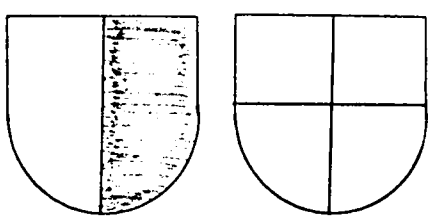
2 = _____ 7 = _____

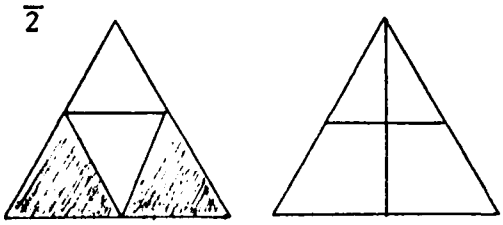
3 = _____ 8 = _____

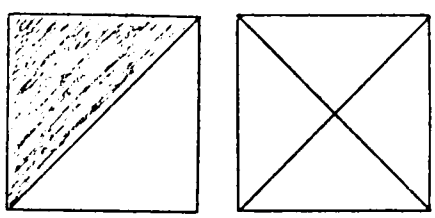
4 = _____ 9 = _____

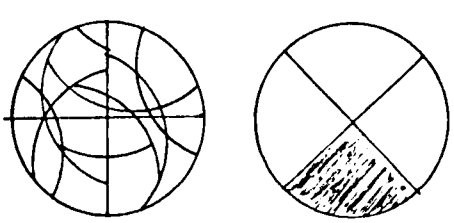
5 = _____ 10 = _____

23. Draw a fraction that means the same thing (color it in):

$\frac{1}{2}$ 

$\frac{1}{2}$ 

$\frac{1}{2}$ 

$\frac{1}{4}$ 

24. Fill in the missing numeral.

2 x 7 = ☐	5 x 3 = ☐
1 x 6 = ☐	3 x 6 = ☐
0 x 4 = ☐	9 x 1 = ☐
6 x 3 = ☐	5 x 4 = ☐
1 x 0 = ☐	4 x 5 = ☐

25.

10 ÷ 2 = ☐	8 ÷ 4 = ☐
10 ÷ 5 = ☐	16 ÷ 2 = ☐
12 ÷ 3 = ☐	12 ÷ 4 = ☐
16 ÷ 8 = ☐	20 ÷ 5 = ☐
27 ÷ 3 = ☐	12 ÷ 4 = ☐

26. Put in a numeral for the greatest number that will make a true sentence.

Example: 5 x 1 > ☐

3 x ☐ < 9	☐ x 2 < 16
4 x 2 > ☐	18 ÷ 2 > ☐
18 ÷ 6 > ☐	4 ÷ ☐ > 2
☐ ÷ 2 < 6	16 ÷ ☐ < 8
☐ ÷ 2 < 5	21 ÷ ☐ > 7

APPENDIX B

APPENDIX B

GEOMETRY CONCEPTS AND MATERIALS

I. Points, Lines, Line Segments, Rays, Angles.

A. Points - the idea.

1. Size.

2. Infinite number exist.

3. Two points determine a line.

B. Lines - the idea.

1. Two points determine a line.

2. Size (Width).

3. Infinite direction both ways.

4. Denotation.

5. Parallel lines.

6. Perpendicular lines.

C. Line Segments.

1. Two points are called the endpoints.

2. Can measure this length.

3. Measurement of length of a line segment.

4. Concrete use of.

5. Infinite number of points between the endpoints.

6. Line segment $\overline{AA}$.

7. Denotation.

D. Rays - partial ideas.

1. Has one endpoint.
2. One end extends like a line.
3. Direction.
4. Denotation.
5. Different rays, same endpoint.

E. Angles.

1. Defined by two rays.
2. Size of rays doesn't matter in measuring.
3. Measurement.
4. Denotation.
5. Importance of angles - experimentation.
6. Greater than, Less than.
7. 0°, 90°, 180°.

II. Curves and Circles

A. Curves.

1. A curve is a path.
2. The line is a curve, of the shortest distance between two points.
3. Simple curves.
4. Closed curves, open curves.
5. Use of curves.
6. All exterior definitions.
7. Interior, exterior, boundary points.

B. Circles.

1. Round simple closed curve.
2. Center.
3. Line segment - radius, diameter.
4. Line segments having same center moving outward, same distance.
5. Measurements of all radii are equal.
6. Concentric circles.
7. Tangent circles.
8. Construction.

III. Triangles and their properties.

A. Simple closed curve.

B. Three line segments.

C. Three vertices or corners.

D. Three sides.

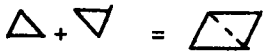
E. Three angles.

F. Right triangle.

G. Equilateral triangle.

H. Isosceles triangle.

I. Angles' sum = 180°.

J. 

K. Point construction.

IV. Rectangles, Squares, Parallelograms, Quadrilaterals.

A. Rectangles.

1. Simple closed curve.

2. Four sides.

3. Four line segments.

4. Four corners or vertices.

5. Four angles - four right angles.

6. Diagonals.

7. Measurement.

    a. Perimeter.

    b. Area.

8. Circumscribing within or without a circle.

9. Point construction.

B. Squares.

1. Are rectangles.

    a. Have four sides, line segments.

    b. Have four corners - vertices.

    c. Have four angles - right angles.

2. All line segments have the same length and measurement.

3. Diagonals.

    a. Same length.

    b. Triangles thus formed.

4. Circumscribing within and without circles.

5. Measurement.

    a. Perimeter.

    b. Area.

6. Point construction.

C. Parallelograms.

1. Have four sides.

2. Have four vertices and four corners.

3. Have four angles.

a. Right angles.

b. Not right angles.

4. Opposite line segments are parallel.

5. Diagonals.

a. Triangles thus formed.

b. Size comparison.

6. Rhombus.

a. Four sides are equal.

b. Angles.

1. May not be equal.

2. May be equal.

c. Construction.

7. Construction.

D. Quadrilaterals.

1. Any simple closed curve with four sides.

2. Includes all others: trapezoid, kite, abnormal quadrilaterals.

V. Solids - Planes, Cubes, Spheres, Boxes, Cylinders, Pyramids.

A. Plane - the idea.

1. Three points not in a line determine a plane.

2. Any flat surface is a plane.

3. Infinite extension.

4. Examples of.

5. Parallel planes.

6. Perpendicular planes.

B. Cubes.

1. Six planes or faces.

2. Each face is a square.

3. Volume of.

4. Number of points or corners.

5. Construction.

C. Boxes.

1. Six faces.

2. Each face is a rectangle.

3. Volume of.

4. Number of points or corners.

5. Construction.

D. Pyramid.

1. Four faces.

2. Each face is a triangle.

a. Equilateral.

b. Isosceles.

3. Construction.

E. Sphere.

1. Group of line segments spaced around one point.

2. Parallel circles of.

3. Perpendicular circles of.

4. Center.

5. Examples of in physical world.

F. Cylinder.

1. Tube.

2. Straight body.

3. Ends are circles.

4. Construction.

a. Rectangle.

b. Two circles.

5. Spinning origin.

VI. Congruence, Similarity, Symmetry, Transformations.

A. Congruence - Similarity.

1. The idea of, and comparison of.

2. Applied to geometric shapes.

B. Symmetry.

1. Concept of.

2. Line of symmetry.

3. Point of symmetry: Circle, Sphere.

4. Applied to geometric shapes.

C. Transformations.

1. Translation.

2. Reflection.

3. Rotation.

4. Combinations.

APPENDIX C

APPENDIX C

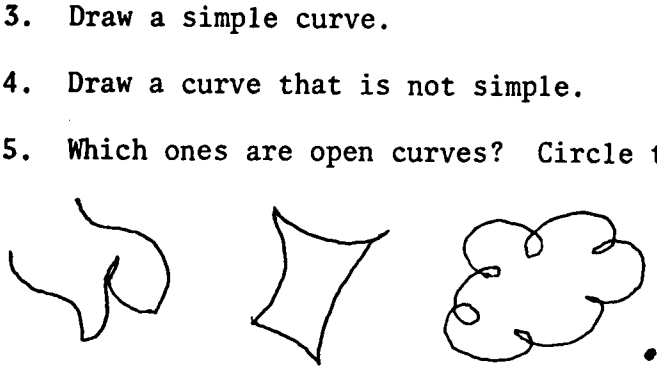
GEOMETRY POSTTESTS

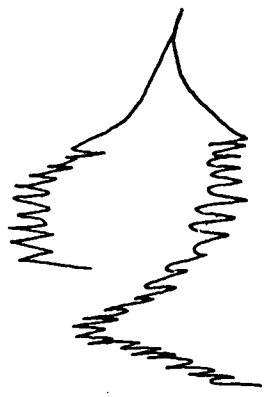
Unit 1.

1. How many points determine a line?
2. Does a point take up any space?
3. Can two lines be parallel?
4. T or F No matter how small a line segment may be, there are still millions of points between the endpoints.
5. Draw a picture of how two lines can come together to form a square corner.
6. Does a line ever stop?
7. Draw a line segment, $\overline{AB}$, and label the endpoints.
8. What might you use to measure a line segment?
9. How many endpoints does a ray have?
10. Can two rays have the same endpoint?
11. How many rays do we have to have to form an angle?
12. Draw an angle.
13. What is the unit of measurement for angles? (Is it feet, or millimeters, or points, or what?)
14. Draw an angle with 90°.
15. Draw two angles. Circle the one which has a greater measurement.

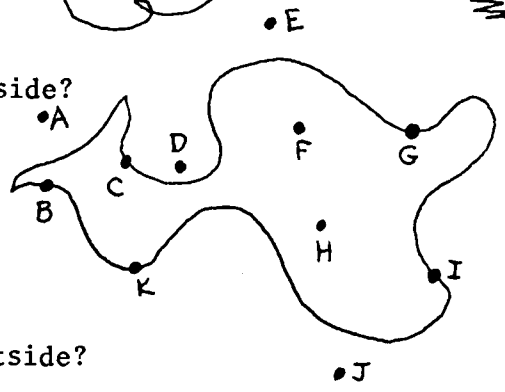
Unit 2.

1. T or F A curve is a path.
2. What is the shortest distance between any two points?
3. Draw a simple curve.
4. Draw a curve that is not simple.
5. Which ones are open curves? Circle them.





6. Which points are inside?



7. Which points are outside?
8. What is the point in the middle of a circle called?
9. Are all radii of a circle equal in length?
10. Is a radius the same thing as a diameter?
11. Two tangent circles touch in how many places?
12. Can two circles have the same center?

Unit 3.

1. How many angles does a triangle have?
2. How many points or corners does a triangle have?
3. Can a triangle have a square corner?

4. Can a triangle have two square corners?
5. Draw a triangle with three equal sides.
6. Draw a triangle that has only two equal sides.
7. If you measure all the angles in a triangle and add them up, how many degrees will you have?
8. Is a triangle a simple curve?
9. Can you draw a triangle that is not closed?
10. If you fold a triangle in half, what do you get?

Unit 4.

1. Can a square be a rectangle?
2. Are all rectangles squares?
3. How many square corners does a rectangle have?
4. What is the figure called with four square corners and four equal sides?
5. Draw a rectangle.
6. Draw the diagonals in the rectangle you just drew.
7. Do the diagonals of a square have the same length?
8. What do you get if you fold a square along one of its diagonals?
9. Can a parallelogram have four equal sides?
10. Draw a four-sided figure that is not a parallelogram.
11. Are all squares parallelograms?
12. Are all rectangles parallelograms?

13. Can a parallelogram have only one square corner?

14. How many diagonals does a parallelogram have?

Unit 5.

1. How many points determine a geometric plane?
2. Can planes be parallel?
3. Can planes come together to form square corners?
4. Do planes ever stop?
5. How many faces does a cube have?
6. Each face of a cube is what geometric figure?
7. How many corners does a cube have?
8. Can a geometric box be a cube?
9. Each face of a geometric box is what geometric figure?
10. How many faces does a pyramid have?
11. Each face of a pyramid is what geometric figure?
12. How many line segments does a pyramid have?
13. What do the ends of a cylinder look like?
14. Is the body of a cylinder straight?
15. What is the point in the middle of a sphere called?
16. Give an example of a sphere.
17. If a sphere is cut straight, through the middle, what geometric shape will you see?
18. Can you cut a sphere twice so that the circles will come together and form a square corner?

19. Are all the radii of a sphere the same length?

20. Can two spheres touch at only one point?

Unit 6.

1. Draw two congruent triangles.

2. Name a figure that has a point of symmetry.

3. Draw a rectangle.

4. Draw a smaller rectangle that is similar to the first rectangle you drew.

5. How many lines of symmetry would a square have?

6. Draw a rectangle; now draw one of its lines of symmetry.

7. Does a circle have a line of symmetry?

8. How many ways can you transform or move a shape?

APPENDIX D

APPENDIX D

Unit 1: Points, Lines, Line Segments, Rays, Angles.

Task Card 1.

1. Discuss with your group:
   (a) How many air dots are there in one inch?
   (b) How many air dots are there in the room?
2. Draw two dots.
3. Can you draw a line between them?
4. Can you think of two dots that don't make a line?

Task Card 2.

1. Get out your geoboard.
2. Make 2 line segments that cross each other.
3. Make 2 line segments that don't touch.
4. Make 2 line segments that are the same line.
5. Make 2 line segments that make a square corner.

Task Card 3.

1. Get out your geoboard.
2. Make some line segments.
3. Draw them on dot paper.
4. Which line segment is longest?
5. Which line segment is shortest?
6. Are there any that are the same size?

Task Card 4.

1. How many pencils would it take to measure our room?

2. What do we usually measure with?
3. List 5 ways that you can measure.
4. Measure your size with your shoe.
5. How many shoes tall are you?
6. Make up some other ways to measure.
7. Now measure a few things with your own ways.

Task Card 5.

1. Draw a ray.
2. Draw another ray.
3. Draw 3 rays with the same dot.
4. Draw 2 rays to make an angle.
5. Draw 2 angles that are same.

Task Card 6.

1. Get out your protractors.
2. Get Sheet A from your teacher.
3. Measure the angles on Sheet A.
4. Discuss the answers you got with your group.
5. Were they different?

Task Card 7.

1. Name as many things in the room that have angles as you can.
2. Ask your group what things in the room they thought of that had angles.
3. Did any of you come up with some square angles?

Task Card 8.

1. Get out your protractors.
2. Ask your teacher for Sheet B.
3. Look at the angles on your paper.
4. Which ones look the biggest?
5. Write down which ones you think are the biggest.
6. Now measure the angles with your protractors.
7. What did you find out?
8. Can you find the square corners?

Task Card 9.

1. Use your protractor and ruler.
2. Draw an angle that has a measure of:

(a) 45°	(f) 70°
(b) 60°	(g) 90°
(c) 120°	(h) 0°
(d) 180°	(i) 25°
(e) 10°	(j) 57°

3. Are you surprised about any of them?
4. What about 0°?
5. What about 180°?

Unit 2: Curves and Circles.

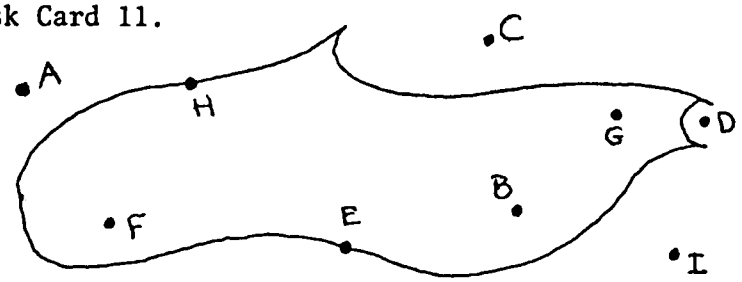
Task Card 10.

1. Draw some curves.
2. Draw some simple curves.

3. Draw some open curves.

4. Draw some closed curves.

Task Card 11.



1. Look at the curve above.

2. Which of the points are on the outside?

3. Which points are inside?

4. Which points are <u>on</u> the curve?

Task Card 12.

1. Draw a closed curve.

2. Draw 2 dots on the inside of your curve.

3. Draw 3 dots on the outside of your curve.

4. Draw 5 dots <u>on</u> your curve.

Task Card 13.

1. Get out your geoboards.

2. Ask your teacher for <u>Sheet 2</u>.

3. Do <u>Sheet 2</u>.

4. Ask your teacher for <u>Sheet 3</u>.

5. Do <u>Sheet 3</u>.

Task Card 14.

1. Get out your geoboard.

2. Make up some open curves.

3. Draw your open curves on the dot paper.

4. Make up some closed curves.

5. Draw your closed curves on the dot paper.

Task Card 15.

1. List as many curves as you can.

2. Ask your group what they got.

3. How many curves did all of you come up with?

Task Card 16.

1. How many circles can you find in this room?

2. Where does a circle begin?

3. How many line segments are there in a circle?

4. Why is it important to know about a line segment when we study circles?

5. What is in the middle of the circle?

Task Card 17.

1. Get out your compass.

2. Draw 5 circles.

3. Draw 2 circles that are different sizes.

4. Draw 2 circles that touch each other in 1 place.

5. Draw 3 circles with the same center.

Task Card 18.

1. Get out your compass.

2. Find the 1 inch mark on it.

3. Now draw a circle with a 1 inch radius.

4. Draw a circle with:

   (a) a 2 inch radius.

   (b) a 3 inch radius.

   (c) a 1-1/2 inch radius.

Task Card 19.

1. Get out your compass.

2. Draw some circle designs and figures.

3. You may use your ruler, your crayons and anything else you may want to.

4. Put your drawings in a booklet.

Unit 3: Triangles and their properties.

Task Card 20.

1. Get out the pegboard.

2. Make as many kinds of triangles as you can with the pegs.

3. Are any of the triangles the same?

4. Can you make a triangle with a square corner?

5. Can you make a triangle with 2 square corners?

Task Card 21.

1. Get out your geoboard.

2. Can you make a triangle with 3 equal sides?

3. Can you make a triangle with 2 equal sides?

4. Can you make a triangle with 3 equal angles?

5. Can you make a triangle with 2 equal angles?

Task Card 22.

1. Get out your protractors.
2. Ask the teacher for Sheet C.
3. Measure the 3 angles in each triangle.
4. Add the measures of the 3 angles in each triangle.
5. What do you see?

Task Card 23.

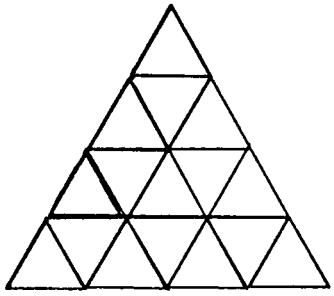
1. Get out your parquetry blocks.
2. Pick out the triangles, only.
3. How many shapes can you make by putting the triangles together?
4. Draw some of them.

Task Card 24.

1. Get out your geoboards.
2. Ask your teacher for Sheet 4.
3. Do Sheet 4.
4. Ask your teacher for Sheet 5.
5. Do Sheet 5.

Task Card 25.

1. How many triangles are in this?



Unit 4: Rectangles, Squares, Parallelograms, Quadrilaterals.

Task Card 26.

1. Get out your geoboard.
2. Make as many figures as you can that have 4 sides.
3. Record them on dot paper.
4. Make some figures with 4 sides that have square corners.
5. Draw these on dot paper.

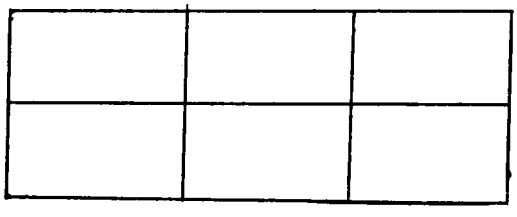
Task Card 27.

1. Get out the pegboard.
2. Make as many rectangles as you can.
3. How many pegs did you have to use for each one?
4. How many squares?

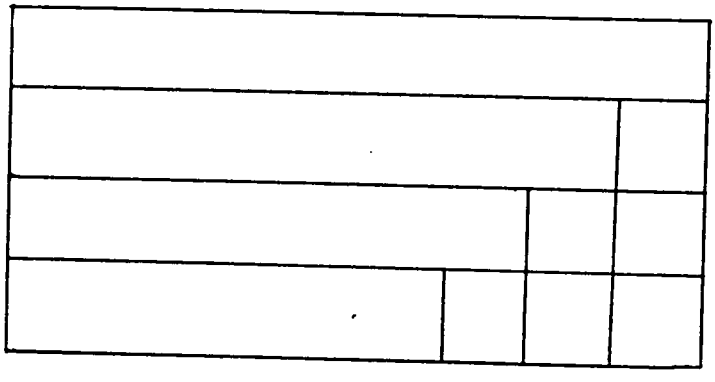
Task Card 28.

1. How many rectangles are in each of these?

(a)



(b)



Task Card 29.

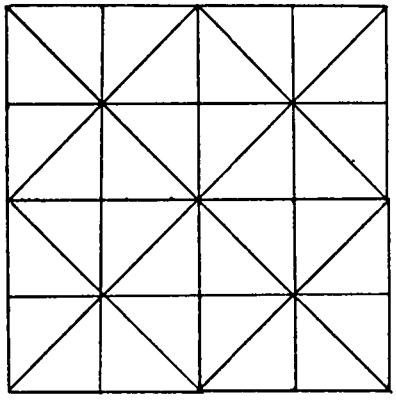
1. Get out your geoboard.
2. Make a rectangle.
3. Connect the opposite corners.
4. How many triangles have you made?
5. How many square units are in your rectangle?
6. How many inches around is it?

Task Card 30.

1. Get out your pegboard.
2. How many squares can you make?
3. How many square inches are inside each square?
4. How many inches around the square is it?

Task Card 31.

1. How many squares are in this?



Task Card 32.

1. Draw a figure that has these in it:

   1 Square

   1 Rectangle

   1 Circle

   4 Triangles

2. Now make up some figures of your own.

3. What shapes are in your figures?

Task Card 33.

1. Get out your geoboard.

2. Make 4 squares on it.

3. How many square inches are in each square?

4. How far around is each square?

Task Card 34.

1. Get out your geoboard.

2. As your teacher for Sheet 10.

3. Do Sheet 10.

4. Ask your teacher for Sheet 11.

5. Do Sheet 11.

Task Card 35.

1. Get out the parquetry blocks.

2. Take out the  shapes, only.

3. See how many designs you can make with them.

4. Draw some of them.

Task Card 36.

1. Get out the pegboard.

2. Use 4 pegs to make a parallelogram.

3. Move 2 of the pegs to change its size.

4. Move 2 more of the pegs to keep the same shape but change the size.

5. Do it all again.

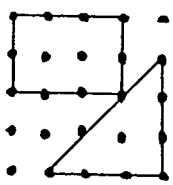
Task Card 37.

1. Get out your geoboard.
2. Make a parallelogram.
3. See how many different triangles you can find in it.
4. Make another parallelogram.
5. Find two ways to divide this parallelogram into triangles.

Task Card 38.

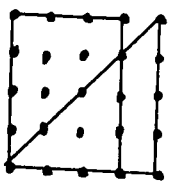
1. Get out your geoboard.
2. Make up a parallelogram that
   (1) Has 4 equal sides.
   (2) Has only 2 equal sides.
   (3) Has 4 square corners.
   (4) Has no square corners.

Task Card 39.



1. Make this figure on your geoboard.
2. How many pegs are inside the triangle?
3. How many pegs are inside the rectangle?
4. How many pegs are on the triangle?
5. How many pegs are on the rectangle?
6. How many pegs are outside the triangle?
7. How many pegs are outside the rectangle?

Task Card 40.



1. Make this figure on your geoboard.
2. How many pegs are inside the rectangle?
3. How many pegs are inside the triangle?
4. How many pegs are inside both?
5. How many pegs are outside the rectangle?
6. How many pegs are outside the triangle?
7. How many pegs are outside both?
8. How many pegs are on the rectangle?
9. How many pegs are on the triangle?
10. How many pegs are on both?

Task Card 41.

1. Get out your geoboard.
2. Make as many 4-sided shapes as you can.
3. Record them on dot paper.
4. How many were squares?

   How many were rectangles?

   How many were parallelograms?
5. Did you make up some that were different?
6. Make up some and draw them on dot paper.
7. Look at Sheet D. Do yours look like these?

Task Card 42.

1. Get out your tangram shapes.
2. See if you can make a square out of all 7 shapes (tans).
3. Ask your teacher for the tangram sheets.
4. See if you can design the tangram shapes to look like the figures. Look at the cat for an example.
5. When you get it to look like the figure, draw the shapes on your tangram sheet.

Unit 5: Solids: Planes, Cubes, Spheres, Boxes, Cylinders, Pyramids.

Task Card 43.

1. Discuss with your group how many planes you can find in the room.
2. How many square corners did you find where two planes come together?
3. How many parallel planes did you find?

Task Card 44.

1. Get out the Playplax pieces that are in the shape of planes.
2. Put them together to make a design.
3. Now, move only 1 or 2.
4. Did that change the shape?
5. How many shapes can you make?
6. List them.

Task Card 45.

1. Ask your teacher for Sheet J.

2. Look at these pictures.
3. Guess how many cubes it takes to make each design.
4. Try to figure it out.
5. Get out your cubes and put the figures together.
6. How many cubes did each one take?
7. How many did you get right?

Task Card 46.

1. Have one person in your group build a design with the blocks.
2. Everyone else try to figure out how many blocks it took to make the design.
3. Try to figure it out without counting.
4. Were you right?
5. Do it again, but change people now.
6. Do it enough so that everyone gets a turn to build.

Task 47.

1. As the teacher for the Cube Sheet.
2. Cut out the cube sheet and tape it together to make a cube.
3. What can you tell about the cube?
4. How many faces does your cube have?
   How many edges does your cube have?
   How many corners does your cube have?

5. How many cubes can you find in the room?

Task Card 48.

1. Get out the blocks.
2. Make a box.
3. Everyone guess how many cubes it takes to make it.
4. Were you right?
5. Do it all again.

Task Card 49.

1. As the teacher for the Box Sheet.
2. Cut out the box sheet, fold it and tape it together.
3. You have made a box. What can you tell about your box?
4. How many faces does your box have?

   How many edges does your box have?

   How many corners (points) does your box have?
5. How many boxes can you find in the room?

Task Card 50.

1. Ask the teacher for the Pyramid Sheet.
2. Cut out the pyramid sheets and tape them to form a pyramid.
3. What do you notice about your pyramid?
4. How many faces does your pyramid have?

   How many edges does your pyramid have?

   How many corners (points) does your pyramid have?
5. Can you find any pyramids in the room?

Task Card 51.

1. Ask your teacher for the Cylinder Sheet.
2. Cut out the sheet. Tape the cylinder sheet together.
3. What do you notice about the cylinder?
4. What shapes is a cylinder made of?
5. How many cylinders can you find in the room?

Task Card 52.

1. Get out the Playplax pieces that are in the shape of cylinders.
2. Put them together to make a design.
3. Now, move only 1 or 2 pieces.
4. Did that change the shape?
5. How many different shapes can you make?
6. List them.

Task Card 53.

1. Get out the Soma Cube.
2. Ask the teacher for Sheet J.
3. See how many of the shapes you can make.
4. Be sure to show each shape to the teacher after you have made it.

Task Card 54.

1. Get out all your Playplax pieces.
2. Put them all together to make a design.
3. Can you move 1 piece and not change the design?
4. Can you move 2 pieces and still not change the design?

5. How many can you move without changing the design?
6. How many shapes can you make using only half of them?
7. How many shapes can you make using all of them?
8. List the designs.

Unit 6: Congruence, Similarity, Symmetry, Transformations

Task Card 55.

1. Get out your geoboards.
2. Ask the teacher for Sheet 7.
3. Do Sheet 7.
4. Ask the teacher for Sheet 8.
5. Do Sheet 8.

Task Card 56.

1. Get out your mirrors.
2. Draw a shape.
3. Put the mirror down beside the shape.
4. What do you get?
5. What happens when you put the two shapes together?
6. Do it again.

Task Card 57.

1. Ask the teacher for Sheet K.
2. Put the mirror halfway between the shapes.
3. What do you see?

   Are they the same?
4. Which of these figures are symmetric?

5. Now draw some shapes like those.

6. Are your shapes symmetric?

Task Card 58.

1. As the teacher for Sheet L.

2. How many of the first set of shapes are symmetric?

   Use your mirrors to help.

3. Look at the second set of shapes.

   How many lines can you find in these that show they are symmetric?

   Use your mirror to help.

4. Draw the mirror lines (lines of symmetry) on the figures.

Task Card 59.

1. Get out your geoboards.

2. Make a small shape.

3. Move the shape over.

4. Now move the shape up.

5. Did you change the shape?

Task Card 60.

1. Get out your geoboard.

2. Make a shape.

3. Flip the shape over, onto different pegs.

4. How did you change the shape?

5. Do it all again.

Task Card 61.

1. Make a shape on your geoboard.
2. Now turn the geoboard a little.
3. How did it change the shape?
4. Make another shape.
5. Change the shape so it will look like you turned the geoboard again, but don't turn the geoboard.
6. How did you change the shape?

Task Card 62.

1. Get out your geoboard.
2. Make a small shape.
3. Slide the shape over.
4. Flip the shape over.
5. Turn the geoboard a little.
6. How have you changed your shape?
7. Do it all again, and draw each shape on dot paper.

VITA

Randall Keith Bassett was born in Oceanside, California on September 30, 1953. He attended elementary school in Enon, North Carolina, and graduated from Northwest Classen High School in Oklahoma City, Oklahoma in 1971. In September of 1971 he entered the University of Tennessee in Knoxville. After graduating from the University of Tennessee in December, 1974, with a major in elementary education, he entered graduate school in Tennessee, also majoring in elementary education. While continuing his graduate studies he taught a third grade class in Townsend, Tennessee, and presently he plans to maintain that position in the near future.