THE EFFECTS OF PRACTICE IN MAKING CLASSIFICATIONS ON ACHIEVEMENT AND INTELLIGENCE

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CHAPTER I

INTRODUCTION

Problem

One of the major goals pursued by educators and psychologists has been the improvement of scholastic achievements. Much investigation has been conducted concerning the various factors that influence the learning ability of children and adults. One such factor is the ability to structure or to classify.

Most educators and psychologists agree that a child can learn more readily if he can perceive some structure to the subject matter or can organize the material into groups or classes. However, there has been practically no research conducted to determine: (1) whether improvement in achievement will result following a program designed to teach children to classify, and (2) whether, as a result of exercise in classifications, measured intelligence will increase.

The study reported here was designed to investigate whether intelligence and achievement will improve following instructions in making classifications.

Significance

This study should be important to both the fields of education and of psychology because it attempts to determine whether children can improve in their ability to learn. It should also lend some evidence as to the factors that will or will not influence intelligence.

Numerous researchers have reported gains in intelligence after specific instructions, but few have revealed whether such gains are accompanied by gains in achievements (Budoff and Friedman 1964; Lorge 1945; Wellman 1940). This study should prove valuable in determining whether or not growth in intelligence is accompanied by an increase in learning as measured by standarized achievement tests. If a relationship could be established between mental exercises and learning ability, it might open the door for new avenues of curriculum development. On the other hand, if mental exercises increase intelligence without increasing learning, it might point out that previous research that has reported increases in intelligence is less meaningful as far as being a predictor of learning ability.

Lastly, but by no means of least importance, this research should be of value in determining what role structure should play in the curriculum of first grade students.

Classifications

The utilization of classifications enables the learner to reduce complexities to manageable proportions so that he can deal with an otherwise overwhelming amount of information. In a sense classifying is a convention for arranging and ordering data so it can be efficiently available for recall.

A teacher uses a classification when she alphabetizes her students by name so she can more effectively locate them. The yellow pages of a telephone book uses the classification of services in addition to the alphabetical listing by names. Even a first grader, when learning to read, uses a classification system when he identifies words with the same beginning letter. The use of classification is a central part of the learning process and is recognized by such noted authorities in the field of intelligence as Bruner, Guilford, and Piaget.

Bruner, who deals with classes as concepts, contends that by categorizing events as being equivalent, the organism reduces the complexity of its environment. With reference to classifications he states:

> . . .reduces the necessity of constant learning. For the abstraction of defining properties makes possible future acts of categorizing without benefit of further learning. We do not have to be taught de novo at each encounter that the object before us is or is not a tree. (Bruner et. al. 1956, p. 12)

Guilford, through factor analysis, has identified classifying as a cognitive factor which has to do with classifying groups of objects or ideas. Wilson says of Guilford's structure of classifications,

> An example of a test of this ability is word classification. The examinee indicates which of four words does not belong to a group, e.g., horse, man, canary, flower. This ability may be an important part of the process of concept formation. In any case, factor analysis results indicate that it involves something more than just seeing similarities. (Wilson 1961, p. 23)

Guilford also recognizes under cognitive factors "comprehending relations", which is the ability to see trends and verbal analogies; "comprehending systems", which is the ability to comprehend patterns or the ability to structure the arrangement of objects in space; symbolic relations, which is the ability to discover patterns or systems among symbolic elements; and general reasoning, which is the ability to comprehend, or structure, a problem when preparing to solve it.

Wilson states of the ability to structure,

> These abilities of discovering patterns or systems differ from those involved in seeing simple relationship. An important aspect of cognizing systems is

> dealing with some kind of organized total structure.
>
> General Reasoning involves understanding a conceptual structure. Next to verbal comprehension it is the most important factor in performance on most intelligence tests - particularly important in achievement on arithmetic reasoning tests. (Wilson, 1961, p. 24)

While Guilford lists classes, relations, and systems as separate cognitive factors, Piaget describes similar mental functions as all a form of classifications (Flavell, 1963). Piaget uses the term "grouping" instead of classification. He lists nine different groupings as being qualities of concrete-operational thought. Of this mental operation Flavell states,

> In summary, Piaget seems to do three things with his logical groupings, and of course the same is true for the other structures we shall examine. First, he views them as precise and parsimonious structural chararacterication of "ideal" cognition in the realm of intensive logical operations of classes and relations. (Flavell, 1963, p. 190)

Although classifying is widely recognized as an important part of the learning process, the research relating to the effect of practice by learning to classify is very limited. Levi (1965) reported gains in intelligence and achievement as a result of practice in categorizing. However, his study was limited to only one subject. Upton (1960) has reported gains in intelligence with college students after lessons in making classifications. His research was conducted without the use of control groups and without an experimental procedure that would allow the study to be replicated.

It is, however, significant that both of these researchers have reported significant results as a result of the treatment. The study by Levi was published by an American Psychological Association journal which seldom publishes studies with such a limited population.

Definition of Terms

Within the structure of this dissertation, the following terms are utilized as defined.

Classification

For the purpose of this study the term classification will mean a grouping of a given set of stimuli into one or more mutually exclusive classes. The term classification will include what Guilford describes as (1) classifying groups of objects or ideas, (2) comprehending relations, and (3) comprehending systems. The term classification will also include what Piaget calls grouping, and what Bruner describes as concept learning.

Structure

The term structure will be used synonymously with that classification.

Achievement

Achievement is defined as grade placement scores on the Stanford Achievement Test, Primary I Battery. This includes Word Reading, Paragraph Meaning, Vocabulary, Spelling, Word Study Skills, and Arithmetic.

Intelligence

In this study intelligence will be that which is measured by the Verbal, Performance and Full Scale IQ scores on the California Short-Form Test of Mental Maturity, Level 0 and 1, and the Cattell Culture Fair Intelligence Test.

Divergent Thinking

The term divergent thinking refers to (1) Fluency, (2) Flexability, and (3) Originality scores on the Circle Test from the Torrance Test *of Creativity*, Figural Test.

Hypotheses

The suppositions are so designed as to fit the construct of the null hypothesis.

1. Achievement test scores of children who have had a program in classifying will not differ significantly from the achievement test scores of children who have had no such program.

2. Intelligence test scores of children who have had a program in classifying will not differ significantly from the intelligence test scores of children who have had no such program.

3. Divergent thinking test scores of children who have had a program in classifying will not differ significantly from divergent thinking test scores of low-ability children who have not had such a program.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The purpose of this chapter is to present a discussion of the independent variable, which is classifications, and the dependent variables, which are intelligence, achievement, and divergent thinking (creativity).

Some theoretical implications of classifications will be discussed. A review of the research will be presented on the influence of organizers or "sets" on classifying and learning, and the magnitude of the influence of structure on learning. A discussion of the material that lends itself to classifying will be reviewed.

The stability of intelligence and achievement will be discussed along with some research designed to increase creative skills. Following this discussion, a summary of the research concerning the learning of classifications and the stability of intelligence and achievement will be made.

Classifications

Aristotle is given credit for being one of the first to show the value of using classifications. He demonstrated that it was possible to analyze and classify natural phenomena into meaningful categories. This procedure is now considered to be one of the four stages in the scientific method (Chaplin and Krawiec, 1961).

Bruner (1956) contends that the learning and utilization of categories represent one of the most elementary and general forms of cognition by which man adjusts to his environment. He states:

> To categorize is to render discriminately different things equivalent, to group the objects and events and people around us into classes, and to respond to them in terms of their class membership rather than to their uniqueness. (1956, p. 1)

By classifying, the learner groups different events as being equivalent thereby reducing the complexity of the environment. This reduces the necessity of constant learning. Bruner comments (156, p. 12), "For the abstraction of defining properties makes possible future acts of categorizing without benefit of further learning." One does not have to be taught all over again at each encounter what the object is before him.

Categorizing behavior and concept formation are frequently considered equivalent process (Bruner, 1956; Loree, 1965). For Mursell (1952) classifying is even more fundamental to the learning process. He holds that without classifying there is no learning. According to Mursell (1952, p. 176), ". . .every learner structuralizes up to a point, and then if he does not structuralize at all, he does not learn." He is of the opinion that when there is no conscious or deliberate intention to structure, this activity will still take place if learning occurs. For example, when memorizing nonsense syllables the learner must devise a pattern of rhymes or positional reference, such as possible graphic, articulatory, and auditory features of a series before it can be learned.

For Ausubel (1960) the cognitive structure of the mind has a classification arrangement. Concepts are stored in the mind according to some kind of hierarchical order. Concepts may be stored by a superordinate class such as male, and under this they may be grouped by subordinate classes such as men, boys, and infants; blondes, brunettes, and red heads; and fat, muscular and thin. There are even neurological theories of thinking (Hebb, 1949; Wulf, 1922) that closely parallel Bruner and Ausubel's conception of the structure of the intellect.

Guilford (1959) through factor analysis also recognizes classifying ability as a mental process. For him, a unit, which is a segregated item of information may combine with other units to form a class by reason of having common properties. Thus, a class contains two or more units of information with common factors. There can also be relations among these classes as in the class of "high units is to low units, as dry units is to wet units." Classes may also be used in "systems," which is a fourth kind of mental process. Systems are organized sets of classes, which may contain units.

There is a definite similarity between Guilford's model of intellectual functioning and that of Bruner. Bruner considers the main grouping and subgrouping as a single vertical classifying function. Guilford, like Ausubel, has broken them down by the complexity of the classifying. Piaget (Flavell, 1963) has suggested that there are nine different classes as part of the cognitive structure of the individual. These exist from simply grouping according to some general property to finding relations which hold between, or "relate," two or more groupings.

The majority of research in the area of classifying has been in the area of concept attainment (Bruner, 1956; McManus, 1964; Bourne and Jennings, 1963; Stedman, 1963; Johnson and O'Rielly, 1964). The research is very limited as to the effects of classifying on learning even though this concept is well accepted as an important part of the learning process (Mursell, 1952; Ruch, 1948; Loree, 1965; Munn, 1966).

Clark L. Hull (1920) was one of the first to demonstrate that learning improved if the subjects were able to classify or structure the subject matter. In this study subjects were to pair Chinese characters with nonsense sounds representing the characteristic which it had in common with others in the series. Learning was more effective when the subjects discovered that each Chinese character had common factors embedded in them. The subjects were able to group the common factors in the same class rather than memorizing each and every Chinese character and sound.

Hall found, in this experiment, that better results could be obtained if the common factor in each character was drawn in red. Katona (1940) also found similar results. In his study, subjects were instructed that sixteen matches could be rearranged to make five squares. It was found that learning was more effective when the organized principle was present first. Learning was more effective under this procedure than by giving demonstrations as to the correct form.

Ausubel (1960) designed a study to show that cognitive structure is hierarchically arranged in terms of highly inclusive concepts that are subsumed under less inclusive subconcepts and informational data. Ausubel presented his subjects with advanced organizers of relevant major concepts. In other words, as in the studies by Hull and Kotona, Ausubel gave the subjects a major principle or class under which they could group information.

Using unfamiliar, but meaningful, verbal material, Ausubel presented his subjects with a five hundred word introductory passage containing material of a conceptual nature presented at a level of generality, abstraction, and inclusiveness. The control subjects received the traditional type historical introduction of the same length. Three days after lessons had been given to the experimental and control groups, they were tested for retention. The experimental group clearly showed superior retention. Ausubel concludes:

> The facilitating influence of advance organizers on the incorporability and longevity of meaningful learning material was attributed to two factors: (a) the selective mobilization of the most relevant existing concepts in the learner's cognitive structure for integrative use as part of the subsuming focus for the new learning task, thereby increasing the task's familiarity and meaningfulness; and (b) the provision of optimal anchorage for the learning material in the form of relevant and appropriate subsuming concepts at a proximate level of inclusiveness. (1960, p. 272)

The advanced organizers are sometimes referred to as "set" (Wittrock, 1962; Reed, 1946; Loree, 1965). The results of using "sets" are consistent with that of the research on advanced organizers and ideational scaffolding (Ausubel and Fritzgerald, 1962). Reed (1946) found that when students were given a set consisting of names of objects to learn, their learning was inferior to students who were given a set to group the names into a classification. It was also demonstrated that when students were asked to read lists of nonsense syllables without being given a set by which to learn them they required from eighty-nine to one hundred trials to learn the material. Students required an average of only thirteen trials when given a set by verbal instructions to learn the syllables (MacDougall and Smith, 1919).

Research has shown the magnitude of learning to be superior when the subject is able to structure the material. For example, Hildreth (1942) found that subjects who were shown completed puzzles were able to reconstruct them quicker than subjects who had not seen the completed puzzles. The time recorded, on the average, was faster in every case for the instructed as compared with the uninstructed subjects.

Guiler (1927) found that subjects could memorize sets of digits easier when the digits were arranged according to some classification. It required subjects an average of less than two repetitions to memorize the digits when they were arranged according to some principle. When digits were arbitarily arranged, the subjects required an average of 3.2 repetitions.

Retention of material has been found to be superior when the material is arranged according to some structure (Mursell, 1952). In this experiment subjects were presented with digits to be memorized in four different ways: (A) told there was a principle but not told the principle; (B) as three place numbers, such as 149, 162, and read rhythmically five times; (C) and given a general lecture on government expenditures with selected numbers. The first method was superior on a memory test given after a one hour period and after three weeks.

The ability to transfer what has been learned has been found to be more effective when there is structure to the learning. Hilgard et al. (1953) designed an experiment to investigate (A) whether retention after learning by structure tends to be greater than retention after learning by rote, and (B) whether transfer to new related tasks is greater after learning by understanding than after learning by rote. It was found that more time was required to teach the problem initially when understanding of the structure was required, but transfer to three tasks requiring problem-solving all favored the understanding group by significant amounts. There also appeared to be more transfer in classifying and defining when there was success in defining the class (Johnson, 1964).

The nature of the material has been found to make a difference in the way it can be structured for learning. Nonsense syllables require more time to learn than digits, meaningful prose, or meaningful poetry (Lyon, 1914).

In an investigation of high, moderate, and low meaningful material on learning and retention after one and seven days, rate of learning was found to be directly related to meaningfulness. When retention was measured, the effects of meaningfulness and retention were significant beyond the .01 level (Dowling and Brau, 1957). Also, words that are related by an associative class, such as table-chair, can be learned more readily by a rote association than words that do not really fit a class such as food-book (Mayzner and Tresselt, 1962).

It is now believed that most school subjects can be learned more effectively if presented with some order or structure (Bruner, 1961). The important aspect, however, is not so much presenting the subject matter with some structure, but allowing the subject to structure the material in some way so that he can retain and transfer the subject matter. Of this Bruner states,

> Science and common-sense inquiry alike do not discover the ways in which events are grouped in the world; they invent ways of grouping. The test of the invention is the predictive benefits that result from the use of invented categories. . . they exist as inventions not as discoveries. . . (1956, p. 7)

When a student learns, he organizes or classifies the material into his own unique meaningful structure. Nonsense syllables have less meaning to most individuals than history, and, therefore, are more difficult to fit into a cognitive class. How meaningful material will be depends on familiarity (Ruch, 1963). To the person who knows no German, a lecture in German would lend itself to little retention. One groups information into classes which have reference points in his personal experiences.

The question as to whether or not subjects can be taught to become better mental classifiers and, consequently, better learners by learning to classify material in a meaningful manner was recently focused upon by Levi (1965). The purpose of his study was to teach the subject an abstract categorical mode of thinking. The specific goals which were set were:

> (a) for Steven to acquire first the notion of categories, i.e., that there is an underlying, organizing class to which each member of a group of things can be assigned, and a more or less limited store of categories and (b) for him to learn to scan this store and select the category most appropriate to the generalizing problem with which he might be faced.

Levi's treatment closely approached the classifications of units and relations which Guilford (1959) describes in his structure of the intellect. Levi's treatment with the sixth grade boy lasted sixteen months. As a result of the experimental program, Levi found that the youngster had increased thirteen points in IQ score on the Full-Scale of the Wechsler Intelligence Scale for Children. The Verbal Scale IQ score increased fifteen points and the Performance Scale IQ increased ten points. On the Raven Progressive Matrices the subject went from the sixth to the thirty-eighth percentile.

The subject's school achievement also increased. Levi reported that the youngster was doing average to good work in all subjects at the termination of experiment. In the four basic subjects that were reported by the investigator the student made increases in all but one, and his scores remained the same in this subject.

It is important to note that Levi used no control subjects. Therefore, there was no way to evaluate the effects of the experimental treatment apart from the effect of individual attention. In other words, Levi's results may have resulted from a therapeutic relationship rather than the practice in making classification.

Stability of Intelligence and Achievement

The purpose of this section is to discuss the stability of intelligence and achievement during the preschool and early school years. Factors that produce variations in creative ability will also be reviewed.

Bayley (1949) in a longitudinal study tested forty children from birth to age eighteen. She found that intelligence at one year of age had a zero correlation with intelligence at age seventeen. Intelligence at two years of age correlated +.41 with intelligence at age seventeen. By the age of eleven it had increased to a correlation of +.92. Her conclusion was that children's scores are very variable during infancy, and later they become more stable. At school age the prediction of general intelligence is fairly stable. However, there are considerable individual differences in variability at all ages.

Hunt (1961) has found similar variations in intellectual ability. Immediate test-retest correlations of intelligence are usually in the range of +.89 to above +.90 for teenagers and adults. Tests separated by 36 months at ages nine and twelve correlate, +.85; at seven and ten, +.76; at five and eight, +.71; at four and seven +.55. For testings at two and five the correlations drop to +.32.

One explanation for the low correlations of preschool intelligence and intelligence test scores at age sixteen is that most preschool tests are heavily loaded with performance items while adult tests stress verbal skills (Bayley, 1966).

Bloom (1964) compared the findings of the six major longitudianal studies of intelligence, one of which is Bailey's. The remaining five are the Harvard Growth Study (Anderson, 1939), the University of Chicago Study (Freeman and Flory, 1937), the California Guidance Study (Honzik et al., 1938), the Buish Foundation Study (Ebert and Simmons, 1943) and the Fels Foundation Study (Sontag et al., 1958). His conclusions about these studies were similar to the findings of Hunt and Bayley. That is, the studies revealed increased stability with age and greater stability for shorter time periods than for longer time periods.

The data suggested that approximately fifty percent of the intellectual development of an individual takes place between conception and age four, about thirty percent between ages four and eight, and about twenty percent between ages eight and seventeen. Bloom generalizes about these findings,

> These results make it clear that a single early measure of general intelligence cannot be the basis for a long-term decision about an individual. These results also reveal the changing rate at which intelligence develops, since as much of the development takes place in the first 4 years of life as in the next 13 years. (1964, p. 88)

Similar results were also found by Bloom on achievement; however, his findings were based on only a few studies that followed achievement for as much as three to eight years. Although achievement test data was not available for his study, he was able to use data from teachers' marks and test results in reading from grades one to twelve.

His findings were based on twenty-three studies ranging from elementary to college in their populations. He concluded on the basis of these research studies that by the time the student reaches the third grade (age nine) at least fifty percent of his general achievement pattern has been developed. At grade seven (age thirteen) at least seventy-five percent of the pattern has been developed. About one-third of a child's achievement pattern has been developed before he enters school. Regarding the importance of the early achievement, he states,

> Also the approximately 17% of growth which takes place between age 6 and 9 seems to us to suggest that the first period of elementary school (grades 1 to 3 is probably the most crucial period available to the public schools for the development of general learning patterns. (Bloom, 1964, p. 110)

The important finding in all of these studies is that the factors that can influence the intelligence and achievement patterns of children are more influential when the child is young (Hunt, 1961; Bloom, 1964). It is also important to note that Bloom (1964) considers a change of twenty IQ points to be a conservative estimate as to the effect of extreme environments on intelligence.

Increases in intelligence and achievement due to special conditions are not uniformly distributed over the intellectual and achievement spectrum. Children with lower intelligence normally benefit more from a stimulating environment, and significant gains in achievement are generally not found at the upper levels of achievement (Bloom, 1964; Thurstone, 1961; Hunt, 1961).

Bloom (1964) is of the opinion that achievement tests may not have equal units at all points, and it may be easier to make a large gain at the less difficult end of the scale than to make a smaller gain at the more difficult end.

In the case of intelligence Thurstone (1961) believed that children with high intelligence may have developed most of their potential, while those with low intelligence may have developed little of their potential.

Other mental functions, such as creativity, have been found to be influenced by the environment. For example, the behavior patterns and interests of parents of creative children have been found to differ from the parents of bright children (Getzels and Jackson, 1962).

Some attempts to increase creativity have also been successful. Maltzman et al. (1958) found that original responses could be increased by praising subjects for making original remarks. Students who took a course in creative problem solving also showed an increase in this skill (Meadow and Parnes, 1959). Some success has been found in increasing creativity by "group ideation" or "brainstorming" (Ruch, 1963). Set appears to make a difference in creative application just as it made a difference in the learning of classifications and other material (Torrance, 1961).

Summary

The use of classifications is well accepted as being an important part of the learning process. Such authorities on learning as Bruner, Guilford, Ausubel, and Piaget all acknowledge classification as a mental operation, and hold similar views as to the function of this mental process.

Learning has been shown to be more effective when the material can be structured or grouped. Retention and transfer both are superior when classifying takes place. However, such conditions as "set" or advanced organizers can make a difference as to whether or not the material is structured.

The dependent variables of intelligence and achievement were found to be more variable in preschool and early school than later in life. By the time a youngster enters the third grade his intelligence and achievement pattern have more or less been established.

A recent study by Levi was presented whereby intelligence and achievement were increased by teaching a subject how to classify. The following experimental procedure is an attempt to extend Levi's experiment. In this procedure, however, more than one subject was used, a control group was utilized, and the subjects were given a set to structure their lessons.

CHAPTER III

METHODS AND PROCEDURES

Subjects

The subjects selected for the study were 160 first grade students attending three schools in the Western Zone of the Clark County School District, Las Vegas, Nevada. The three schools were selected because of similar student achievement on the California Achievement Test for the three year period 1964, 1965, and 1966.

Table I shows that the achievement patterns were relatively stable over the three year period. No school was consistently higher or lower in achievement for the full period. Intelligence test scores were also similar over the three years. The greatest variation in mean IQ was seven points, and the mean IQ scores for the three year period were 108 for Red Rock; 107 for E. W. Griffith; and 108 for Rose Warren School.

All schools were located in close proximity to each other and were considered to be of comparable socioeconomic level. Each of the three schools had an experimental and control group with approximately 27 children in each group. There was no apparent bias in assigning children to the experimental and control groups.

Table II lists the number of students in each group by schools at the beginning of the study.

Mentally retarded subjects were eliminated from the study. All children suspected as being retarded were referred to the school

TABLE I

FOURTH GRADE ACHIEVEMENT BY SCHOOLS ON THE CALIFORNIA ACHIEVEMENT TEST AND THE CALIFORNIA TEST OF MENTAL MATURITY OVER A THREE YEAR PERIOD

			Mean Grade Placement Scores					
School	Year	TIQ	AV	RC	AR	AF	ME	SP
Red Rock	1966	108	4.7	4.3	4.5	4.0	4.2	4.7
E. W. Griffith	1966	107	5.0	4.6	4.5	4.4	4.4	4.6
Rose Warren	1966	107	4.8	4.4	4.6	4.2	4.4	4.7
Red Rock	1965	105	4.5	4.7	5.0	4.3	4.4	4.5
E. W. Griffith	1965	105	4.8	4.7	4.8	4.4	4.7	4.7
Rose Warren	1965	108	4.1	4.7	4.9	4.5	4.5	4.8
Red Rock	1964	112	3.6	3.6	3.6	3.3	3.6	3.6
E. W. Griffith	1964	109	3.6	3.4	3.5	3.3	3.4	3.2
Rose Warren	1964	109	3.7	3.5	3.6	3.3	3.6	3.3

TIQ -Total IQ Score
RV -Reading Vocabulary
RC -Reading Comprehension
AR -Arithmetic Reasoning
AF -Arithmetic Fundamentals
ME -Mechanic of English
SP -Spelling

psychologist for individual testing. If they were diagnosed as being mentally retarded, they were placed in a special class. The same procedure was followed for emotionally disturbed children. No other selection procedure was used to eliminate children from the study. Children who were enrolled in a class after the program began were not included in the research.

TABLE II

CALIFORNIA TEST OF MENTAL MATURITY SCORES, LEVEL 0
FOR EXPERIMENTAL AND CONTROL GROUPS

Groups	School	Mean IQ	SD	N
Experimental	Red Rock	114.37	14.3	27
	E. W. Griffith	130.60	14.8	29
	Rose Warren	107.19	15.2	31
Total		117.98	14.8	87
Control	Red Rock	124.60	14.9	23
	E. W. Griffith	107.30	17.2	29
	Rose Warren	110.48	12.2	31
Total		114.13	14.8	83

Teachers

Two teachers from each of the three schools were selected by the school principal to take part in this study. One teacher served in the experimental program and the other in the control. The principal rated each teacher to be of equal ability, and they were equated as much as possible for experience. All teachers were asked if they would take part in the experiment. All agreed to take part, but one requested to serve in the control group. The other teacher serving this school was assigned to the experimental group. The teachers at the remaining two schools were assigned to the experimental and control groups by flipping a coin.

Pre-Testing

The California Test of Mental Maturity, Level O, was administered to all subjects in September, 1966. This was approximately three weeks after the beginning of the school. This test was administered by the classroom teacher during school hours. The tests were graded by the investigator.

The California Test of Mental Maturity, Level O, reports a reliability coefficient of .78, a standard deviation of 14.9 and a mean Full-Scale IQ of 109.4 (California Test Bureau, 1963).

The validity measurement for this test was obtained by correlating it with the Stanford Binet Test of Intelligence, Form L-M. The correlation between these tests was .74 using the Pearson Product-Moment formula corrected for range.

The testing was supervised by the principals of each school. Only one difference in procedure was noted. The principal of E. W. Griffith School reported that the experimental teacher had the children use a piece of paper as a marker while the teacher of the control group did not. He was of the opinion that the children in the experimental group followed instructions better than the children of the control group. In general the conditions for testing were considered good.

Table II reflects the mean IQ scores and standard deviations for the three experimental and three control groups. Although the mean IQ scores vary considerably for the six groups, the means of the experimental and control groups differ only 3.85 points. The standard deviations for these two groups are identical.

Experimental Treatment

Five series of classifications were used for the experimental treatment. These were presented in a hierarchical order, starting at an elementary or concrete level and progressing to an abstract level. These classifications included (1) the grouping of classes, which is the grouping of objects or units with common properties; (2) classifying relations, which is noting the connections between units; and (3) grouping systems, which is detecting the organized structure.

The teachers of the experimental groups used the exercises in classifications in conjunction with the regular school curriculum. Three to four exercises were presented each week. This required fifteen to twenty minutes for each group of exercises. A recommended weekly time table for presenting the exercises was given to the teachers, and a definite time schedule for each series was made. The time schedule is listed in Appendix A, along with instructions for administering the lessons.

All teachers started each series of classifications at the same time, but progressed at different rates in presenting the materials. In most cases the time schedule was closely approximated. All teachers required more time to complete the third series than was called for in the time schedule, and only the teacher from Rose Warren school failed to complete the last series before the post-testing. More than half of the lessons in this series were presented by this teacher.

The teachers were given individual instructions as to how to use the materials and the purpose of each series of classification. These were also listed in the instruction booklet, which was given to the teachers at the beginning of the experiment. (See Appendix A).

All subjects were given individual copies of the exercises. The teachers were given some liberty as to whether the children would cut-out, draw lines or simply discuss the various groupings. Whenever possible, the teacher used inclusion classification. That is, the teachers attempted to get the children to group according to likeness rather than differences.

There were two group meetings with the experimental teachers in which the experimental program was discussed. The first meeting was in December, 1966, and the second in February, 1967. There was no other extended discussion of the materials, and no other contacts with the experimental teachers except when a new series of classifications were delivered to them. This contact was limited to an explanation of the material. The visits approximated the time schedule for the program listed in Appendix A. The attitude of the teachers in the experimental group was considered to be excellent.

The teachers of the control groups were visited when a new series of exercises were given to the experimental teachers. This contact was limited to a brief discussion as to how the subjects in the control group were progressing and topics relating to a philosophy of teaching. The attitude of the teachers in the control group was considered to be excellent.

The exercises in classifications commenced on September 27, 1966, and terminated on April 25, 1967. The following is a description of the five series:

Series I

This series consists of 32 exercises in visual classifications. This activity involves grouping objects by visual similarities.

Examples of these exercises are grouping two beds as being alike and a couch as being different. In addition to external differences, these exercises also include classifying according to size and direction.

The materials for this stage were taken from the Reading Readiness Series, Continental Press, Inc. Twenty of the exercises were from series one, and eighteen were from series two. Level I is a kindergarten and first grade level and Level II is a first grade level.

Series II

This stage consists of exercises in making abstract classifications. Series II includes what Guilford describes as comprehending classes, which is classifying groups of objects or ideas (Wilson, 1963). An example of such activities would be to group an apple, pear, banana, and lemon as being fruit and cabbage as being different. Other classifications include the grouping of such abstract concepts as furniture, machines, farm animals, beginning consonant sounds, multiple meanings, and texture.

The material for this series was taken from the Reading Readiness Series, Continental Press, Inc. Twenty of the exercises were from series one, and eighteen were from series two. Level I is a kindergarten and first grade level, and Level II is a first grade level.

Series III

This series is concerned with classifying objects into superordinate and subordinate classifications. It is designed to enable the subjects to see that there are classifications within classifications. That is, the students may place a fireman, farmer, paper boy and a boy who is playing in a superordinate class of being all males, or all living. He may further divide them into subordinate classes of men and boys, big and little, etc.

In addition to simply classifying objects into superordinate and subordinate groupings, the students are helped to see that superordinate groupings are more comprehensive in number than the subordinate groupings. This is a rather difficult concept for children to grasp before six years of age (Flavell, 1963; Wallach, 1960).

The subjects were also taught to (1) classify according to classes, which is grouping according to common characteristics; and to (2) classify according to relations, which is classifying according to trends (Wilson, 1963). For example, the student may discover the relationship that appears in a sequence of pictures, e.g. apple, beet, and carrot (initial letter in alphabetical order) or he may group pictures of males according to increase size. The subjects were continually encouraged to group in all possible ways.

The materials for this series consisted of fifteen lessons with four pictures on each of twelve pages. Twelve of the lessons were taken from the _Reading for Meaning Series_, Houghton, Mifflin Co. The first three lessons were patterned after the material used in the First Grade Project in New York City Schools (1965).

Series IV

This series consisted of fourteen exercises in classifying by multiple dimensions. This is sometimes referred to as grouping by a classification matrix (First Grade Project in New York City Schools, 1965; Flavell, 1963). For example, the subjects may classify objects according to color and size. The size may be in an increasing or decreasing order, and the color may be in an increasing or decreasing shade. This series would correspond to what Guilford describes as comprehending systems (Wilson, 1963).

The materials for this series were patterned after the materials used in the First Grade Project in New York City Schools (1965).

Series V

This series consisted of classifying three subject areas of school material by any of the preceding methods of grouping. The students could classify according to classes, relations, and systems.

Reasons for classifying the subjects taught in school was to help the student to transfer his proficiency in grouping to a learning situation. Such lessons should also have given the learner a set to perceive the structure of his school subjects. Studies have shown that set can be an important factor in learning (Loree, 1965; Ausubel, 1960).

There were fourteen lessons in all in this series. Five were concerned with reading, six with arithmetic and three with finding the structure in English. The subjects were encouraged to structure the materials in as many ways as possible and not to focus on a single correct answer. The materials are listed in Appendix B.

The teacher at Rose Warren School was unable to complete all of this series. The remaining two teachers of the experimental groups completed all of the lessons.

Evaluative Tests

Four tests were used to measure the effects of practice in making classifications. The California Short-Form Test of Mental Maturity, Level I, was used to measure intelligence; the Stanford Achievement Test was used to measure achievement; the Circle Test from Torrance Test of Creative Thinking was used to measure what Guilford describes as "divergent production of classes" (Wilson, 1963). Cattell's Cultural Fair Intelligence Test was used to measure intelligence independent of the effect of culture.

The California Short-Form Test of Mental Maturity

The California Short-Form Test of Mental Maturity, Level I, yielded a Verbal, Performance, and Full-Scale IQ score. The seven sub-tests measure such mental functions as logical reasoning, numerical reasoning, verbal concepts, and memory. The Technical Report prepared by the California Test Bureau (1965) lists a reliability coefficient of .75 using the Pearson Product-Moment formula corrected for range. The Standard deviation is listed as 10.7 for the Full-Scale IQ. This test is reported to have a correlation coefficient of .75 with the Stanford Binet Form L-M. The mean IQ score for the Full-Scale is 111.6.

This intelligence test was administered as part of the post-testing. Tests were administered by the teachers during the week of April 24, 1967. Conditions were similar to that of the pre-testing with the principals again supervising the evaluations. There were no differences in testing procedure reported by the principals. The tests were hand-scored.

Stanford Achievement Test

The Stanford Achievement Test, Level I, has six subtests which measure Word Reading, Paragraph Meaning, Vocabulary, Spelling, Word Study Skills, and Arithmetic. The manual for this test lists reliability coefficients ranging from a .79 to .95 for the six sub-tests. (Split-half reliabilities coefficients were corrected by the Spearman-Brown Prophecy formula.) No standard deviations were listed. The authors made the following comment about validity:

> The validity of the Stanford Achievement Test is best thought of as the extent to which the content of the test constitutes a representive sample of the skills and knowledge which are the goals of instruction (Kelley, et al, 1961).

The Stanford Achievement Test was given during the first week of

May, 1967, in all schools except Red Rock where it was administered during the last week of April, 1967. The conditions for administering this instrument were similar to those of the pre-testing. The principals reported that there were no differences in procedure for the experimental and control groups.

Scoring was done by machine and treated as part of the Clark County School District's spring testing program.

Culture Fair Intelligence Test

Raymond B. Cattell's Culture Fair (or Free) Intelligence Test is designed to measure general mental capacity as contrasted with such tests as Thurstone's Primary Mental Abilities Test, which measures various primary abilities. Cattell's instrument attempts to avoid, as much as possible, the influence of cultural factors. The manual for Scale I, which is the scale used in this study, states,

> Unlike the remaining scales, Scale I is not entirely culture free, due to the difficulty of obtaining a sufficiency of tests in the new perceptual test medium that would command the sustained interest of young children, and meet other requirements special to this age range (Cattell, 1962).

For this study the abbreviated form of the Culture Free Intelligence Test, Scale I, was used. This form consists of four sub-tests most of which are concerned with perceptual factors. The four sub-tests are substitution, mazes, selecting named objects, and similarities. The standard deviation for this form is twenty. No reliability or means are listed in the manual. Letters were written to the publisher on April 5 and 21, 1967, requesting information concerning the reliability and validity for this test. These letters accompanied orders for materials, but were never acknowledged.

The Culture Fair Test was administered to the experimental groups during the second week of May, 1967. The testing was conducted by the experimenter who was assisted by two under-graduate students. Testing conditions were considered to be excellent. All testing was conducted in the morning. The tests were hand-scored by the examiner.

When a subject attained a score of zero on any subtest, the entire test was eliminated. It was assumed that if the child was unable to score above zero, there was a misunderstanding of the instructions. The elimination of tests because of zero scores was not part of the standard scoring. However, scoring as listed in the manual was based on individual administration. No norms are available for group administration but the manual states that the test lends itself to such a procedure.

Torrance Tests of Creative Thinking

The *Circle Test* from *Torrance Tests of Creative Thinking* was used to measure divergent thinking of units and classes. Torrance lists the *Circle Test* as a Figural Test.

This is the only Figural Test that lends itself to group administration at the first grade level. On this test the subjects are given ten minutes in which to make pictures using a circle as a base. This test was scored for fluency, which is the number of items completed, flexability, which is the number of different categories completed, and for originality, which is based on the statistical infrequency and/or obviousness of a response. The fluency and flexability classifications correspond to Guilford's production of units and classes respectively.

The test manual lists test-retest reliability coefficients of .82 for fluency, .78 for categories and .59 for originality. This was for the entire figural battery and not just the *Circle Test*. One reliability study is listed for the *Circle Test* with 101 ninth-grade students. The testing was conducted one week apart and a reliability coefficient of .69 was reported.

Torrance (1966) quotes as evidence for construct validity a study by Weisberg and Springer where the personalities of highly creative children were compared with less creative ones. Judgements of the children and their parents were made by psychiatrists on the basis of interviews. The highly creative children were rated significantly higher on strength of self-image, ease of early recall, humor, availability of Oedipal anxiety, and uneven ego development. Torrance also reports a correlation of .32 between the composite creativity measure and the measure of preference for open-structure learning experiences. Other validity studies are mentioned in the manual.

The standard deviation for first grade students is listed as 5.4 for fluency, 3.2 for flexibility and 4.6 for originality for the entire Figural Test. No standard deviation is given for the Circle Test alone.

The Circle Test was administered to both the experimental and control groups during the second week of May, 1967. The testing was conducted by this investigator with the help of two students from the University of Southern Nevada. Testing was conducted in the regular classroom and conditions were considered ideal. The instructions for this instrument were modified in order that they might be better comprehended by first grade students. The modified instructions are listed in Appendix D.

Statistical Procedures

Analysis of the four different groups of data are completed in one major procedural operation. This analysis is made for the experimental and control groups using an analysis of covariance for data conforming to a randomized block design.

This statistical technique is a combination of analysis of variance and multiple regression techniques. This procedure allows one to draw conclusions about treatment effects after variables which effect the observations are adjusted statistically. This method allows for the control of initial differences in intelligence, achievement and creativity of the experimental and control groups.

Separate analysis will be made of each of the intelligence achievement and creativity measures. A more detailed discussion of the analysis is made in Chapter IV.

CHAPTER IV

RESULTS

Introduction

This chapter will present the findings of the statistical tests used to determine the statistical significance of the results of this investigation. The .05 level of confidence will be used to determine significance on all tests. The results of the achievement testing will be presented first, followed by those for intelligence and divergent thinking. A discussion and summary of the statistical findings will follow the presentation of the analyses.

Analysis of Covariance, Randomized Block Design

The data for the three schools comprising the experimental and control groups were analyzed by EG & G, Inc., contractor for the Atomic Energy Commission, Las Vegas, Nevada. Part of the calculations were performed on the CDC 1604B computor using existing programs. Some of the calculations had to be performed using a desk calculator.

The analysis of covariance, randomized block design was the statistical technique utilized to analyze the data. The computations followed those presented in Ostle (1963) page 137 to 449 and are similar to those found in Snedecor (1956). This program calculates the $\underline{F}$ ratio for the adjusted treatment means while removing the variation from error due to the initial difference in the three schools.

Garrett states the following concerning analysis of covariance:

> Analysis of covariance represents an extension of analysis of variance to allow for the correlation between initial and final scores. Covariance analysis is especially useful to experimental psychologists when for various reasons it is impossible or quite difficult to equate control and experimental groups at the start: a situation which often obtains in actual experiments. Through covariance analysis one is able to effect adjustments in final or terminal scores which will allow for differences in some initial variable. (Garrett, 1958, p. 295).

In this analysis the California Short-Form Test of Mental Maturity, Level 0, which was given as a pre-test, is used as the X variable; and the various intelligence, achievement, and tests of creativity given as post-test are used as Y variables. These post-tests, of course, are the dependent variables under consideration. The objective for using the F ratio is to test the hypothesis that there are no significant differences among the true effects of the treatment on the Y variables (post-scores) after adjusting for the effects of the X variable (pre-scores).

In addition to reporting the summary data for the F test previously indicated, a table of adjusted treatment means will be presented to aid in the interpretation of the experimental results. The analysis of the data will be presented in tables similar to those used by Ostle (1963) for analysis of variance, randomized block design. The assumptions for this statistical technique are homogenous variance, linearity, independence, and fixed X's (Ostle, 1963; Snedecor; 1956).

In performing the analysis the following simplications were made: (1) only the scores of students for whom all fourteen measurements were available were used, and (2) the minimum number of students having all scores was fourteen. Consequently the remaining classes were reduced to fourteen students by randomly selecting the students to be included. This left a total of eighty-four students in the experiment, forty-two in the experimental group and forty-two in the control group. The number of degrees of freedom is more than adequate and the loss of some students is not considered critical to the experiment. For one and 79 degrees of freedom compared to one and an infinite number of degrees of freedom, the *F* ratio changes from 3.96 to 3.84. The test data are listed in Appendix C.

The results of the analysis of covariance for the six measures of achievement are presented in Table III. In the case of Vocabulary and Arithmetic a significant *F* ratio was obtained at or beyond the .05 level of confidence. In other words, one would expect a difference as large as this to occur through chance only five times out of a hundred. Table IV presents the adjusted means for the six measures of achievement on the *Stanford Achievement Test*. The significant differences on Vocabulary and Arithmetic are in favor of the control group.

These results lead to a rejection of the first null hypothesis of no significant difference in achievement test scores of children who have had a program in classifying as compared to the scores of children who have had no such program. This rejection of the null hypothesis applies to the achievement measure of Vocabulary and Arithmetic.

The means of five of the achievement measures favored the experimental group before the adjustment for initial intelligence took place. Vocabulary was the only achievement skill that favored the control group in unadjusted mean scores. No test of significance, however, was made for these differences because the pre-test scores indicated the experimental group had higher intelligence than the control group.

The second major analysis was conducted on the intellectual measures. The results of the analysis of covariance for the Verbal, Performance and Full-Scale IQ scores on the *California Short-Form Test*

TABLE III

ANALYSIS OF COVARIANCE FOR THE SIX ACHIEVEMENT MEASURES AFTER THE EXPERIMENTAL TREATMENT

Source of Variation	df	Sums of Squares	df	Mean Square	F
Word Reading					
Treatment	1				
Error	80	10.56	79	.13	
For testing treatment difference		.07	1	.07	.52
Paragraph meaning					
Treatment	1				
Error	80	19.94	79	.25	
For testing treatment difference		.04	1	.04	.16
Vocabulary					
Treatment	1				
Error	80	29.71	79	.38	
For testing treatment difference		2.10	1	2.10	5.59*
Spelling					
Treatment	1				
Error	80	13.24	79	.17	
For testing treatment difference		.28	1	.28	1.68
Word Study					
Treatment	1				
Error	80	82.02	79	1.04	
For testing treatment difference		.31	1	.31	.30
Arithmetic					
Treatment	1				
Error	80	13.60	79	.17	
For testing treatment difference		5.61	1	5.61	32.62**

* $p. < .05.$
** $p. < .01.$

TABLE IV

ADJUSTED MEANS FOR THE SIX ACHIEVEMENT MEASURES AFTER THE EXPERIMENTAL TREATMENT

Measurement Category	Control Means $\bar{Y}_{.1}$	adj $\bar{Y}_{.1}$	Experimental Means $\bar{Y}_{.2}$	adj $\bar{Y}_{.1}$
Word Reading	2.109	2.164	2.159	2.104
Paragraph Meaning	2.052	2.091	2.181	2.142
Vocabulary	2.536	2.623	2.383	2.295
Spelling	2.431	2.465	2.619	2.585
Word Study	3.348	3.492	3.500	3.355
Arithmetic	2.183	2.255	2.202	2.130

of Mental Maturity are presented in Table V. The *F* ratio for the Verbal and Full-Scale IQ's were significant at or beyond the .01 level of confidence. The *F* ratio for Performance IQ was at a borderline .05 level of significance.

The adjusted means for intelligence, as measured by the *California Short-Form Test of Mental Maturity*, are presented in Table VI. The significant *F* ratios were found to favor the experimental group. This means the experimental group made significantly more improvement in intellectual growth than did the control group.

An inspection of Table VI shows that the unadjusted means also favored the experimental group just as did most of the unadjusted achievement measures. For example, the unadjusted means for the Full-Scale IQ was 131.55 for the experimental group compared to 124.64 for the control group. These unadjusted means were not subjected to a test of significance because of initial mean difference on the pre-test scores.

TABLE V

ANALYSIS OF COVARIANCE ON THREE MEASURES OF INTELLIGENCE ON THE CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

Source of Variation	df	Sums of Squares	df	Mean Square	F
Verbal IQ					
Treatment	1				
Error	80	8115.36	79	102.73	
For testing treatment difference		1682.19	1	1682.19	16.38**
Performance IQ					
Treatment	1				
Error	80	9536.62	79	120.72	
For testing treatment difference		446.70	1	446.70	3.70
Full-Scale IQ					
Treatment	1				
Error	80	6351.96	79	80.40	
For testing treatment difference		1188.94	1	1188.94	14.79**

* $p. < .05$.
** $p. < .01$.

TABLE VI

ADJUSTED MEANS ON THREE MEASURES OF INTELLIGENCE OF THE CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

Measurement Category	Control Means $\bar{Y}_{.1}$	adj $\bar{Y}_{.1}$	Experimental Means $\bar{Y}_{.2}$	adj $\bar{Y}_{.1}$
Verbal IQ	119.71	121.41	128.07	126.37
Performance IQ	124.76	126.12	128.57	127.21
Full-Scale IQ	124.64	126.23	131.55	129.97

The analysis of covariance for the *Cattell Culture Fair Intelligence Test* is reflected in Table VII. A significant *F* ratio was found on this analysis.

TABLE VII

ANALYSIS OF COVARIANCE FOR THE *CATTELL INTELLIGENCE TEST*

Source of Variation	df	Sums of Squares	df	Mean Square	F
Treatment	1				
Error	80	26813.67	79	339.41	
For testing treatment difference		3646.16	1	3646.16	10.74**

**p. < .01.

Table VIII indicates that the increase in mean IQ score was significantly greater for the experimental group than for the control group when the means were adjusted for initial difference in IQ score. This indicates that the experimental treatment did improve intellectual ability as measured by the *Cattell Culture Fair Test of Intelligence*.

TABLE VIII

ADJUSTED MEANS FOR THE *CATTELL INTELLIGENCE TEST*

Measurement Category	Control Means $\bar{Y}_{.1}$	adj. $\bar{Y}_{.1}$	Experimental Means $\bar{Y}_{.2}$	adj. $\bar{Y}_{.1}$
Cattell IQ	139.57	140.50	152.64	151.71

The adjusted IQ means was 151.71 for the experimental group compared to 140.5 for the control group. The unadjusted mean IQ score for the experimental group was 152.64 compared to 139.57 for the control group. No test of significance was conducted to measure this mean difference because of initial difference in mean score on the pre-tests.

The null hypothesis of no significant difference in intelligence after treatment effects was rejected because of the significant difference in intellectual growth on two measures of the California Short-Form Test of Mental Maturity and the Cattell Cultural Fair Intelligence Test.

The analysis of covariance for measures of divergent thinking are presented in Table IX. No analysis was made for originality because the high number of zero scores did not lend itself well to analysis of covariance. The *F* ratio indicates both measures of divergent thinking are significant at or beyond the .05 level of confidence.

TABLE IX

ANALYSIS OF COVARIANCE FOR TWO MEASURES OF CREATIVITY AFTER THE EXPERIMENTAL TREATMENT

Measurement Variation	df	Sums of Squares	df	Mean Square	F
Fluency					
Treatment	1				
Error	80	635.91	79	8.09	
For testing treatment difference		45.59	1	45.59	5.66*
Flexibility					
Treatment	1				
Error	80	207.74	79	2.63	
For testing treatment difference		22.74	1	22.74	8.65**

* $p. < .05$.
**$p. < .01$.

Table X presents the adjusted means for this measure of divergent thinking on the Circle Test from the Torrance Test of Creativity. An inspection of this table shows that the two groups differed significantly on fluency of idea, and these differences were in favor of the experimental group. This analysis indicates that the experimental group made larger increases in fluency and flexibility scores than did the control group when means were adjusted for initial differences. The initial means also favored the experimental group on both measures. The unadjusted means on the test of originality were 2.18 for the experimental group and 1.38 for the control group.

TABLE X

ADJUSTED MEANS FOR TWO MEASURES
OF DIVERGENT THINKING

Measurement Category	Control Means $\bar{Y}_{.1}$ adj.	$\bar{Y}_{.1}$	Experimental Means $\bar{Y}_{.2}$ adj.	$\bar{Y}_{.1}$
Fluency	7.811	7.702	9.124	9.231
Flexibility	5.190	5.068	6.024	6.146

The third major hypothesis of no difference between the two groups on scores of divergent thinking is rejected as a result of these findings.

Discussion

The findings of this study could be explained in a number of ways. However, the research conducted on "convergent" versus "divergent" thinking seems to offer the best explanation. Convergent thinking in this case applies to learning that requires the student to converge on a particular bit of information. This type of learning is normally thought of as being the acquisition of factual information taught through the lecture method. Divergent thinking, on the other hand, is concerned with the teaching of critical thinking and is generally taught through the discussion method.

McKeachie (1964) summarized the finding as to the effects of the lecture method versus discussion method in a manner that appears to parallel the findings of this investigation. For example, in reviewing seven studies McKeachie found the lecture method to be superior for later recall. For the discussion method the seven studies suggested that the discussion method favored critical thinking, general problem solving, transfer and attitude toward the field being taught. The effects of the discussion method varied as to the types of discussion used.

The experimental procedure employed in this experimental investigation closely approximates the divergent and convergent methods of teaching. The central purpose of the exercise in classifying was to allow the child to classify the materials in as many ways as possible and not to focus on the generally accepted single correct answer. The results did indicate that on the measures of divergent thinking the experimental group achieved superior results.

The children in the control group were exposed only to normal classroom lectures designed to transmit specific information. The results confirm that in at least two subject areas they gained significantly more knowledge of subject matter than the experimental group. The intelligence test scores, on the other hand, which measure general problem-solving ability, were significantly higher for the experimental group. This was true for both the Verbal and Full Scale Intelligence tests on the California Short-Form Test of Mental Maturity and for the Cattell Cultural Fair Intelligence Test.

It is important to note that the Vocabulary test on which the control group exceeded the experimental group in adjusted mean score, is sometimes considered a test of convergent thinking (Guilford, 1959). The Arithmetic sub-test from the Stanford Achievement Test is described as consisting of parts concerned with measures, problem-solving and number concepts. This test is not broken down into tests of arithmetic reasoning and arithmetic computations which would give evidence as to whether it is a test of convergent or divergent thinking.

The findings of this research, in part, support Levi's (1965) results. Increases in intelligence were found, and the increases were greater for verbal intelligence just as in Levi's study. However, an increase in general achievement was not shown by the data of this study. This suggests that studies which show improvement in intelligence after specific instructions may have little or no effect on the general learning ability of children as measured by standard achievement instruments. In fact, it is possible that such mental exercises may have a negative effect on specific areas of learning as was the case in this study.

The importance of these findings should not be under-estimated. The results offer some degree of confirmation to Bruner's and Ausubel's theory of cognitive processes and add to the mounting array of evidence to show that mental functions can be changed.

Summary

The general findings of the analysis of covariance demonstrated higher mean scores for the control group on two measures of achievement after the means of the two groups had been adjusted for initial difference in intelligence.

The opposite finding was found with respect to intelligence. On two measures of the California Short-Form Test of Mental Maturity, the experimental group made more growth in intelligence than did the control group when means were adjusted for initial difference. This finding was also true for the Cattell Culture Fair Intelligence Test. On the test of divergent thinking the experimental group had significantly greater gains in both fluence and flexibility of ideas than did the control group when means were adjusted for initial differences.

All of the null hypothesis of no significant difference in the dependent variables for the experimental and control groups after practice in making classifications, were rejected. The effects of classifying appears to have had a facilitating effect on intelligence as measured by the California Short-Form Test of Mental Maturity and the Cattell Cultural Fair Intelligence Test. However, the experimental treatment did not result in any improvement in achievement. In fact, it appears to have resulted in lower scores in the areas of vocabulary and arithmetic.

There is a definite need for additional research in this area. The effects of the set to see structure to the material used in class needs to be evaluated. The similarity of the material used in the experiment with that of the intelligence tests which were used, needs to be explored. Additional research should be conducted on divergent and convergent teaching with respect to intelligence, creativity and achievement. Also, this study should be repeated using other measuring instruments, preferably individual intelligence tests. Such studies should be of both practical and theoretical significance.

CHAPTER V

SUMMARY, LIMITATIONS, AND CONCLUSIONS

Summary

The primary purpose of the study is to determine the effects of practice in making classifications on achievement, intelligence and creativity. The experimental procedure consisted of presenting a series of five levels of classifications arranged in a hierarchical order to first grade children over an eight month period. A control group equated for all pertinent variables served to test the effects of the experimental treatment.

According to theories by Bruner (1956) and Ausubel (1960), the learner learns by placing subject matter into meaningful categories. For Ausubel the mind is arranged in a categorical order of a superordinate and subordinate relationship. Levi (1965) had demonstrated the importance of mental classifications by teaching a youngster to become a more effective classifier. The intelligence and achievement test scores of his one subject increased over a sixteen month period. The experimental plan of this project extended Levi's study and at the same time furnished information as to the role of classifications on mental processes.

This study called for a pre-test post-test design. Subjects in the experimental and control group were administered the California Short-Form Test of Mental Maturity, Level 0, as a pre-test in September, 1966.

At the termination of the investigation the subjects were administered the Stanford Achievement Test to measure six areas of achievement; the California Short-Form Test of Mental Maturity, Level I, to measure Verbal, Performance and Full-Scale intelligence; the Cattell Culture Fair Intelligence Test to measure intelligence free from cultural influences; and the Circle Test from the Torrance Test of Creativity to measure two areas of divergent thinking.

The lessons in making classifications were presented by the regular classroom teachers during normal school hours. Three to four exercises were presented each week. This required fifteen to twenty minutes for each group of exercises. The students were encouraged to group the materials in as many ways as possible. The materials used for the study were taken from Reading Readiness Series, Continental Press, Inc., and the Reading for Meaning Series, Houghton, Mifflin Co. Some were patterned after materials used in the First Grade Project in New York City Schools (1965).

For the study eighty-four children were selected randomly from a larger population so as to have an equal number in the control and experimental groups. Analysis of covariance, randomized block design, was used to test the null hypotheses. One analysis revealed that the control group scored higher on two achievement measures, vocabulary and arithmetic. Significance differences were not obtained on any of the other achievement measures.

The experimental group had significantly higher mean IQ scores on the Verbal, and Full-Scales of the California Short-Form Test of Mental Maturity. Their IQ scores were also significantly higher than the control group's scores on the Cattell Culture Fair Intelligence Test. Significantly higher mean scores were also found in favor of the experimental group on the two measures of divergent thinking.

Limitations

In interpreting the findings of this investigation, the reader should be aware of certain limitations. A brief discussion of the factors that may have influenced the findings of this study will be presented.

The population for this study was a group of children who were of above average intelligence before and after the experimental treatment. Their unadjusted mean achievement scores show them to be achieving above grade level in each of the six achievement categories measured. There is no evidence to indicate that these children are typical of a larger population of children on a national basis.

An important factor that might have influenced the present findings is the Hawthorne effect (Zaleznik, 1964). The teachers of both the experimental and control groups realized that they were participating in a study, and they knew that their children would be given an achievement test at the termination of the experiment. They also administered the achievement test at the end of the project.

The teachers of the experimental group became enthusiastic about the materials to such an extent that they invited other teachers to view the materials. One teacher even informed the children's parents about the materials. Such actions as this caused a teacher of the control group to request that she have the materials for making classifications for the next school year. All experimental teachers made the same request, and all voiced the opinion that the materials helped the children to learn. None of the teachers knew that growth in intelligence was a factor under consideration. However, they did know that intelligence would be measured.

A more standardized testing procedure might have also influenced the outcome. The teachers did the pre-testing and the post-testing of achievement and of intelligence as measured by the California Short-Form Test of Mental Maturity. The investigator administered the Cattell Culture Fair Intelligence Test and the Torrance Test of Creativity. Ideally, the same individual should administer all pre- and post-tests and without knowledge of which children comprised the experimental and control groups.

The findings must be interpreted with caution with respect to the use of the California Short-Form Test of Mental Maturity as a pre-test. In the first place, the assumption was made that the intelligence of the children will be fixed and not changed as a function of the experiment. The results indicate that the intelligence of both groups increased during the treatment, but that the experimental group was significantly higher in adjusted mean score at the termination of the study. An analysis of covariance using the post-intelligence test scores may have shown the control to be superior in adjusted means on additional measures of achievement.

The correlations of intelligence test with later intelligence at this early age also leaves something to be desired as was indicated in the review of the literature. Individual intelligence tests with higher reliabilities may have improved the experiment. Also, it was noted that one teacher in the control group failed to have the children use a marker in the pre-testing. This could have resulted in lower initial intelligence test scores for the control group, thus reducing the effects of the experimental treatment.

Also, the achievement measures, as well as the intelligence tests, may not have equal units at all points, making it easier to make a large gain at the less difficult end than at the difficult end (Bloom, 1964).

Conclusions

In view of the discussion of results in the preceding chapter and the discussion of the limitations of the study in this chapter, an interpretation of the results will be conservatively stated.

The results of this investigation suggest that for the population in question, practice in making classifications appears to increase intelligence test scores and scores on the Torrance Tests of Creativity. Achievement was not increased by the practice in making classification. In fact, it appears that on test of vocabulary and arithmetic, scores may be lowered as a result of the lessons in classification.

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APPENDIX A

General Instructions To The Teacher

The teacher is asked to refer to the index of instructions in order to determine the proper instructions for each lesson.

A time schedule is also listed which gives the teacher ample flexability in presenting the lessons. If the time schedule proves unreasonable, adjustments will be made.

In presenting the exercises the teacher will be allowed to use her own discretion as to whether or not the child cuts out, colors, or merely refers to the correct answer. However, the teacher should insure that the children are allowed to discuss why an object does or does not belong to a class.

The teacher is encouraged to observe the following:

1. Always allow the students ample time to study the pictures before it is pointed out which one does not belong.
2. Allow students time to hold up their hands indicating that they have determined why an object does not belong.
3. Accept all reasonable explanations as to why an object does not belong and explain to the class. When other than the standard classification is given but is a reasonable explanation, the teacher will say, "Yes, that is correct because--(explains), but that is not my secret." Encourage the children to classify the material in a number of different ways.
4. Allow the students to classify objects with his own concept, i.e., they have four legs, rather than "animals" or they grow in the ground rather than "vegetables". The teacher, however, should tell the children that they are also

animals or vegetables.

5. Help the children to understand that if the characteristics of a classification can be determined, we can add other objects to the group (inclusion classification).

A

Teacher's Instructions

Classifications

Visual Discriminations

First Day

(Before passing out exercises, teacher says:)

We have some games to do today. I will pass out some pictures to you. I have a secret about the pictures. You are to try to find out my secret.

(Gives each child the first exercise.)

Let's look at the pictures on the first page. You see there is a (names). The (names) does not belong, does it? Now what is my secret in order to belong? (Allows the class to respond.) Yes, my secret is that it must be a (names) in order to belong. Now put an "X" through the (names) because it does not belong. Why doesn't the (names) belong? (Allows the class to explain. Teacher gives a more detailed explanation if necessary.)

This outline will be followed for the following: Visual Discriminations 1-14 (Level 1)

B

Teacher's Instructions

Classifications

Visual Discriminations

(Before passing out exercises, teacher says:) We are going to play some more games today. I will pass out some pictures to you and you are to find a picture just like the one I ask for.

(Gives each child the first exercise.) Look at the first picture (or design) at the top of the page. There is another picture (s) on the page that is just like one. Can you find it? (Allows class time to locate picture.)

Yes, why are they alike? (Gives more detailed explanation if necessary.)

This outline will be followed for the follow lessons:

15-25 (Level I)

C

Teacher's Instructions

Thinking Skills (Abstractions)

(Before passing out exercises, teacher says:) We are going to play some more games today. I will pass some pictures to you. I have a secret about the pictures. You are to find my secret.

(Gives the children the first exercise.) Look at the pictures on the first page. You see (names objects). Some of the objects do not belong with the (names). Find the objects that belong with the (names).

(Allows the class to respond). Yes, that's correct. The (names) goes with the (names).

Now why do these things go together? (Allows class to explain. Teacher gives a more detailed explanation if necessary.)

This outline will be followed for all exercises for Level 1 and 2.

D

Teacher's Instructions

Subordinate Classifications

Part I

(Teacher says:) We are going to play some games again today. Look at these (number) pictures. I have a secret about the pictures. They are alike in some way. What is my secret? (Allows class to respond.)

Yes, they are all alike because (explains). How are these (number) pictures (teacher refers to a subordinate class) alike? Allows class to respond. Teacher gives explanation when necessary.)

See if you can guess how some of the other pictures are alike. (Allows class to explain. Teacher helps class when necessary.)

Part II

Now children, are there more (names subordinate class) than (names superordinate class)? (Allows class to respond.) Yes, there are more (names) than (names). (Teacher explains when necessary.)

Are there more (subordinate class) than (other subordinate class)? (Allows class to respond). Yes, (teacher explains when necessary.)

This outline will be followed for the all subordinate classifications exercises.

E

Teacher's Instructions

Matrix Classifications

(Before passing out exercises, teacher says:) We are going to play some games today. I will pass out some pictures to you. I have a secret about the pictures. (Gives children the first exercise.)

Look at the picture (figure) on the first page. One (some of the pictures (figures) at the bottom of the page belongs in this space (teacher indicates).

Notice that this is (indicating one dimension such as purple) and this one is (indicating the other dimension such as a circle). The picture (figure) from the bottom of the page must also be (indicate dimensions).

See if you can find my secret. Which one goes here? (Allows class to respond. Gives help when necessary.) Yes, (explains and allows children to discuss why some of the other pictures do not belong).

Visual Discriminations

Purpose: These exercises are designed to give the child a "set" to place objects in classifications according to visual characteristics.

In order to aid the student in discriminating the difference between objects, have him (1) start from a specific frame-of-reference and work systematically from that point, i.e., top to bottom, right to left, and (2) have the child trace the figures with his eyes before making a discrimination.

Day	Exercises
1	1-3
2	4-6
3	7-9
4	10-12
5	13-14
6	15-17
7	18-19
8	20-21
9	22-23
10	24

Thinking Skills

Level I

Purpose: These exercises are designed to give the child a "set" to group objects according to abstract characteristics.

(1) Allow the child to use his own grouping if correct, even though it may not be the most comprehensive grouping. (2) Point out additional groupings to the students.

Day	Exercise
1	1 and 3
2	4 and 5
3	6, 7, 8
4	12-13
5	14-16
6	17-18
7	19-20

Thinking Skills

Level II

Purpose: These exercises are designed to give the student a "set" to group objects according to abstract characteristics.

(1) Allow the child to use his own grouping if correct even though it may not be the most comprehensive grouping.

(2) Point out additional groupings to the students.

Day	Exercise
1	1
2	2
3	3,5
4	6,7
5	11,12
6	13,14
7	15
8	16
9	20
10	22

Subordinate Classifications

Purpose: These exercises are designed to give the student a "set" to group objects according to superordinate and subordinate characteristics.

(1) The child should be helped to understand that when an object has a characteristic common with all members of class, it can be grouped with those objects even though it differs in many ways.

(2) The child should be helped to understand that a superordinate group is composed of a larger number of objects than a subordinate group.

Day	Exercise
1	1-3
2	4-6
3	7-9
4	10-12
5	13-15

Superordinate and Subordinate Classes

Exercise	Superordinate	Subordinate
1	Circles	Large, small
2	Circles	Large, medium, small
3	Circles	Black, white
4	Toys	Taps, Jacks
5	Men (Males)	Sailors, Policemen
6	Males	Boys, Men
7	Garden Tools	Wheels, Handles, Cutting
8	Animals Horned Hoofed	Wild, Domestic (Farm) Give Milk
9	Wooden Objects (Found in House)	Musical Instruments (Play), Furniture
10	Fowl (Birds)	Water Land, Farm, Wild
11	Clothing	Pairs, Singles, Worn on Extremities, Worn on Body
12	Living (Mammals)	Pets Children Human Animal
13	Ocean-Going	Living Non-Living Ships Water Creatures
14	Farm Animals	Fowls, Mammals Feathered, Hoofed
15	Living	Children Amphibious

Matrix Classifications

Purpose: These exercises are designed to help the child understand that objects can be grouped according to multiple dimensions, i.e., black and cup, size and shape, etc.

Day	Exercise
1	1-2
2	3-5
3	6-7
4	8-9
5	10-11
6	13-15

Time Schedule

For Instructions

Lesson	Completion Date
Visual Discrimination	Oct. 17, 1966
Thinking Skills	Nov. 7, 1966
Level I	
Level II	Dec. 5, 1966
Subordinate Classifications	Jan. 4, 1967
Matrix Classification	Feb. 1, 1967
Classifying School Work	______

The teacher may present the materials at her own rate as long as each lesson is complete by the date indicated. The teacher should insure that the exercises are not presented at such a rate that the children become fatigued. The material has been scheduled so that the teacher present three lessons per week and meet the completion dates. The instructions in classifications will commence September 19, 1966.

Testing Schedule

Test	Testing Date
California Test of Mental Maturity	Sept. 13, 1966
Cattells Cultural Fair Intelligence Test	May 5, 1967
California Achievement Test	May 5, 1967
California Test of Mental Maturity	May 5, 1967

APPENDIX B

Classifying School Work

Purpose: Subject matter can be retained and transferred more effectively if the child comprehends the structure. Modern math is presented in such a way that the structure is apparent. Other subject matter can also be presented in this manner. The object of this lesson is to demonstrate to the child that all school subjects can be classified or structured.

Arithmetic

1. (A) The product is always one less than the numeral added to nine.
   (B) The product of the answer always adds to what is added to equal nine.
2. When one subtracts a numeral that is one more than the numeral in the ones column, the answer is always nine. (B) All subtraction problem.
3. When adding or multiplying, the answer is always the same regardless of which numeral comes first.
4. (A) Every other numeral ends in 0 or 5. (B) Each column increases by ten etc. (C) The numerals of each column follow the sequence from one to ten. (D) Increases by five. (E) First numeral in each column is the same.
5. Columns end in the same numeral. (B) The first numeral of each column follows an order of 0,1,2,3,4, etc. (C) The last numeral of each line is a repeat of counting by two's from two to ten. (D) Diagonal lines end in sequence of 2,4,6,8,0 and begin with 1,2,3,4 sequence.

1.

9 + 3 =

9 + 5 =

9 + 2 =

9 + 7 =

9 + 6 =

9 + 4 =

9 + 8 =

9 + 9 =

9 + 1 =

2.

17 - 8 =	6 - 2 =
12 - 3 =	10 - 6 =
14 - 5 =	13 - 4 =
16 - 7 =	12 - 2 =
18 - 9 =	16 - 7 =
13 - 4 =	11 - 1 =
15 - 6 =	14 - 2 =

3.

2 x 3 =	1 + 5 =
3 x 2 =	5 + 1 =
1 x 2 =	7 + 2 =
2 x 1 =	2 + 7 =
2 x 2 =	9 + 1 =
2 x 2 =	1 + 9 =
3 x 4 =	10 + 2 =
4 x 3 =	2 + 10 =

4.

05	10
15	20
25	30
35	40
45	50
55	60
65	70
75	80
85	90
95	

5.

2	4	4	8	10
12	14	16	18	20
22	24	26	28	30
32	34	36	38	40
42	___	___	___	___
___	___	___	___	___
___	___	___	___	___
___	___	___	___	___

I HAVE A SECRET

CAN YOU FIND THE RIGHT WORD FOR EACH SENTENCE? WRITE THE WORDS IN THE SQUARES UNDER EACH SENTENCE. YOU WILL FIND THE WORDS AT THE BOTTOM OF THE PAGE.

I LIKE MILK.

___ ___ ___

I LAY EGGS FOR YOU.

___ ___ ___

YOU SLEEP IN ME AT NIGHT.

___ ___ ___

I GIVE YOU MILK.

___ ___ ___

BABY BIRDS LIVE IN ME.

___ ___ ___ ___

GIRLS LIKE TO PLAY WITH ME.

___ ___ ___ ___

MOTHER BAKES ME FOR YOU.

___ ___ ___ ___

YOU RIDE IN ME ON THE WATER.

___ ___ ___ ___

I PLAY WITH A DOLL.

___ ___ ___ ___

CHILDREN LIKE TO DRINK ME.

___ ___ ___ ___

I LIVE IN THE WATER.

___ ___ ___ ___

I FLY AND SING.

___ ___ ___ ___

BIRD	CAT	HEN	GIRL	BOOK
FISH	MILK	CAKE	NEST	HOUSE
BED	DOLL	COW	BOAT	WATER

SOON	SPOON	FOOL	SPOOL	______	______
OIL	BOIL	JOINT	POINT	______	______
BOY	TOY	JOY		______	______
OWL	CLOWN	TOWN	FROWN	______	______
STOUT	FOUND	SCOUT	ROUND	______	______

MY	TRY	FLY	DRY	________	________
SAY	PLAY	LAY	GRAY	________	________
FAN	PANT	LAND	CAN	________	________
BALL	CALL	FALL	TALL	________	________
SACK	ACNE	RACK	BACK	________	________

CHOP	MOP	HOP	OPEN	______	______
RAT	SAT	ATTEND	BAT	______	______
LUMP	UMPIRE	CLUMP	MUMPS	______	______
BAGS	RAG	TAG	LAGS	______	______

TOT	OTTER	COT	DOT	________	________
BIN	BEGIN	SPIN	KIN	________	________
LIT	BITTER	MITTEN	SIT	________	________
NAME	TAME	FAME	DAME	________	________

THE TEACHERS TALK A LOT.

THE PRINCIPAL TALKS A LITTLE.

BILL TALKS SOME,

BUT GIRLS TALK ALL THE TIME.

PETE RUNS TO SCHOOL

THE BOYS RUN TO SCHOOL

SALLY RUNS TO SCHOOL.

THE GIRLS RUN JUST FOR FUN.

I _______ AND RUN.

THE GIRL LIVES IN A RED HOUSE.

THE GIRLS LIVE IN A RED HOUSE.

THE BOY LIVES IN A WHITE HOUSE.

THE BOYS LIVE IN A TREEHOUSE.

I ______ IN A ______ HOUSE.

SHE WILL HELP MOTHER MAKE CANDY.

SHE HELPED MOTHER MAKE CANDY.

OUR TEACHER JUMPED FOR THE CANDY.

WE WILL JUMP FOR THE CANDY.

DO NOT DROP THE CANDY.

WE DROPPED THE CANDY.

QUICK! THE DOG WILL GRAB THE CANDY!

THE DOG GRABBED THE CANDY.

IT'S GONE.

APPENDIX C

PRE- AND POST TEST SCORES
FOR THE CONTROL GROUP
ROSE WARREN SCHOOL

	PRE-TEST	POST-TEST												
	CTMM	Stanford Achievement Test						CTMM			Torrance Test of Creativity			Cattell
Subject	IQ	Word Read	Para. Mean	Vocab.	Spell.	Word Study	Arith.	Verbal IQ	Perf. IQ	Full IQ	Flu.	Flex.	Orig.	IQ
1	102	1.5	1.5	1.4	1.1	1.3	1.4	87	97	91	5	4	0	164
2	113	1.7	1.6	1.5	1.6	1.5	2.0	116	122	120	7	5	0	171
3	125	1.7	1.6	2.3	1.7	1.5	1.5	130	98	115	9	5	2	105
4	115	1.6	1.4	2.2	1.7	1.3	1.7	132	119	127	5	4	0	144
5	94	1.7	1.7	2.1	1.7	1.7	1.7	107	105	107	3	2	0	118
6	116	2.0	1.9	3.1	2.6	2.8	1.9	123	137	132	5	2	0	133
7	111	1.8	1.7	2.7	2.0	2.5	2.0	119	117	119	7	5	2	158
8	96	1.7	1.5	1.6	1.6	1.5	1.7	106	102	104	3	2	0	118
9	109	1.3	1.4	1.3	1.5	1.5	1.6	128	121	127	10	5	3	140
10	127	1.7	1.7	1.7	1.9	2.0	2.0	124	124	128	4	2	0	149
11	121	1.7	1.6	2.1	1.8	2.1	2.6	95	113	105	3	2	0	107
12	116	1.7	1.4	2.9	1.9	1.4	1.9	138	132	138	5	5	2	144
13	104	1.7	1.6	1.8	2.1	2.0	1.7	122	94	109	6	3	2	114
14	125	1.8	1.5	2.9	1.8	2.3	1.8	132	119	128	8	4	0	149

*Perfect Scores

PRE- AND POST TEST SCORES
EXPERIMENTAL GROUP
ROSE WARREN SCHOOL

	PRE-TEST	POST-TEST												
	CTMM	Stanford Achievement Test						CTMM			Torrance Test of Creativity			Cattell
Subject	IQ	Word Read	Para. Mean	Vocab.	Spell.	Word Study	Arith.	Verbal IQ	Perf. IQ	Full IQ	Flu.	Flex.	Orig.	IQ
1	116	1.6	1.5	1.8	1.7	1.7	1.7	123	113	119	8	6	1	171
2	121	1.6	1.6	1.5	1.8	1.7	1.4	124	121	127	9	3	0	126
3	126	1.7	1.7	2.2	2.0	1.8	3.2	130	144	140	8	4	0	158
4	109	2.0	1.7	1.4	1.9	1.5	1.7	116	140	133	14	9	1	167
5	129	1.7	1.6	2.9	2.0	2.8	1.8	122	127	127	6	4	0	143
6	127	1.7	1.7	3.6	1.9	2.3	2.1	135	132	137	7	4	2	168
7	117	2.5	2.6	2.5	2.4	3.4	2.9	119	128	125	8	7	3	168
8	95	1.4	1.5	1.2	1.9	1.4	1.6	117	125	130	10	5	0	177
9	117	1.7	1.6	1.6	1.5	1.8	1.7	124	114	121	11	5	2	132
10	102	1.6	1.5	1.5	2.0	1.5	1.4	111	115	117	12	7	0	140
11	87	1.4	1.5	1.3	1.1	1.3	1.2	121	97	110	8	5	2	148
12	95	1.5	1.4	1.5	1.6	1.2	1.3	123	101	114	13	7	2	133
13	123	2.6	2.3	2.5	3.4	3.9	1.5	121	113	118	10	6	2	123
14	127	1.9	1.6	2.4	1.6	1.8	1.9	150	137	147	13	5	2	174

*Perfect Scores

PRE- AND POST TEST SCORES
FOR THE CONTROL GROUP
E. W. GRIFFITH SCHOOL

	PRE-TEST	POST-TEST												
	CTMM	Stanford Achievement Test						CTMM			Torrance Test of Creativity			Cattell
Subject	IQ	Word Read	Para. Mean	Vocab.	Spell.	Word Study	Arith.	Verbal IQ	Perf. IQ	Full IQ	Flu.	Flex.	Orig.	IQ
1	124	2.9	*4.0	2.7	3.0	5.5+	2.1	108	140	125	6	5	0	138
2	123	2.9	2.1	2.4	2.6	5.5+	2.4	122	137	131	7	6	2	149
3	102	3.2	3.6	1.9	*3.4	5.5+	2.5	109	130	121	8	5	0	154
4	79	1.6	1.5	1.5	1.6	1.4	1.4	110	124	118	11	7	0	123
5	110	1.9	2.1	1.7	*3.4	5.5+	2.2	114	137	131	12	7	3	158
6	88	1.3	1.7	1.5	1.8	2.1	1.3	117	102	109	7	5	0	158
7	110	1.8	1.8	2.2	2.6	3.2	2.4	113	124	121	7	4	0	168
8	110	2.4	2.2	1.4	3.0	3.4	1.8	100	127	114	9	6	5	123
9	135	2.2	2.0	2.5	2.6	4.8	2.9	131	123	130	10	8	5	164
10	108	2.6	2.0	2.2	2.8	2.7	2.5	149	123	144	7	6	1	114
11	106	2.3	2.3	1.7	*3.4	3.2	2.2	125	135	132	14	6	1	177
12	118	2.7	2.5	2.3	2.8	5.5+	1.9	110	134	123	5	4	0	133
13	104	1.4	1.8	1.6	2.1	2.1	1.7	95	119	108	4	3	0	114
14	82	1.7	1.5	1.4	2.6	2.2	2.0	104	132	123	7	5	0	110

*Perfect Scores

PRE- AND POST TEST SCORES
EXPERIMENTAL GROUP
E. W. GRIFFITH SCHOOL

	PRE-TEST	POST-TEST												
	CTMM	Stanford Achievement Test						CTMM			Torrance Test of Creativity			Cattell
Subject	IQ	Word Read	Para. Mean	Vocab.	Spell.	Word Study	Arith.	Verbal IQ	Perf. IQ	Full IQ	Flu.	Flex.	Orig.	IQ
1	124	2.7	2.2	2.3	*3.4	5.5+	2.5	140	141	144	9	5	2	179
2	144	2.9	2.3	2.4	3.0	3.4	2.6	136	138	140	6	5	2	154
3	121	2.7	2.4	2.1	2.6	4.8	2.6	130	125	130	7	5	4	160
4	132	3.2	2.7	2.7	3.0	4.8	2.6	141	107	128	10	7	2	143
5	139	2.1	2.3	2.1	2.8	4.8	2.0	127	135	136	3	2	0	154
6	120	2.0	2.0	2.7	3.0	5.5+	2.8	128	120	128	9	6	3	133
7	139	2.1	2.2	2.4	3.0	5.5+	2.9	128	117	125	6	4	0	160
8	129	2.2	2.4	3.3	*3.4	3.2	2.9	128	121	128	11	7	5	168
9	122	2.4	2.9	2.4	3.0	2.5	2.6	123	117	123	7	5	1	138
10	125	1.8	1.8	2.5	2.1	2.3	2.5	136	134	138	8	5	0	165
11	145	2.7	2.7	2.3	3.4	5.5+	2.4	141	134	141	9	5	3	164
12	135	2.5	2.5	1.9	2.8	*5.6	2.3	130	134	134	6	4	4	158
13	139	2.4	2.3	2.2	2.8	3.2	2.5	128	117	124	8	5	1	130
14	126	2.9	2.7	3.3	2.8	5.5+	3.5	140	131	140	6	4	2	168

*Perfect Scores

PRE- AND POST TEST SCORES
EXPERIMENTAL GROUP
RED ROCK SCHOOL

	PRE-TEST	POST-TEST												
	CTMM	Stanford Achievement Test						CTMM			Torrance Test of Creativity			Cattell
Subject	IQ	Word Read	Para. Mean	Vocab.	Spell.	Word Study	Arith.	Verbal IQ	Perf. IQ	Full IQ	Flu.	Flex	Orig.	IQ
1	131	3.2	*4.0	3.3	*3.4	4.8	2.8	140	139	143	10	9	4	149
2	105	1.9	1.9	2.1	*3.4	2.8	1.6	86	120	103	9	6	3	154
3	123	2.1	1.9	2.9	3.0	5.1	2.4	126	137	134	13	9	6	170
4	127	2.4	1.6	3.3	2.6	3.2	2.0	125	124	128	8	8	6	143
5	135	2.7	*4.0	2.4	*3.4	4.8	2.3	139	158	154	7	5	2	179
6	122	1.9	2.7	1.9	2.8	5.5	2.4	129	138	137	17	11	8	154
7	113	2.2	2.7	3.1	*3.4	5.4	1.8	137	141	143	8	7	1	144
8	132	2.9	3.1	3.1	*3.4	5.5+	2.4	126	138	135	10	9	4	154
9	104	1.7	2.7	2.4	*3.4	3.2	2.9	128	145	139	12	9	5	143
10	112	2.1	2.0	2.7	3.0	2.8	2.0	121	149	141	8	7	0	123
11	94	1.8	2.0	3.5	2.6	4.8	1.5	122	117	122	6	3	0	143
12	113	1.7	1.8	2.9	2.1	2.2	2.2	135	134	138	11	11	8	158
13	122	2.2	1.7	1.5	2.8	2.8	1.7	133	141	140	10	7	1	123
14	122	2.4	2.3	2.5	2.8	3.9	2.4	140	141	144	12	6	1	172

*Perfect Scores

PRE- AND POST TEST SCORES
OF THE CONTROL GROUP
RED ROCK SCHOOL

	PRE-TEST	POST-TEST												
	CTMM	Stanford Achievement Test						CTMM			Test of Creativity			Cattell
Subject	IQ	Word Read	Para. Mean	Vocab.	Spell.	Word Study	Arith.	Verbal IQ	Perf. IQ	Full IQ	Flu.	Flex.	Orig.	IQ
1	110	2.1	2.5	3.6	2.6	*5.5+	2.7	143	150	153	7	4	0	179
2	132	2.9	2.3	2.7	3.0	4.8+	2.8	132	145	141	7	6	2	140
3	119	2.6	2.2	2.9	3.0	*5.5+	1.9	124	144	136	12	5	0	110
4	133	2.3	1.9	3.6	3.0	3.5+	3.8	123	135	132	9	7	2	129
5	128	2.5	2.2	4.8	2.4	4.8	2.6	113	127	123	10	6	2	123
6	120	2.6	3.1	3.3	2.8	5.5+	2.6	119	128	127	20	10	1	149
7	133	3.2	3.6	5.5+	*3.4	5.5+	3.8	113	131	123	9	7	5	129
8	134	2.2	2.2	4.0	3.0	5.5+	2.8	129	118	126	6	5	2	149
9	121	2.5	2.1	4.4	2.8	5.5+	2.4	115	121	121	10	6	6	110
10	102	2.0	1.9	2.4	2.6	2.7	2.0	136	146	149	8	7	2	138
11	129	2.2	2.0	4.0	2.4	3.4	2.5	135	142	142	9	8	4	149
12	127	1.8	1.6	2.7	2.2	2.7	2.3	131	145	141	9	6	0	114
13	115	2.6	2.5	3.6	2.8	3.2	2.6	124	107	118	7	5	2	153
14	112	2.6	2.9	2.4	*3.4	2.5	2.1	125	114	123	12	9	2	143

* Perfect Scores

APPENDIX D

Modified Instructions for the Torrance Circle Test

Children, I have given you a page of circles and you are going to make things from the circles. Using the circles as a base you can make a wheel, tire, steering wheel, a jack-o-lantern (demonstrate) and many other things.

In ten minutes see how many objects you can draw which have a circle as the main part. Try to think of as many different and unusual ideas as you can. If you have any questions please raise your hand. Please do not say your answers so that the other children will hear you.

VITA

Donald James Dickinson

Candidate for the Degree of

Doctor of Education

Thesis: THE EFFECTS OF PRACTICE IN MAKING CLASSIFICATIONS ON ACHIEVEMENT AND INTELLIGENCE

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Biographical:

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