THE EFFECTS OF ROTE AND DISCOVERY TEACHING METHODS ON FIFTH, SEVENTH, AND NINTH GRADE STUDENTS OF A LOW AND MIDDLE SOCIO-ECONOMIC BACKGROUND

By

JOANNA MAY MARTIN

Bachelor of Science
Central Missouri State College
Warrensburg, Missouri
1960

Master of Science
Central Missouri State College
Warrensburg, Missouri
1967

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of the Oklahoma State University
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Thesis Approved:

Idella Lahmann
Thesis Adviser

Sue Hawkins

Robert L. Brown

Lawrence D. Rose

Arnold C. Base

D. Dunham
Dean of the Graduate College

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The alternatives of teaching by rote or teaching by discovery may be regarded as extensions or applications of two current theories of learning: the association theory and the phenomenological or "field" theory. The former theory emphasizes the learning of elicited and emitted responses by the processes of instrumental conditioning. In its simplified form instrumental conditioning may be illustrated by the pairing of two responses in time to two stimuli with the effect that the "new" stimulus, the conditioned stimulus, has the ability to elicit some of the responses that were the result of the application of the "old" stimulus, the unconditioned stimulus.

In its elemental form, under instrumental conditioning, the experimental animal learns the "tricks" of a problem, such as pushing a convenient button as a means to escape from a cage. The animal does not perceive the rationale of the mechanism that responds to the "trick." His main concern is to escape from the cage. Consequently, the principles of conditioning are illustrated by the rote learning of a child or an unsophisticated adult.

On the other hand, the phenomenological theory emphasizes that the learner himself is the most important factor in the perception of the learning-field. An application of this theory is illustrated by the learning-by-discovery method. The act of discovery is the result of

problem solving and can be an illustration of creative activity. It is a personal experience to the learner and is accomplished by the learner himself. Essentially it consists of the perception of certain relationships among data. (27)

The frequent vociferous arguments between the adherents of the two theories have left the impression that the two viewpoints are irreconcilable. The perceptual background of a person consists of a vast accumulation of data acquired by the conditioning processes plus what happens to these data by the continuous activity of the neural structure of the person. This activity is constantly organizing and reorganizing these data in terms of internal and external stimuli that affect the person.

At this juncture, the concept of meaning should be briefly mentioned. The person constructs his meanings from his experiences, however derived. To a non-German the sounds expressed by die Schnee mean nothing besides the sounds of long e and long a accompanied by sch and en sounds. The German has been conditioned to associate die Schnee with snow. Also, meaning can be "internally" developed by the process of generalization, discrimination, insight, cue-reduction, and many other mechanisms.

The term discovery may be defined in many ways. In some circles it has become a shibboleth for educational modernity. The term has even supplanted learning as illustrated by the expression of a yokel at a county fair who became involved in the shell game, "I discovered that the pea was never under the shell I picked out." Some teachers may regard discovery as stressing the "tricks" in learning, such as how to divide fractions, how to divide words into syllables, and so on.

According to Bruner (8), discovery is a matter of rearranging or transforming evidence in such a way that one is enabled to go beyond the evidence gained to new insights. This method assists the learner (a) to understand related material, (b) to be motivated by intrinsic rather than extrinsic reinforcements, (c) to learn a more efficient approach to the solution of problems, and (d) to improve the ability to reconstruct his past experiences in keeping with the requirements of the present situation. On the other hand, experimental findings do not unanimously support the efficacy of learning by discovery. Ausubel (3) concludes that "most of the reasonably well-controlled studies report negative findings." The lack of unanimity on the part of the researchers is due to the many uncontrolled factors, such as pupil-motivation, teacher bias, lack of clear differentiation between learning by rote or by discovery and the ambiguity of training situations, such as intermediate guidance as reported by Kittell. (34)

The achievement background and socio-economic status of the pupil appear to be important variables in determining whether or not rote or discovery learning should be employed. Achievement background could be a corollary of age, as it takes a certain amount of time to arrive at the criterion level of achievement. According to studies by Piaget (40), students in the concrete stage of development need the experience of manipulating the data in order to arrive at the generalizations that are necessary to perform the operations. When most students reach the stage of abstract thought it is no longer necessary for most of them to have actual contact with the material. It is often a waste of the students' time in this stage to use the discovery method.

Studies by Erickson (20), Almy (1), Carlson (15), Rose (44), and Stephenson (46) indicate that progress from one level of understanding to the next is considerably slower for children who come from a lower class background.

It becomes necessary for educators to be more aware of the many variables that both aid and retard the learning process. What effect, then, does the method of presentation have on varying grade level students with differing socio-economic backgrounds?

The Problem

The purpose of this study is to compare the effects of rote and discovery teaching methods for fifth, seventh, and ninth grade students of a low and middle socio-economic background status as measured by students' scores on the Lomarke Concept Test* designed to determine the competency in the transfer of learning.

Assumptions

The investigator made the following assumptions: (a) the responses of students to the Two-Factor Index of Social Position and The Home Index accurately reflect their socio-economic background status, (b) interaction between the groups involved in the study will have little or no effect on their reactions to the method of presentation, (c) randomization of subjects within each grade level and within each socio-economic background level to the method of presentation will control the influential variables of sex, motivation, anxiety, and achievement

*Lomarke, a term devised by the author, is a composition of syllables taken from names which are personally meaningful to her.

level, (d) The Lomarke Concept Test, an experimental instrument, will measure the concept development of one particular mathematic concept, and (e) the sex of the Method teachers will not influence scores on the Lomarke Concept Test.

Hypotheses

The hypotheses developed for investigation in this study are:

Hypothesis 1: There will be no significant difference between groups taught by the Rote method and those taught by the Discovery method as measured by scores on the Lomarke Concept Test.

Hypothesis 2: There will be no significant difference between students of a middle and low socio-economic background status as measured by scores on the Lomarke Concept Test.

Hypothesis 3: There will be no significant interaction effect between groups taught by the Rote and Discovery methods of presentation and students of a low and middle socio-economic background as measured by scores on the Lomarke Concept Test.

Hypothesis 4: There will be no significant difference among students of grades five, seven, and nine as measured by scores on the Lomarke Concept Test.

Hypothesis 5: There will be no significant interaction effect between groups taught by the Rote and Discovery methods of presentation and students of grades five, seven, and nine as measured by scores on the Lomarke Concept Test.

Definitions

Rote Method - Subject matter is presented to the students in detail. Teacher poses situation without allowing opportunity for the students to question the rationale behind the problem: Telling as a means of teaching. As applied in this study, each student is given a sheet of detailed directions explaining how to solve the problems. The student is given time to read over the list of directions and then the

Method teacher puts a problem on the board that can be solved using this list. No explanation is given and no questions answered concerning the reasoning behind the solution of the problems. Pupils were actually drilled in the memorization of the list of directions.

Discovery Method - Teacher presents a problem, children are given the opportunity to rearrange, explore, and present ideas in such a way that they are able to go beyond the evidence assembled to form solutions to the problems. As applied in this study, the Method teacher puts a problem on the board without any explanation other than it can be solved without the use of addition. Children are given the opportunity to ask questions, give opinions and suggestions as to the solution of the problem.

Home Index Scale - An index developed by Harrison G. Gough, Institute of Personality Assessment and Research, and Department of Psychology, University of California, Berkeley, California, for use in determining socio-economic status in grades 4-12.

Two-Factor Index of Social Position - An index developed by August B. Hollingshead for the purpose of measuring social position through the use of occupational and educational scales.

Lomarke Concept Test - An experimental instrument used to measure concept development. The concept involved finding the sum of a series of equally-spaced, consecutive numbers by the technique of multiplying the middle number in the series by the number of members in the series.

Low Socio-Economic Status - Those students who fell two points or more below the mean on The Home Index, received a Partial Score between forty-eight and seventy-seven (Classes IV and V) on the Two-Factor Index of Social Position and were rated by the regular classroom

teacher as having a low socio-economic background status. The students who met only part of the three criteria were excluded from the study.

Middle Socio-Economic Status - Those students who fell two points or more above the mean on The Home Index, received a Partial Score between eleven and thirty-one (Classes I and II) on the Two-Factor Index of Social Position and were rated by the regular classroom teacher as having a Middle Socio-Economic background status. The students who met only part of the three criteria were excluded from the study. (In this study no distinction is made between middle and high socio-economic background levels.)

Cooperating Teachers - The teachers at the junior high and the high school who assumed the responsibility for the students' mathematic instruction and the teachers at the two elementary schools who served as regular classroom instructors for all areas of the curriculum.

Method Teachers - The two teachers used in the presentation of the concept.

Limitations

Certain limitations are inherent in the study. These include: (a) the findings of this study were limited to the public schools of a community in central Oklahoma. More specifically, the findings were limited to the fifth, seventh, and ninth grade students of two elementary schools, a junior high and a high school in this community, (b) the study made use of only a single discovery technique in mathematic concept formation, (c) the Lomarke Concept Test is an experimental instrument designed for use in this study, (d) two different teachers worked with the groups as opposed to one teacher, and (e) the time

devoted to actual concept development involved only a five day period.

Significance

In recent years there have been numerous arguments concerning the effectiveness of the Rote and Discovery methods of presentation. Many research studies have been conducted in an effort to determine the more effective method, but the results have been inconclusive.

Piaget (40), through his work with both children and adults, has given evidence which indicates that there are certain levels of development through which individuals progress; and at each stage in this development, thinking patterns are altered enabling the individual to handle information in a more efficient and effective manner. For example, a child of seven or eight is usually unable to mentally manipulate material he cannot see or feel, whereas the child of twelve or more, in most cases, has reached a stage of development where it is possible to make abstractions. This individual no longer needs the actual experience with the material as he can mentally generalize from one situation to another. Children do not all make this developmental change at the same time. Evidence indicates that some never reach the abstract stage of thought. With the above evidence it becomes necessary for teachers to be aware of this developmental change in children and present material in a manner that is consistent with these developmental stages. Thus, grades five and nine were chosen, as they represent two different stages in the development of the child, while grade seven represents a transition stage from the concrete to the abstract.

Numerous evidence (15, 18, 35) support the theory that the socio-economic level of the family is an influential determinate in the total

development of the student. If this socio-economic background level is a determinant as the evidence indicates and children from a lower socio-economic background progress through the developmental stages at a slower rate than the middle socio-economic background individuals, the classroom teacher will need to adjust the method of instruction to meet individual learning styles.

It is hoped that through this study, which presents a concept by two different methods with students at different age and developmental levels and different socio-economic background status levels, it will be possible to determine a more effective method of presentation for a particular child at a particular age and socio-economic background level.

Summary

The need for further study in determining the more effective method of presentation (Rote or Discovery) for different socio-economic background levels and at different grade levels has been pointed out in Chapter I. It has been suggested that there are many variables in determining whether or not rote or discovery learning should be employed. Piaget states that the student in the concrete stage of development needs more experience with manipulation, whereas the student in the abstract stage no longer needs this actual contact. Achievement background and socio-economic status have been shown to have an effect on the level of understanding. Therefore, this study will deal with the following problem:

> The purpose of this study is to compare the effects of Rote and Discovery teaching methods for fifth, seventh, and ninth grade students of a Low and Middle Socio-economic background status as measured by students' scores on the

Lomarke Concept Test designed to determine the competency in the transfer of learning.

The reader will find in Chapter II the review of the literature. Chapter III includes the methodology of the study. The results of the statistical analysis are found in Chapter IV. Chapter V contains the conclusions, observations, and suggestions.

CHAPTER II

REVIEW OF SELECTED LITERATURE

The purpose of this chapter is to review the important literature associated with the concepts that guided the study.

During the past few years the discussion of the role of discovery in teaching has intensified. Some authors (17, 37) have stressed the educational benefits derived from this method in aiding students in the discovery of concepts for themselves. Kersh (32) stated that the benefit of learning by discovery comes from the fact that sometimes the learner may engage in greater amounts of practice in employing problem-solving strategies and in making applications than he would by some other teaching-learning process. Other authors (3) have stressed the fact that the discovery learning is often time consuming, wasteful, inefficient, and should not replace rote learning. Bruner (9) conceded, "One cannot wait forever for discovery. One cannot leave the curriculum and let discovery flourish willy-nilly wherever it may occur."

This review is presented under four subheadings entitled: Comparison of Teaching Method, Achievement and Grade Level, Socio-Economic Background Status, and Teacher Sex Influence.

Comparison of Teaching Method

This section of the review will discuss the studies conducted in the areas of "discovery" and "rote" in two segments. The first segment

will review studies done with students in high school and college situations, while the second will deal with those studies conducted with elementary level students.

On the secondary level, studies by Cummins (17) and Hendrix (26) seem to support Bruner's (8) arguments that learning by discovery is more effective than the mere presentation of fundamental facts and ideas. Bruner argues that one of the most important ingredients is the sense of excitement that is involved in the act of discovery. This discovery involves seeing relations between ideas that did not previously present themselves for the individual and as a result the person gains a sense of self-confidence. Cummins worked under the hypothesis that a student experience-discovery approach to calculus will yield better results than those taught by the deductive system. One group in the study was taught in an atmosphere rich in encouraging discovery, whereas the control group was taught more or less traditionally by men of long teaching experience. The subjects in Cummins' study that were in the experience-discovery approach group appeared to gain a deeper understanding of the calculus and this gain in understanding was not at the sacrifice of proficiency in manipulations and applications. Cummins concluded that on the basis of his experiment the students taught by the "discovery" approach had these advantages:

1. They do as well on problems and manipulative skills as those with traditional instruction but, in addition, they have increased understanding.

2. They possess a superior knowledge of the fundamental theory and logical relations among parts of the calculus.

3. They experience the thrill of discovery and the satisfaction of producing results through creative effort--all of which lead to greater enjoyment of mathematics and a deeper understanding of its nature and use.

4. They express ideas of the calculus in their own language and they undergo the stimulating and disciplinary experience of having their expressions and ideas sharpened through examination by other students as well as by the teacher. (17)

Hendrix (26) did a study in which she presented a mathematic generalization to three groups of high school students using three different methods. In Method I the generalization was stated first, then illustrated, and then applied to new problems. The Method II students were taught by the unverbalized awareness procedure. In the unverbalized awareness procedure the learning situation was set in such a way that as soon as the generalization dawned the learner began to apply it. The learner displayed in some unverbal way that understanding had been achieved. The students in Method III were asked to state the rule they discovered. Hendrix concluded from this study that the unverbalized awareness method in learning a generalization is more effective than a method in which an authoritative statement of the generalization came first. She also concluded that the kind of learning periods in which the desired generalizations emerged required a high degree of linguistic skill--skill to formulate good questions and to give clear directions.

Ray (42) concluded that the type of presentation showed no difference in mathematic achievement. Ray used 117 ninth grade boys in his randomly selected sampling. He found in his study on the relative effect of directed discovery in situations providing numerous problem solving opportunities that the directed and detailed, which was synonymous with the "tell and do" method, and directed discovery methods of teaching were equally effective with regard to initial learning of micrometer principles and skills. In this study "directed discovery"

called upon the students to be active in the pursuit of the generalizations. Ray also found no interaction of teaching method and intellectual level.

At the elementary level, Rogus (43) used eighth grade civics students from twenty-two elementary schools for his study. The two methods in this study involved an interrogative method which was an attempt to actively involve students by providing experiences in acquiring concepts and an expository method where the teacher played the role of an expositor of knowledge and students acted as recipients. At the end of the ten-week period he concluded that one method was as effective as another in fostering student achievement in civics.

In a study using sixth-grade students working in the area of arithmetic, Miller (37) found that significantly higher gains were made by subjects using a "discovery" approach over the control teaching approach. It also appeared from Miller's study that the lack of interactions between teaching approach and gain indicated that the "discovery" teaching approach was superior for pupils of high, average, and low ability-- rather than being a selective factor.

Wittrock (51), in his review and analysis of the literature, reported that the current state of research on discovery is very disappointing and precludes any important conclusions about teaching or learning.

The following studies will deal primarily with Rote Learning.

Studies on the secondary level that appear contradictory to those conducted by Cummins (17) and Hendrix (26) include those of Craig (16), Haselrud (24), Kersh (32), and Moss (38). In each of these instances students receiving more direction seemed to perform consistently better

than those of the groups using the "discovery" method.

The studies by Craig (16) and Haselrud (24) used college students in their research. In both cases two dichotomous methods of instruction were compared. Working under the hypothesis that principles derived by the learner solely from concrete instances will be more readily used in a new situation than those given to him in the form of a statement of principle and an instance were tested. In both studies, however, the subjects did significantly better on those problems with the rule given. Craig concluded that teachers should be liberal with information designed to assist learners in the discovery of concepts.

In Kersh's study (32) high school geometry students were used to compare the directed learning method and the guided discovery method. The data from this study suggested that under certain conditions of learning, highly formalized "lecture-drill" techniques produced better results than techniques which attempted to develop "understanding."

Moss's study investigated the relative effectiveness of two methods of verbal instruction on high school students. He used the direct-detailed method which stressed solving problems in a step-by-step fashion and the directed discovery approach which presented a minimum of information to the student. The results of the tests showed that the direct-detailed method group did perform consistently better than the directed discovery method group. He also concluded that there was no advantage in using either method for teaching particular intellectual levels.

At the elementary level, Kittell (34) worked with three groups of sixth-grade pupils who were supplied with different amounts of direction during the process of determining the solution of multiple-choice

verbal items. In this study intermediate direction meant that the students were given a verbal statement of the principle involved. The author concluded that furnishing the learner with information in the form of underlying principles will promote transfer and retention of learned principles and may provide a background enabling future discovery of new principles.

Another study with similar results was that conducted by TerKeurst (49) using fourth grade students. The hypothesis used by this author stated that school children in the middle elementary grades achieved better results in learning when the instruction emphasized rote learning rather than learning by discovery. The results of this study confirmed the hypothesis.

The investigator selected the reported studies as they all dealt with material presented using different methods of presentation and were representative of both the elementary and secondary levels. According to Piaget (40) students in the stage of abstract thought no longer need actual contact with material, for most students at this stage discovery learning is a waste of time. The reviewed studies at the secondary level tend to confirm this hypothesis. On the other hand, Piaget suggests that children in the concrete stage of development would benefit from the discovery method. From the studies reviewed, this need for discovery learning is evident but for the most part, the findings reported concerning rote and discovery learning are ambiguous and inconclusive.

Achievement and Grade Level

Many variables enter into the act of learning. One of the

variables considered in this study included that of achievement and grade level.

Piaget (40) has done much research with children in the area of cognitive development and these findings have two implications that are of importance in the area of Rote and Discovery learning:

1. The age of attainment indicates when a child may have an understanding of a concept.

2. The analysis of the development process indicates what material and procedures might be appropriate in aiding the child in concept formation.

Piaget's theory suggests that the development of knowledge passes through four main stages whose order is constant, but whose time of appearance may vary with the individual and the culture. Each of these stages represents a new coherence and a new structuring of elements which until that time had not been systematically related to each other. This theory also suggests that differences between age groups is chiefly a matter of the way they organize and systematize the experience they have.

Szabo (47) agreed with Piaget and also stated that there is evidence to support the fact that too-early verbalization of discovered generalizations with mathematically immature children can be damaging due mainly to lack of verbal facility.

Eaton (19) concluded from his study of high school students that students of more ability learn far more from lecture than from a discussion type approach. He continued to state that the effect of classroom discussions and activities on this above average ability student may tend to cause a retarding of progress and lead to negative attitudes toward learning. Eaton also stated that this type of student needs the freedom to move ahead unrestrained by the intellectual needs

of others. He concluded by stating that the most important factor would seem to be the mental age of the student. The students with average and low mental ages achieve much higher scores when taught through individual activities where the above average ability student learns more from the lecture method. These conclusions concurred with Ausubel's statement (3) that discovery learning is often time consuming and inefficient.

Erickson (20) did a study involving 269 sixth grade pupils concerning the relationship of socio-economic status background and arithmetic achievement. He concluded that although pupils of higher intelligence are more numerous in the higher socio-economic levels, children of like intelligence can be expected to achieve equally in arithmetic regardless of their socio-economic status.

A study by Almy (1) showed that progress from one level of understanding to the next was considerably slower for the children who came from the lower class background. This study also showed that differences between the middle and lower class groups may also be matters of cognitive style. The findings also indicate that increasing chronological age is associated with increased success in the conservation tasks which highlights the importance of the maturational factors and this also suggests that within whatever limits may be set by maturational factors, experience also contributes importantly.

Socio-Economic Background Status

Many studies have been done that indicate that there is a direct correlation between placement of the family in the socio-economic strata and the educational attainment of the child.

Baker (5) attempted to determine whether the academic achievement of pupils with "average" and "high" mental ability would differ significantly when socio-economic status was controlled. He concluded that the academic achievement of pupils with "average" and "high" mental ability did differ significantly on all achievement criteria even after adjustments through the analysis of covariance were made for individual differences in socio-economic status.

Carlson (15), in his review of the literature concerning the relationship of the child's achievement and his environment, attempted to point out these important aspects:

1. Home environment of the young child is particularly powerful and important.
2. Environment can act as a very powerful force in determining individual development.
3. The total environment can be broken down into specific dimensions.
4. These dimensions have relationships to certain behaviors that a child may exhibit.

Passy (39) observed in his study, using third grade children, that elementary mathematics instruction seemed to provide a bias against the child from a lower socio-economic environment. Passy used two approaches in the mathematics instruction. One group worked mainly with the textbook, while the other was based on the use of manipulative devices having structurally developed mathematical implications. He concluded that there were significant differences among the various levels of socio-economic status regardless of the program of instruction. He suggested that methods of instruction should be reappraised so that it will be possible to provide a mode of instruction for each child that will foster learning without a cultural bias.

In each of the studies by Davis (18), Rose (44), and Stephenson (46), the importance of the family in the development of the child was stressed.

Davis observed that the most powerful systems of status in our society are the family, age-groups, and sex-groups. The child learns from his own family the basic social and emotional pattern of response to status position and that this family life imprints deeply within the child.

Rose hypothesized that the social and cultural background of children is directly related to their success in arithmetic. Using third grade children from a high socio-economic suburban area and children from a middle-class area he concluded that there was a greater significance between children of a higher socio-economic status background and arithmetic performance.

Stephenson made the following observations:

1. There is a direct correlation between the economic placement of the family and the educational attainment of the child.

2. Each social stratum tends to develop a sub-culture characterized by relatively similar sets of attitudes, values, and behavior patterns which may be distinguished from those of other strata.

3. Child rearing practices differ significantly with socio-economic position as do the concepts of parenthood.

4. The child tends to associate informally with children in his own socio-economic level and membership in many groups also depend upon economic resources.

5. The type of adjustment the student makes profoundly affects the work he will do, the grades he receives and the length of time he will spend in school.

It was reported in James Coleman's study, Equal Educational Opportunity (36), that our schools can teach only children who come

from homes that provide certain prerequisites for learning. The school curriculum and instructional procedures seem to work when the children of the middle class come to school and when their attitudes and behavioral dispositions are in harmony with the school's patterns.

From the studies reviewed it can be concluded that the socio-economic background status of the students does have an effect on their achievement in school. If, as Carlson and Almy state, environment is an important determinant of intelligence and school achievement and progress from one level of understanding to the next is considerably slower for children of a lower class background, it becomes necessary to concern ourselves with providing methods of instruction that keep in mind the implications involved with different socio-economic levels.

Teacher Sex Influence

The teacher appears to be a significant variable that cannot be overlooked in any study. In this study it was necessary to use two teachers to present the material, thus causing a concern as to their effect on the achievement of the students.

A study by Veldman and Peck (50) investigated a possible sex bias in students' reactions, such as girls favoring men teachers over women teachers or vice versa. It was found in the over-all results that student evaluations of teaching behavior and teaching effectiveness were not severely biased by a preference of one sex over the other. In this same study there did seem to be a significant tendency for boys to want to be like male teachers and girls to want to be like female teachers, but according to the authors this was a healthy, sex appropriate reaction and did not appear to bias the students' perceptions of

the teaching qualities of their instructors.

Callender (14) conducted an exploratory study to determine whether any relationship existed between the preference of boy or girl students for men or women teachers at a junior and senior high school level. He concluded that girls displayed a preference for men instructors while boys, rather reluctantly in some cases, acknowledged favoring women in the classroom; however, many of the students, both boys and girls, stated that they liked their teachers "mixed" (both men and women).

In a study using ninth grade boys and girls from the Nokomis Junior High of Minneapolis, Leipold (35) found that the preference expressed for teachers related to characteristics or traits of teachers rather than to sex alone.

Summary

The literature appears to be ambiguous as to what method (Rote or Discovery) is more effective for students. These ambiguous results could be due to several factors including the age of the students, the socio-economic level of the groups involved, the size of the sample, and the type of concept being presented.

There is evidence to show that the age of attainment indicates when a child may have an understanding of a concept and by what method and materials this concept can be developed but that differences between socio-economic classes may influence this concept development.

The literature concerning socio-economic status and grade level is far more conclusive. It can be inferred that according to the studies reviewed, there is a direct correlation between the economic placement of the family and the educational attainment of the child.

The literature regarding Teacher Sex Influence appears to indicate that students do not prefer one sex over the other in the classroom situation. Callender (14) did find a relationship existing between the preference of boy or girl students for men or women teachers but that many stated they liked their teachers "mixed."

CHAPTER III

METHOD AND DESIGN

The purpose of this study is to compare the effects of Rote and Discovery teaching methods for fifth, seventh, and ninth grade students of a low and middle socio-economic background status as measured by students' scores on the Lomarke Concept Test designed to determine the competency in the transfer of learning. A solution to the problem is proposed in this chapter.

Subjects

The population for this study included students of the fifth, seventh, and ninth grade classes enrolled in the public schools of a middle-sized community of about 34,000 population in central Oklahoma. The fifth grade population was determined by randomly selecting three classes from the five fifth grade classes at two elementary schools (schools A and B). These schools were selected because they represented a cross section of the population with respect to socio-economic background. The results of this selection produced one fifth grade class at school A and two fifth grade classes from school B.

The seventh grade population was determined by randomly selecting three classes from the thirteen seventh grade mathematics classes at the junior high school (school C). Two of the three randomly selected classes were scheduled during the first hour period and the remaining

class was scheduled during the third hour period.

The ninth grade population was determined by randomly selecting three classes from the seven ninth grade mathematics classes at the high school (school D). The three classes selected were scheduled during first, third, and fifth hours of the school schedule.

The randomization was accomplished by placing the total number of mathematics classes at each grade level in separate containers and drawing out the number of desired classes from the total at each grade level. This drawing resulted in the above distribution of classes with the principals at the respective institutions present during the selection process.

Procedure

Selection of Socio-Economic Groups

The investigator administered the Home Index Scale and the Two-Factor Index of Social Position to the 241 students in the nine randomly selected fifth, seventh, and ninth grade classes. The cooperating teachers for these classes were asked to designate by writing next to each student's name, whether the students in their classes were, in their estimation, of a low or middle socio-economic background status.

After scoring the Home Index Scale, the total number of "Yes" responses were calculated and a local mean of 14.838 was determined. The number of "Yes" responses was determined by counting the boxes marked "Yes" on the first twenty items and adding extra points for Item 21 according to the scheme designed by the author that is described under Instruments, pages 32-33. Those students who fell two

points or more below the mean on the Home Index Scale were classified on this scale as having a low socio-economic background status, and those students who fell two points or more above the mean on the Home Index Scale were classified on this scale as having a middle socio-economic background status.

The Two-Factor Index of Social Position was then evaluated. Those students receiving a score between 48-77 (Classes IV and V) were designated for this study as having a low socio-economic background status, and those students receiving a score between 11-31 (Classes I and II) on the Two-Factor Index of Social Position Scale were classified for this study as being of a middle socio-economic background status.

Selection of subjects to be included in the low socio-economic background status group included those students who scored two points or more below the mean on the Home Index Scale, received a score between 48-77 (Classes IV and V) on the Two-Factor Index of Social Position and received a rating of "low" by the cooperating teacher.

Selection of subjects to be included in the middle socio-economic background status group included those students who scored two points or more above the mean on the Home Index Scale, received a score between 11-31 (Classes I and II) on the Two-Factor Index of Social Position and received a rating of "middle" by the cooperating teacher. (See Table I.) Any student who failed to meet all three criteria for inclusion in either socio-economic group was excluded from the study.

From the students in each grade level receiving the "low" rating, ten were randomly assigned to the Rote method and ten were randomly assigned to the Discovery method. From the students in each grade level receiving the "middle" rating, ten were randomly assigned to the

Rote method and ten were randomly assigned to the Discovery Method. (See Table II.) All 241 students in the nine classes were placed in either the Rote method or the Discovery method group and were taught by one of these methods for the duration of the study. The 120 students who actually participated in the study were not identified, thus controlling for the Hawthorne effect.

TABLE I

NUMBER OF STUDENTS IN EACH GRADE LEVEL RECEIVING THE SAME RATING ON THE TWO STANDARDIZED SOCIO-ECONOMIC EVALUATION AND THE TEACHER ESTIMATION

	Grades		
	5	7	9
Total Population	84	79	78
Same Standardized Instrument* Rating	45	50	43
Same Standardized Instrument Rating and Teacher Estimation	45	47	40

*Standardized Instruments - Home Index and Two-Factor Index of Social Position

TABLE II

DISTRIBUTION ACCORDING TO SCHOOLS OF THE POPULATION WITH RESPECT TO SOCIO-ECONOMIC BACKGROUND STATUS

Schools	Low Socio-Economic	Middle Socio-Economic
Grade 5		
A (Elementary)	11	0
B (Elementary)	9	20
Grade 7		
C^1 (First Hour)	2	11
C^2 (Second First Hour)	3	9
C^3 (Third Hour)	15	0
Grade 9		
D^1 (First Hour)	6	5
D^2 (Third Hour)	9	10
D^3 (Fifth Hour)	5	5

Intelligence Score Variable

For each one of the one hundred twenty students in the study an intelligence quotient was obtained from the permanent record files. (See Table III.) A California Test of Mental Maturity score was obtained for the 40 fifth grade students, 35 of the seventh grade students, and 31 of the ninth grade students. For the 14 students without a California Test of Mental Maturity score, the scores from the SRA, Lorge-Thorndike, and Otis were obtained and through conversion to standard scores were used as the covariables. The intercorrelations among these tests ranged from .60 to .79. It was assumed that the inclusion of these alien scores would not alter the covariable. It is reported in Buros (13) that the SRA (Science Research Associates) Intelligence tests have correlations with the California Test of Mental Maturity ranging from .66 to .79. Buros (12) reports that the Lorge-Thorndike Intelligence Tests were correlated with other tests of intelligence and with few exceptions the coefficients were .60 or higher.

TABLE III

MEAN INTELLIGENCE SCORES FOR THE THREE GRADE LEVELS ACCORDING TO SOCIO-ECONOMIC LEVEL

Grade Level	Low Socio-Economic Level	Middle Socio-Economic Level
5	95.950	120.800
7	95.200	120.300
9	106.450	117.550

Instructional Content

During the initial presentation period the students were questioned regarding their knowledge concerning the mathematic concept to be used in the study. All students who were familiar with the concept were excluded from the study.

The instructional content for the Rote method and Discovery method groups was identical, but the method of presentation differed. The differences in the two approaches were in the materials used and the method of building understanding.

The problem for all twelve groups in the nine classes was to learn the concept of finding the sum of a series of equally-spaced, consecutive numbers by the technique of multiplying the middle number in the series by the number of members in the series. For example, the sum of 19, 23, 27, 31, and 35 is 135. It can be calculated by multiplying 27 by 5. The initial presentation period for all groups was twenty minutes. During this initial twenty-minute period all students were assigned to either the Rote group or the Discovery group, and the Method teacher proceeded with the development of the concept according to the approach under which that Method teacher was working at the time. A ten-minute practice period was held each day for the four consecutive days directly following the initial presentation period. The Method teachers administered the Lomarke Concept Test during the final period. Since the two Method teachers would be presenting material in both the Rote and Discovery approaches, it was necessary to establish guidelines for the teaching of each method so they would be comparable.

The Rote method groups were taught to calculate the sum of the numbers with the use of a list of directions. The students were asked to memorize the five steps on the Direction Sheet:

1. Look to see if the numerals are consecutive and equally spaced
2. Find the middle numeral
3. Multiply the middle numeral by the number of numerals in the series
4. Add up all the numerals in the series
5. The two answers should be the same

No rationale was taught as to why the problem was effective. The mathematic concept examples used in the practice sessions included those the students made up to try on other classmates.

The Discovery method groups were given an example of a problem and asked to suggest possible reasons for its solution. Questions were elicited from the groups concerning its possible solution. All questions and suggestions were accepted and evaluated for their worth toward the solution of the problem. For example, the Method teacher would place the following series of numbers on the chalkboard: 88, 90, 92, 94, and 96, and explain to the students that one way of finding the sum of this series of numbers would be to simply add them up, but this often becomes a tiresome task. Tell the students that there is another way to find the answer to the problem and with the new way no addition is involved. After this short presentation, the students are invited to ask questions concerning the solution of the problem. Through these questions a generalization concerning its solution is arrived at and the students continue to work problems presented by their classmates.

Examples used in the practice sessions for both the Rote method groups and the Discovery method groups included those the students devised themselves. None of the examples used in the practice sessions

were included on the Lomarke Concept Test.

The two groups remained in the same room, with the Rote group working with a Method teacher in one area of the room and the Discovery group working in another area of the room with the other Method teacher. The same procedure was used in all nine rooms.

The two Method teachers involved in the study were both doctoral candidates in the College of Education at Oklahoma State University, Stillwater, Oklahoma. Both Method teachers had approximately the same number of hours of college work, years of teaching experience, and age. The two did, however, differ in sex.

To avoid bias as to a particular method of presentation, the two Method teachers were randomly assigned to method of presentation (Rote or Discovery) to be used for each group in the study. This randomization resulted in one Method teacher having six Discovery presentations and three Rote presentations and the other having six Rote presentations and three Discovery presentations. The probability of this occurrence is .2539 or approximately a one in four chance of such a selection. The formula was according to Seigel (45).

Instruments

Three instruments were used in this study. The instruments were the Home Index Scale, the Two-Factor Index of Social Position, and the Lomarke Concept Test.

The Home Index Scale

The Home Index Scale (Appendix A) was developed by Harrison Gough. This scale is used in determining socio-economic status in grades 4-12.

The form used has twenty-one items. The score on the Home Index was obtained by counting the number of "Yes" responses on the first twenty items and then adding extra points according to the following scheme for Item 21 which asks the following question: How many books does your family have? Zero through ninety-nine books received no points; one hundred through four hundred ninety-nine books received one point; and five-hundred or more books received two points. The total range of possible scores was from zero through twenty-two. The reliability of these twenty-one items was suggested by a test-retest correlation on a sample of fifty-five college students and was reported at .989. The coefficient calculated by the Kuder-Richardson method on a sample of two hundred fifty-two high school students was .74. The Home Index correlates with other socio-economic scales of a similar nature. (22) Written permission to use the Home Index Scale was obtained from Harrison Gough (Appendix B).

The Two-Factor Index of Social Position

August B. Hollingshead (28) has developed the Two-Factor Index of Social Position. He describes the index in the following manner:

> The Two-Factor Index of Social Position was developed to meet the need for an objective, easily applicable procedure to estimate the positions individuals occupy in the status structure of our society. Its development was dependent both upon detailed knowledge of the social structure, and procedures social scientists have used to delineate class position. . . .
>
> Occupation and Education are the two factors utilized to determine social position. Occupation is presumed to reflect the skill and power individuals possess as they perform the many maintenance functions in the society. Education is believed to reflect not only knowledge but also cultural taste. The proper combination of these factors by the use of statistical techniques enables a researcher to determine

> within approximate limits the social position an individual occupies in the status structure of our society. (28)

Both education and occupation are scaled. Education is scaled from 1 to 7 and weighted by 4. Occupation is scaled from 1 to 7 and weighted by 7.

The students were requested to list the occupation of the "head of the household" and to the best of their knowledge the number of years of education that that particular person had obtained. This information was not available in the permanent files of the selected students, so it was necessary to ask the students for the information. The above information was secured at the same time the Home Index was administered. The requested data were written on the Home Index Scale form. The Two-Factor Index of Social Position was scored by first referring to the Occupation and assigning the corresponding scale score. The scale score was then multiplied by the factor weight which was 7 for Occupation. This resulted in a partial score. The same procedure was used for the Educational Scale with the exception of the factor weight being 4. The partial scores for the Occupation and Education were summed and a total score was obtained. The total score was referred to the Range for the Two-Factor Index and a social class number was determined. Social class is delineated in the following manner:

Social Class	Range of Compiled Scores
I	11-17
II	18-31
III	32-47
IV	48-63
V	64-77

In his book, Social Class and Mental Illness, Hollingshead reported the intercorrelations between judged class position, ecological area of residence, education, and occupation of sample families in New Haven,

Connecticut in 1948:

A. Intercorrelations of Scale Variables

	Correlation
Education with residence	.451
Occupation with residence	.505
Occupation with education	.721

B. Criterion Predicted from One Variable

Judged class with residence	.692
Judged class with education	.782
Judged class with occupation	.881

C. Criterion Predicted from Two Variables

	Multiple Correlation
Judged class with residence and education	.870
Judged class with residence and occupation	.926
Judged class with education and occupation	.906

For a complete description on the Two-Factor Index of Social Position, see Appendix C.

The Lomarke Concept Test

The Lomarke Concept Test (Appendix D) is an experimental instrument used to measure concept development for one particular concept in the area of mathematics. The instrument consists of fifty problems similar to the ones used in the presentation period and the practice sessions. Fifteen of the problems are not "workable" as they represent series that are not consecutive and/or not equally spaced. Ten of the fifty problems are presented in a descending order of magnitude, although this characteristic was not presented in the prior sessions. This was done in an attempt to determine if an effective transfer of learning took place. The students were requested to read each problem and circle the correct response, and if the problem was not "workable" the letter "d" was circled. The score of the Lomarke Concept Test was obtained by counting the number of correct responses and assigning one

point to each of the correct answers. The total range of possible scores was from zero to fifty. Using the Spearman-Brown reliability coefficient technique, a coefficient of .974 was obtained between the odd and even numbered items on the Lomarke Concept Test (23). (See Appendix E.) Mathematics textbooks from the fifth, seventh, and ninth grades were reviewed to determine if the Lomarke Concept Test contained any material unfamiliar to the students. It was determined through this review that the Lomarke did not contain new material. The investigator also asked the cooperating teachers to look at the Lomarke Concept Test to check for new material. On this basis it was the judgement of the investigator that content validity was present.

Statistical Treatment

In order to test the hypotheses stated (Chapter I, page 5), two analyses of covariance designs were utilized. In both cases the intelligence quotient scores as obtained from the California Test of Mental Maturity, SRA, Otis, and Lorge-Thorndike tests were used as covariables. When statistically significant differences among groups were reported the Duncan Multiple-Range test was employed.

The analysis of covariance was selected as it statistically matches the students, affording the investigator the opportunity to study the performance of several groups which are unequal with regard to an important variable as though they were equal in this respect. One of the main advantages of analysis of covariance is that it reduces the size of the error term which is used as the denominator of the F ratio, thus increasing the size and the significance of the F values (31).

A 2 x 2 analysis of covariance design was employed to test the separate and interactive effects of methods of presentation and socio-economic status on the Lomarke Concept Test scores.

A 2 x 3 analysis of covariance design was employed to test the separate and interactive effects of method of presentation and grade level on the Lomarke Concept Test scores.

Since method of presentation was analyzed in both models, the more conservative estimate was utilized in the determination of the statistical decision. The more conservative estimate was used in order to prevent a Type II error, which in essence is accepting the null hypothesis when in fact it is false.

Summary

The purpose of this study was to compare the effects of Rote and Discovery teaching methods on fifth, seventh, and ninth grade students of a low and middle socio-economic background status.

The two hundred forty-one students in the three grade levels were administered the Home Index Scale, the Two-Factor Index of Social Position, and were rated by their cooperating teacher as being of either a low or middle socio-economic background status.

Of the students in each grade level who met all three criteria for "low class," ten were randomly assigned to the Rote group and ten were randomly assigned to the Discovery method group. Of the students in each grade level who met all three criteria for "middle" class, ten were randomly assigned to the Rote group and ten were randomly assigned to the Discovery method group. An intelligence quotient was obtained for the one hundred twenty students remaining in the study.

A mathematic concept was taught to the two groups by two methods of presentation (Rote and Discovery) for a period of one week. The initial presentation period was twenty minutes with a ten-minute practice session each day for 4 consecutive days. On the final day the Lomarke Concept Test was given to measure the level of concept development for one particular concept in mathematics.

Two analysis of covariance designs were employed to test the separate and interactive effects of method of presentation and socio-economic status on the Lomarke Concept Test scores and the separate and interactive effects of method of presentation and grade level on the Lomarke Concept Test scores. The Duncan Multiple-Range was employed when statistical differences among groups were determined.

CHAPTER IV

RESULTS OF THE STATISTICAL ANALYSIS

A concept involving the use of mathematics was presented by two methods of teaching (Rote and Discovery) to students in three grade levels (fifth, seventh, and ninth) and at two socio-economic background levels (low and middle) for a period of one week. Twenty students at each grade level receiving the low socio-economic background level rating and twenty students at each grade level receiving the middle socio-economic background level rating were used according to the criteria established. Of the students at each grade level receiving the low socio-economic background level rating, ten were randomly assigned to the Rote method and ten were randomly assigned to the Discovery method. Of the students at each grade level receiving the middle socio-economic background level rating, ten were randomly assigned to the Rote method and ten were randomly assigned to the Discovery method.

The Lomarke Concept Test was administered during the final period. The mean scores for each group were determined (Table IV).

The results of the statistical analysis are presented in this chapter. Each hypothesis is repeated and the result of the analysis of covariance follows it. The .05 level of confidence was used for each hypothesis.

TABLE IV

MEAN LOMARKE CONCEPT TEST SCORES FOR THE THREE GRADE LEVELS ACCORDING TO SOCIO-ECONOMIC LEVELS

Grade Level	Low Socio-Economic Level	Middle Socio-Economic Level
5	31.10	38.45
7	35.60	40.50
9	42.25	44.20

Hypothesis 1: There will be no significant difference between groups taught by the Rote Method and those taught by the Discovery Method as measured by scores on the Lomarke Concept Test.

The computed F ratio for Methods* was 0.34, a nonsignificant statistic (Table V). Therefore, the null hypothesis is accepted and it is concluded that in this study the method of presentation did not significantly affect the Lomarke Concept Test scores.

Hypothesis 2: There will be no significant difference between students of a middle and low socio-economic background status as measured by scores on the Lomarke Concept Test.

The computed F ratio for socio-economic background status groups was 0.68, a nonsignificant statistic (Table V). Therefore, the null hypothesis is accepted and it is concluded that in this study the socio-economic background status did not significantly affect the Lomarke Concept Test scores.

*It will be noted for statistical reasons Methods were computed twice (Chapter III, pages 36 and 37) with the more conservative F ratio being utilized.

TABLE V

ANALYSIS OF COVARIANCE OF LOMARKE CONCEPT TEST SCORES ON SUBJECTS OF TWO SOCIO-ECONOMIC LEVELS TAUGHT BY TWO METHODS OF PRESENTATION

Source	SS	DF	MS	F Ratio	P
Total	3724.25	118			
Methods	10.89	1	10.89	0.34	NS
Socio-Economic Status	21.59	1	21.59	0.68	NS
Methods x Socio-Economic Status	53.89	1	53.89	1.70	NS
Error	3637.86	115	31.63		

Hypothesis 3: There will be no significant interaction effect between groups taught by the Rote and Discovery methods of presentation and students of a low and middle socio-economic background as measured by scores on the Lomarke Concept Test.

The computed F ratio for interaction between method of presentation and socio-economic background was 1.70, a nonsignificant statistic (Table V). Therefore, it is concluded that in this study the interactive effect of socio-economic background status and method of presentation has no effect on the Lomarke Concept Test scores.

In Table V it was reported that neither of the main effects (methods and socio-economic status) was significant. That is, the means did not differ significantly from chance. Figure 1 is presented here as there does appear to be a tendency for the low socio-economic

groups to do better under the Discovery method and the middle socio-economic groups to perform better with the Rote method. This tendency is further supported by an F value of 1.70 which is significant between .10 and .05.

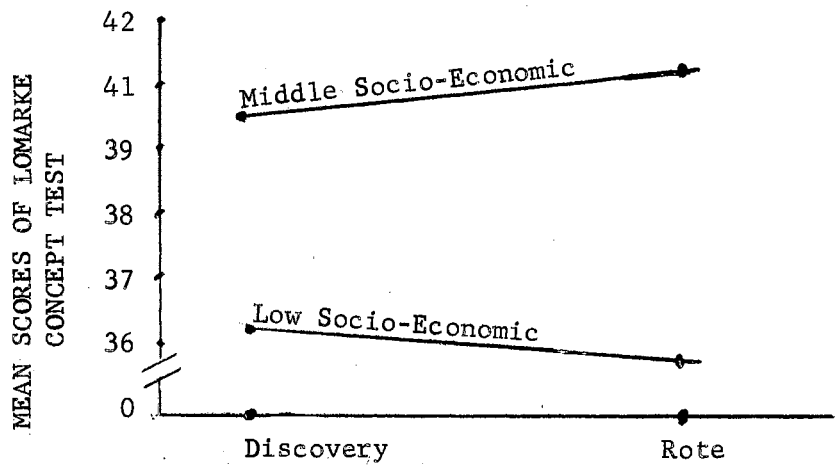

Figure 1. Effect of Method of Presentation and Socio-Economic Status on the Lomarke Concept Test Scores

Hypothesis 4: There will be no significant difference among students of grades five, seven, and nine as measured by scores on the Lomarke Concept Test.

For grade level, an F ratio of 25.32 was obtained ($p < .001$) (Table VI). Therefore, the null hypothesis is rejected and it is concluded that in this study there is a significant difference among grades five, seven, and nine as measured by Lomarke Concept Test scores.

TABLE VI

ANALYSIS OF COVARIANCE OF LOMARKE CONCEPT TEST SCORES ON SUBJECTS OF THREE GRADE LEVELS TAUGHT BY TWO METHODS OF PRESENTATION

Source	SS	DF	MS	F Ratio	P
Total	3686.51	118			
Methods	9.03	1	9.03	0.40	NS
Grade Level	1132.33	2	566.16	25.32	S
Methods x Grade Level	18.70	2	9.35	0.41	NS
Error	2526.44	113	22.35		

The test of Hypothesis Four indicated that a statistically significant difference among grades five, seven, and nine as measured by the Lomarke Concept Test was obtained. The Duncan Multiple Range test for nearly equal numbers was computed and it was determined through this statistical analysis that a significant difference existed between grades seven and nine and between grades five and nine but a nonsignificant difference existed between grades five and seven (Table VII).

> Hypothesis 5: There will be no significant interaction effect between groups taught by the Rote and Discovery methods of presentation and students of grades five, seven, and nine as measured by scores on the Lomarke Concept Test.

The computed F ratio for interaction between method of presentation and grade level was 0.41, a nonsignificant statistic (Table VI). Therefore, it is concluded that in this study, the interactive effect

of grade level and method of presentation had no effect on the Lomarke Concept Test scores.

TABLE VII

RANKED GROUP MEANS AND AREAS OF NONSIGNIFICANCE FOR THE LOMARKE CONCEPT TEST BASED ON DUNCAN MULTIPLE RANGE TEST

Group	II	I	III
Mean	107.75	108.37	112.00
	* ⟵	⟶	

*Lines indicate areas of nonsignificance.

Summary

Two analysis of covariance designs were utilized for analysis of the five hypotheses. In both analysis of covariance designs the intelligence quotient scores from the California Test of Mental Maturity, SRA, Otis, and Lorge-Thorndike tests were used as covariables.

The 2 x 2 analysis of covariance tested the separate and interactive effects of methods of presentation and socio-economic status on the Lomarke Concept Test scores. The results indicated nonsignificant statistics for both methods of presentation and socio-economic status and the interactive effects of both methods of presentation and socio-economic status.

A 2 x 3 analysis of covariance tested the separate and interactive effects of methods of presentation and grade level on the Lomarke Concept Test scores. The results indicated a nonsignificant statistic for methods of presentation and interactive effects of both method of presentation and grade level, but a significant statistic was found among grades five, seven, and nine. The Duncan Multiple-Range Test was employed to determine the areas of difference. Statistical analysis revealed a significant difference between grades five and nine and between grades seven and nine, but no significant difference between grades five and seven.

Methods of presentation were analyzed in both designs, and the more conservative estimate was utilized in an effort to prevent a Type II error.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Overview

The intent of this study was to compare the effects of two different teaching methods (Rote and Discovery) on fifth, seventh, and ninth grade students of a low and middle socio-economic background status for a period of one week. The effectiveness of one method over the other was measured by the Lomarke Concept Test, which was designed to determine the competency in the mastery and transfer of learning. The two teaching methods were designated as Rote and Discovery. The two methods were chosen as they appear to represent the polar extremes of two current teaching approaches.

The Rote method is similar in this study with learning through conditioning. Under this approach the student is given the problem material without the necessary rationale concerning its solution.

The Discovery method emphasizes that the learner himself is the important factor in the "perception field." The "discovery" is the result of problem solving. The learner becomes personally involved with the experience and through this personal involvement with the problem, certain relationships are perceived and "discovery" is made on the behalf of the learner.

The students involved in this study included 120 fifth, seventh, and ninth graders in a community in central Oklahoma. The students

in each grade level were classified, by the use of three devices, as being of either a low or middle socio-economic background status. The twenty students in each grade level that were designated as "low" class were randomly assigned to either the Rote or the Discovery group. Twenty students in each grade level that were designated as "middle" class were randomly assigned to either the Rote or the Discovery group.

The basic question in the study was, Is there a relationship between the age level of students, method of presentation and socio-economic background?

The 120 fifth, seventh, and ninth grade students were presented a mathematic concept by either the Rote or Discovery method for a period of one week. During the final day of the study the Lomarke Concept Test was administered.

Findings

Utilizing the .05 level of confidence, the results of testing the hypotheses yielded the following:

1. The difference between groups taught by the Rote method and those taught by the Discovery method as measured by scores on the Lomarke Concept Test was nonsignificant.

2. The difference between students of a middle and low socio-economic background status as measured by scores on the Lomarke Concept Test was nonsignificant.

3. The interaction effect between groups taught by the Rote and Discovery methods of presentation and students of a low and middle socio-economic background as measured by student scores on the Lomarke Concept Test was nonsignificant.

4. The difference among students of grades five, seven, and nine as measured by scores on the Lomarke Concept Test was significant. The Duncan Multiple Range Test was employed to determine the areas of difference among the grade levels. Statistical analysis revealed that a statistical difference existed between grades five and nine and between seven and nine but not between five and seven.

5. The interaction effect between groups taught by the Rote and Discovery methods of presentation and students of grades five, seven, and nine as measured by scores on the Lomarke Concept Test was nonsignificant.

Conclusions

The conclusions which can be drawn from this study should be considered in light of several factors. Included among these factors to be considered are: (a) The findings of this study were limited to the public schools of a community in central Oklahoma. More specifically, the findings were limited to the fifth, seventh, and ninth grade students of two elementary schools, a junior high and a high school in this community; (b) The study made use of only a single "discovery" technique in mathematic concept formation; (c) The Lomarke Concept Test is an experimental instrument designed for use in this study; (d) Two different teachers worked with the groups as opposed to one teacher; and (e) The time devoted to actual concept development involved only a five-day period.

The following conclusions may be drawn based on the findings:

The lack of a statistically significant difference between the Rote and Discovery methods of presentation appears to support the

belief of many educators, including Ausubel and Bruner who stress the importance of the above two teaching methods being concomitant learning rather than alternatives.

The statistically nonsignificant difference between middle and low socio-economic background status groups appeared when the covariable of intelligence adjusted the scores of the Lomarke Concept Test. There would appear, from this study, to be a correlation between the intelligence quotient and the socio-economic background status of the students.

From this study there did not appear to be any statistically significant interaction effect between method of presentation (Rote and Discovery) and socio-economic background (low and middle) as measured by scores on the Lomarke Concept Test. There did appear (Figure 1) to be a tendency for the low socio-economic groups to have a higher mean score on the Lomarke Concept Test when presented with the concept using the Discovery method, whereas the middle socio-economic group produced higher mean scores when the concept was presented by the Rote method. This tendency on the part of the two groups supports the hypothesis reported in the literature that students of a low socio-economic background need more direct and actual experiences with situations in order to develop concepts whereas middle socio-economic background students have the necessary experience and can develop the concepts without the direct contact. (14, 15)

The statistically significant results between grades five, seven, and nine as measured by student scores on the Lomarke Concept Test appear to indicate that due to age, the achievement level of students becomes greater as they progress from one grade level to the next. It could also be due to the students' experience with a concept similar to

the one presented although the students who professed knowledge of the concept were excluded from the study. Although this finding is not new, it does tend to reflect the construct validity of the instrument. After the Duncan Multiple-Range Test was employed, it was determined that a statistically nonsignificant difference existed between grades five and seven, while significant differences appeared between grades five and nine and seven and nine. The significant differences between grades five and nine and seven and nine tend to confirm the observation in the preceding paragraph which states that the achievement level of students becomes greater as they progress from one grade level to the next. The nonsignificant difference between grades five and seven could be due to a lack of a significant degree of achievement gain between these two grade levels and/or the lack of a significant change in learning styles. According to Piaget, seventh grade or 12- and 13-year-old students are in a transition period as they progress from the concrete to the abstract stage in their development.

The interaction effect between method of presentation (Rote and Discovery) and grade level (five, seven, and nine) as measured by scores on the Lomarke Concept Test did not produce any statistically significant results. It would appear from these results that since there is no significant interaction between these certain grade levels and methods of presentation that it then becomes necessary for teachers to be aware of the fact that there is no one best method of presenting material to all children at any one particular grade level.

Method Teachers' Observations

The following observations were made by the two Method teachers during the time of the study. It was felt these observations were worthy of mention and consideration because they indicate areas of concern; namely, ways in which teachers can enrich the curriculum and make learning more profitable for all children.

Seventh grade boys and girls, compared with fifth and ninth graders, appeared to do a large amount of reading during the times they were waiting for planned shifts in activity. This seems to further verify the findings in several research studies that indicate more reading is done in intermediate grades than at any other time in an individual's life.

The ninth graders, for the most part, appeared bored and docile during the experiment. The time required to learn the concept at grade nine may have been less than at the other grade levels, thus resulting in the docile, bored attitude. The same or better results may have been accomplished by maintaining the same time but doing it in one or two sessions.

The responses to the Lomarke Concept Test required the same time at all grade and socio-economic levels.

The lower socio-economic background groups appeared more enthusiastic about the project in general than the middle socio-economic students. This observation was made when many of the children involved in the study arrived at school early to share problems worked at home. They also talked more freely about sharing their work with friends and family.

Teacher's estimation of a child's socio-economic level appeared to correlate highly with the standardized test used in the study.

Less stress should be placed on grades and more emphasis on providing experiences for the student in which he will be able to succeed. This recommendation is a result of the students' continuous questioning about what grades they would receive from the Lomarke Concept Test.

Implications for Classroom Instruction

The following recommendations are made as a result of the study.

Teachers should become aware of the differences among children and teach for those differences. The need for individualization of instruction becomes a primary concern for all teachers. Results from the hypothesis concerning the best method of presentation indicates that, according to this study, there is no best method for instructing an entire group of students. It then becomes necessary for teachers to look at each student and find a best method for that particular individual.

On the basis of observations made by both Method teachers, it is suggested that teachers should be more aware of differences in age level groups with respect to the relationship between social environment and learning. For example, the low socio-economic group in the fifth grade displayed more enthusiastic responses to the small group activity because of the individual attention they received. It should also be pointed out that the groups least interested in any of the activities but more concerned about grades were the ninth graders. Thus, it seems logical to suggest that teachers should become more aware of the influence of social and physical environment on learning

activities.

Teacher training institutions should be more successful in training teachers to understand that despite the differences, such as socio-economic levels and intelligence in human beings, there is also a degree of commonality shared by all.

Recommendations for Further Research

Further research is needed which will produce statistically significant evidence as to effective methods of instruction individual students.

The writer makes the following suggestions for studies to stimulate further research studies:

A study to determine the logical thinking of different age groups and socio-economic levels.

Studies should be made using the same teacher to teach both methods of presentation in order to control the teacher variable.

A study conducted for an entire academic year involving the two methods of presentation used in the present investigation or variations of each method.

A study to determine the correlation between the California Test of Mental Maturity and the Home Index.

Studies to determine the correlation between teacher estimation of a student's socio-economic level and scores from standardized tests measuring socio-economic status.

A study to determine whether significance would be obtained if the concept presentations were lengthened.

A study to determine whether variables such as age of teacher, education of teacher, and number of years of experience relate to the method of presentation.

A study to determine the relationship between the achievement level of the student and the frequency with which his name is discussed in the teacher's lounge.

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APPENDIX A

THE HOME INDEX

Name_____ Date_____

Age_____ Sex_____ Education (year in school)_____

School_____
Name of school City

What is your father's occupation? _____

Directions: Mark your answer by putting an X in the proper box. For example, in the question, "Does your family have a car?" put an X in the box under YES if your family does have a car, and under NO if it does not. Be sure to answer all of the questions.

	YES	NO
1. Is there an electric or gas refrigerator in your home?	☐	☐
2. Is there a telephone in your house?	☐	☐
3. Do you have a bathtub in your home?	☐	☐
4. Is your home heated with a central system, such as by a furnace in the basement?	☐	☐
5. Does your family have a car?	☐	☐
6. Did your mother go to high school?	☐	☐
7. Did your mother go to a college or university?	☐	☐
8. Did your father go to high school?	☐	☐
9. Did your father go to a college or university?	☐	☐
10. Do you have a fireplace in your home?	☐	☐
11. Do you have a piano in your home?	☐	☐
12. Does your family have any servants, such as a cook or maid?	☐	☐
13. Does your family leave town every year for a vacation?	☐	☐
14. Does your mother belong to any clubs, or organization, such as study, art, or civic clubs?	☐	☐

		YES	NO
15.	Does your father belong to any civic, study, service, or political clubs, such as the Lions Club, Chamber of Commerce, etc.?	☐	☐
16.	Have you ever had private lessons in music, dancing, art, etc., outside of school?	☐	☐
17.	Do you have your own room at home?	☐	☐
18.	Does your family take a daily newspaper?	☐	☐
19.	Do you belong to any clubs where you have to pay dues?	☐	☐
20.	Does your family have a radio-phonograph combination?	☐	☐
21.	How many books does your family have?	_____	

UNIVERSITY OF CALIFORNIA, BERKELEY

INSTITUTE OF PERSONALITY ASSESSMENT AND RESEARCH
2240 Piedmont Avenue
Berkeley, California 94720

March 21, 1969

Miss Joanna Martin
Graduate Assistant
Department of Education
Oklahoma State University
Stillwater, Oklahoma 74074

Dear Miss Martin:

A copy of the Home Index is enclosed, along with a sheet of illustrative norms. If you want to use the Index, you may have my permission to reproduce copies. The easiest way would probably be to have a photocopy of the form made and printings extracted from the photo; the process we use is called Bruning Process, with the plate costing about $1.00 and then a cost per 100 reproductions of about $ 3.00. An attractive reproduction can thus be obtained at a cost not much more than mimeographing.

The Index has been used in some recent studies, including a doctoral dissertation at Connecticut by Stanley C. Speer, a study in Troy, New York, by Joseph Reppen, and papers in Educational and Psychological Measurement (1959, 19, 351-362) and the Journal of Applied Psychology (1960, 44, 172-174).

Sincerely,

/s/ Harrison Gough

Harrison Gough

HG:fc

Enclosures

APPENDIX C

THE TWO FACTOR INDEX OF SOCIAL POSITION

I. Introduction.

The Two Factor Index of Social Position was developed to meet the need for an objective, easily applicable procedure to estimate the positions individuals occupy in the status structure of our society. Its development was dependent both upon detailed knowledge of the social structure, and procedures social scientists have used to delineate class position. It is premised upon three assumptions: (1) the existence of a status structure in the society; (2) positions in this structure are determined mainly by a few commonly accepted symbolic characteristics, and (3) the characteristics symbolic of status may be scaled and combined by the use of statistical procedures so that a researcher can quickly, reliability, and meaningfully stratify the population under study.

Occupation and education are the two factors utilized to determine social position. Occupation is presumed to reflect the skill and power individuals possess as they perform the many maintenance functions in the society. Education is believed to reflect not only knowledge, but also cultural tastes. The proper combination of these factors by the use of statistical techniques enable a researcher to determine within approximate limits the social position an individual occupies in the status structure of our society.

II. The Scale Scores.

To determine the social position of an individual or of an household two items are essential: (1) the precise occupational role the head of the household performs in the economy; and (2) the amount of formal schooling he has received. Each of these factors are then scaled according to the following system of scores.

A. The Occupational Scale.

B. Higher Executives, Proprietors of Large Concerns, and Major Professionals.

a. Higher Executives

Bank Presidents; Vice Presidents
Judges (Superior Courts)
Large Business, e.g., Directors, Presidents, Vice-Presidents, Assistant Vice-Presidents, Executive Secretary, Treasurer
Military, Commissioned Officers, Major and above,
Officials of the Executive Branch of Government, Federal, State, Local, e.g., Mayor, City Manager, City Plan Director, Internal Revenue Directors,
Research Directors, Large Firms

b. Large Proprietors (Value over $100,000[1])

Brokers
Contractors
Dairy Owners
Lumber Dealers

c. Major Professionals

Accountants (C.P.A.)
Actuaries
Agronomists
Architects
Artists, Portrait
Astronomers
Auditors
Bacteriologists
Chemical Engineers
Chemists
Clergyman (Professionally Trained)
Dentists
Economists
Engineers (College Grad.)
Foresters
Geologists
Lawyers
Metallurgists
Physicians
Physicists, Research
Psychologists, Practicing
Symphony Conductor
Teachers, University, College
Veterinarians (Veterinary Surgeons)

2. Business Managers, Proprietors of Medium Sized Businesses, and Lesser Professionals.

a. Business Managers in Large Concerns

Advertising Directors
Branch Managers
Brokerage Salesmen
District Managers
Executive Assistants
Executive Managers, Govt. Officials minor, e.g., Internal Revenue Agents
Farm Managers
Office Managers
Personnel Managers
Police Chief, Sheriff
Postmaster
Production Managers
Sales Engineers
Sales Managers, National Concerns
Sales Managers (Over $100,000)

b. Proprietors of Medium Businesses (Value $35,000-$100,000)

Advertising Owners (-$100,000)
Clothing Store Owners (-$100,000)
Contractors (-$100,000)
Express Company Owners (-$100,000)
Fruits, Wholesale (-$100,000)
Furniture Business (-$100,000)
Jewelers (-$100,000)
Labor Relations Consultants
Manufacturer's Representatives
Poultry Business (-$100,000)
Purchasing Managers
Real Estate Brokers (-$100,000)
Rug Business (-$100,000)
Store Owners (-$100,000)
Theater Owners (-$100,000)

c. Lesser Professionals

Accountants (Not C.P.A.)
Chiropodists
Chiropractors
Correction Officers
Director of Community House
Engineers (Not College Grad.)
Finance Writers
Health Educators
Librarians
Military, Commissioned Officers, Lts., Captains
Musicians (Symphony Orchestra)
Nurses
Opticians
Pharmacists
Public Health Officers (M.P.H.)
Research Assistants, University (Full-time)
Social Workers
Teachers (Elementary and High)

3. Administrative Personnel, Small Independent Businesses, and Minor Professionals.

a. Administrative Personnel

Adjusters, Insurance
Advertising Agents
Chief Clerks
Section Heads, Federal, State, and Local Government Offices

Credit Managers
Insurance Agents
Managers, Department Stores
Passenger Agents--R.R.
Private Secretaries
Purchasing Agents
Sales Representatives
Section Heads, Large Businesses and Industries
Service Managers
Shop Managers
Store Managers (Chain)
Traffic Managers

b. Small Business Owners ($6,000-$35,000)

Art Gallery
Auto Accessories
Awnings
Bakery
Beauty Shop
Boatyard
Brokerage, Insurance
Car Dealers
Cattle Dealers
Cigarette Machines
Cleaning Shops
Clothing
Coal Businesses
Convalescent Homes
Decorating
Dog Supplies
Dry Goods
Electrical Contractors
Engraving Business
Feed
Finance Co., Local
Fire Extinguishers
5 & 10
Florist
Food Equipment
Food Products
Foundry
Funeral Directors
Furniture
Garage
Gas Station
Glassware
Grocery-General
Hotel Proprietors
Inst. of Music
Jewelry
Machinery Brokers
Manufacturing
Monuments
Package Store (Liquor)
Painting Contracting
Plumbing
Poultry Producers
Publicity & Public Relations
Real Estate
Records and Radios
Restaurant
Roofing Contractor
Shoe
Shoe Repairs
Signs
Tavern
Taxi Company
Tire Shop
Trucking
Trucks and Tractors
Upholstery
Wholesale Outlets
Window Shades

c. Semi-Professionals

Actors and Showmen
Army M/Sgt; Navy C.P.O.
Artists, Commercial
Appraisers (Estimators)
Clergymen (Not professionally trained)
Concern Managers
Deputy Sheriffs
Dispatchers, R. R. Train
I. B. M. Programmers
Morticians
Oral Hygienists
Photographers
Physio-therapists
Piano Teachers
Radio, T. V. Announcers
Reporters, Court
Reporters, Newspapers
Surveyors
Title Searchers

Interior Decorators
Interpreters, Court
Laboratory Assistants
Landscape Planners
Tool Designers
Travel Agents
Yard Masters, R. R.

d. Farmers

Farm Owners ($25,000-$35,000)

4. Clerical and Sales Workers, Technicians, and Owners of Little Businesses (Value under $6,000)

a. Clerical and Sales Workers

Bank Clerks and Tellers
Bill Collectors
Bookkeepers
Business Machine Operators Offices
Claims Examiners
Clerical or Stenographic
Conductors, R. R.
Employment Interviewers
Factory Storekeeper
Factory Supervisor
Post Office Clerks
Route Managers (Salesmen)
Sales Clerks
Shipping Clerks
Supervisors, Utilities, Factories
Toll Station Supervisors
Warehouse Clerks

b. Technicians

Camp Counselors
Dental Technicians
Draftsmen
Driving Teachers
Expeditor, Factory
Experimental Tester
Instructors, Telephone Co., Factory
Inspectors, Weights, Sanitary Inspectors, R. R., Factory
Investigators
Laboratory Technicians
Locomotive Engineers
Operators, P. B. X.
Proofreaders
Safety Supervisors
Supervisors of Maintenance
Technical Assistants
Telephone Co. Supervisors
Timekeepers
Tower Operators, R. R.
Truck Dispatchers
Window Trimmers (Store)

c. Owners of Little Businesses

Flower Shop ($3,000-$6,000)
Newsstand ($3,000-$6,000)
Tailor Shop ($3,000-$6,000)

d. Farmers

Owners ($10,000-$20,000)

5. Skilled Manual Employees.

Adjusters, Typewriter
Auto Body Repairers
Bakers
Barbers
Blacksmiths
Bookbinders
Boilermakers
Brakemen, R. R.
Brewers
Bulldozer Operators
Butchers
Cabinet Makers
Carpenters
Casters (Founders)
Cement Finishers
Cheese Makers
Chefs
Compositors
Diemakers
Diesel Engine Repair & Maintenance (Trained)
Diesel Shovel Operators
Electricians
Electrotypists
Engravers
Exterminators
Fitters, Gas, Steam
Firemen, City
Firemen, R. R.
Foremen, Construction, Dairy
Gardeners, Landscape (Trained)
Glassblowers
Glaziers
Gunsmiths
Gauge Makers
Hair Stylists
Heat Treaters
Horticulturists
Lineman, Utility
Linoleum Layers (Trained)
Linotype Operators
Lithographers
Locksmiths
Loom Fixers
Lumberjacks
Machinists (Trained)
Maintenance Foremen
Installers, Electrical Appliances
Masons
Masseurs
Mechanics (Trained)
Millwrights
Moulders (Trained)
Painters
Paperhangers
Patrolmen, R. R.
Pattern and Model Makers
Piano Builders
Piano Tuners
Plumbers
Policemen, City
Postmen
Printers
Radio, T. V., Maintenance
Repairmen, Home Appliances
Riggers
Rope Splicers
Sheetmetal Workers (Trained)
Shipsmiths
Shoe Repairmen (Trained)
Stationary Engineers (Licensed)
Stewards, Club
Switchmen, R. R.
Tailors (Trained)
Teletype Operators
Toolmakers
Track Supervisors, R. R.
Tractor-Trailer Trans.
Typographers
Upholsterers (Trained)
Watchmakers
Weavers
Welders
Yard Supervisors, R. R.

Small Farmers

Owners (under $10,000)
Tenants who own farm equipment

6. Machine Operators and Semi-Skilled Employees

Aides, Hospital
Apprentices, Electricians, Printers Steamfitters, Toolmakers
Assembly Line Workers
Bartenders
Bingo Tenders
Building Superintendents (Cust.)
Bus Drivers
Checkers
Clay Cutters
Coin Machine Fillers
Cooks, Short Order
Delivery Men
Dressmakers, Machine
Drill Press Operators
Duplicator Machine Operators
Elevator Operators
Enlisted Men, Military Services
Filers, Benders, Buffers
Foundry Workers
Garage and Gas Station Assistants
Greenhouse Workers
Guards, Doorkeepers, Watchmen
Hairdressers
Housekeepers
Meat Cutters and Packers
Meter Readers
Operators, Factory Machines
Oiler R. R.
Paper Rolling Machine Operators
Photostat Machine Operators
Practical Nurses
Pressers, Clothing
Pump Operators
Receivers and Checkers
Roofers
Set-up Men, Factories
Shapers
Signalmen, R. R.
Solderers, Factory
Sprayers, Paint
Steelworkers (Not Skilled)
Stranders, Wire Machines
Strippers, Rubber Factory
Taxi Drivers
Testers
Timers
Tire Moulders
Trainmen, R. R.
Truck Drivers, General
Waiters, Waitresses ("Better Places")
Weighers
Welders, Spot
Winders, Machine
Wiredrawers, Machine
Wine Bottlers
Wood Workers, Machine
Wrappers, Stores and Factories

Farmers

Smaller Tenants who own little equipment

7. Unskilled Employees.

Amusement Park Workers (Bowling Alleys, Pool Rooms)
Ash Removers
Attendants, Parking Lots
Cafeteria Workers
Car Cleaners, R. R.
Car Helpers, R. R.
Carriers, Coal
Countermen
Dairy Workers
Deck Hands
Domestics
Farm Helpers
Janitors, Sweepers
Laborers, Construction
Laborers, Unspecified
Laundry Workers
Messengers
Platform Men, R. R.
Peddlers
Porters
Roofer's Helpers
Shirt Folders
Shoe Shiners
Sorters, Rag and Salvage
Stagehands

Fishermen (Clam Diggers)
Freight Handlers
Garbage Collectors
Grave Diggers
Hod Carriers
Hog Killers
Hospital Workers, Unspecified
Hostlers, R. R.
Stevedores
Stock Handlers
Street Cleaners
Unskilled Factory Workers
Truckmen, R. R.
Waitresses--"Hash Houses"
Washers, Cars
Window Cleaners
Woodchoppers

Relief, Public, Private

Unemployed (No Occupation)

Farmers

Share Croppers

This scale is premised upon the assumption that occupations have different values attached to them by the members of our society. The hierarchy ranges from the low evaluation of unskilled physical labor toward the more prestigeful use of skill, through the creative talents of ideas, and the manipulation of men. The ranking of occupational functions implies that some men exercise control over the occupational pursuits of other men. Normally, a person who possesses highly trained skills has control over several people. This is exemplified in a highly developed form by an executive in a large business enterprise who may be responsible for decisions affecting thousands of employees.

B. The Educational Scale

The educational scale is premised upon the assumption that men and women who possess similar educations will tend to have similar tastes and similar attitudes, and they will also tend to exhibit similar behavior patterns. The educational scale is divided into seven positions: (1) Graduate Professional Training.

(Persons who complete a recognized professional course leading to a graduate degree are given scores of 1). (2) Standard College or University Graduation. (All individuals who complete a four-year college or university course leading to a recognized college degree are assigned the same scores. No differentiation is made between state universities, or private colleges.) (3) Partial College Training. (Individuals who complete at least one year but not a full college course are assigned this position. Most individuals in this category complete from one to three years of college.) (4) High School Graduates. (All secondary school graduates whether from a private preparatory school, a public high school, a trade school, or a parochial high school, are assigned the same scale value.) (5) Partial High School. (Individuals who complete the tenth or the eleventh grades, but do not complete high school are given this score.) (6) Junior High School. (Individuals who complete the seventh grade through the ninth grade are given this position.) (7) Less Than Seven Years of School. (Individuals who do not complete the seventh grade are given the same scores irrespective of the amount of education they receive.)

III. Integration of Two Factors

The factors of Occupation and Education are combined by weighing the individual scores obtained from the scale positions. The weights for each factor were determined by multiple correlation techniques.

The weight for each factor is:

Factor	Factor Weight
Occupation	7
Education	4

To calculate the Index of Social Position score for an individual the scale value for Occupation is multiplied by the factor weight for Occupation, and the scale value for Education is multiplied by the factor weight for Education. For example, John Smith is the manager of a chain supermarket. He completed high school and one year of business college. His Index of Social Position score is computed as follows:

Factor	Scale Score	Factor Weight	Score X Weight
Occupation	3	7	21
Education	3	4	12
	Index of Social Position Score		33

IV. Index of Social Position Scores.

The Two Factor Index of Social Position Scores may be arranged on a continuum, or divided into groups of scores. The range of scores on a continuum is from a low of 11 to a high of 77. For some purposes a researcher may desire to work with a continuum of scores. For other purposes he may desire to break the continuum into a hierarchy of score groups.

I have found the most meaningful breaks for the purpose of predicting the social class position of an individual or of a nuclear family is as follows:

Social Class	Range of Computed Scores
I	11-17
II	18-27
III	28-43
IV	44-60
V	61-77

When the Two Factor Index of Social Position is relied upon to determine class status, differences in individual scores within a specified range are ignored, and the scores within the range are treated as a unit. This procedure assumes there are meaningful differences between the score groups. Individuals and nuclear families with scores that fall into a given segment of the range of scores assigned to a particular class are presumed to belong to the class the Two Factor Index of Social Position score predicts for it.

The assumption of a meaningful correspondence between an estimated class position of individuals and their social behavior has been validated by the use of factor analysis.[2] The validation study demonstrated the existence of classes when mass communication data are used as criteria of social behavior.

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[1]The value of businesses is based upon the rating of financial strengh in Dun and Bradstreet's Manual.

[2]See August B. Hollingshead and Frederick C. Redlich, Social Class and Mental Illness, John Wiley and Sons, New York, 1958, pp. 398-407.

APPENDIX D

LOMARKE CONCEPT TEST

Directions

Below are fifty problems. Look them over carefully. If the problem can be solved, find the answer and circle the correct letter. If the problem cannot be solved circle letter "d".

1. 25 30 34 41 45 49 57
   a. 463
   b. 287
   c. 601
   d. cannot be solved

2. 98 96 94 92 90
   a. 470
   b. 520
   c. 601
   d. cannot be solved

3. 15 18 21
   a. 36
   b. 45
   c. 54
   d. cannot be solved

4. 98 99 101 102 103
   a. 550
   b. 505
   c. 496
   d. cannot be solved

5. 49 56 63
   a. 168
   b. 96
   c. 172
   d. cannot be solved

6. 81 72 63 54 45
   a. 305
   b. 295
   c. 315
   d. cannot be solved

7. 50 48 46 44 42 40 36
   a. 298
   b. 308
   c. 263
   d. cannot be solved

8. 5 - 13
   a. 72
   b. 81
   c. 63
   d. cannot be solved

9. 12 14 16 18 20
   a. 80
   b. 100
   c. 75
   d. cannot be solved

10. 88 77 65 57 44
    a. 320
    b. 325
    c. 405
    d. cannot be solved

11. 143 180 217 254 295
    a. 1085
    b. 1000
    c. 985
    d. cannot be solved

12. 1498 1501 1504
    a. 3935
    b. 4303
    c. 4503
    d. cannot be solved

13. 567 576 585 594 603
    a. 2925
    b. 3250
    c. 2875
    d. cannot be solved

14. 103 113 120
    a. 400
    b. 350
    c. 452
    d. cannot be solved

15. 1111 1114 1117 1120 1123
    a. 5450
    b. 5585
    c. 4985
    d. cannot be solved

16. 89 138 187 236 285 334 383
    a. 1552
    b. 1675
    c. 1652
    d. cannot be solved

17. 1001 - 1029
    a. 29,435
    b. 28,945
    c. 30,540
    d. cannot be solved

18. 54 59 62 66 69
    a. 295
    b. 325
    c. 310
    d. cannot be solved

19. 1 2 3 4 5
    a. 12
    b. 15
    c. 18
    d. cannot be solved

20. 456 459 461 463 465
    a. 2305
    b. 1560
    c. 2195
    d. cannot be solved

21. 99 97 95
    a. 193
    b. 271
    c. 291
    d. cannot be solved

22. 2565 2580 2595 2610 2625
    a. 12,975
    b. 13,725
    c. 11,295
    d. cannot be solved

23. 23 - 30
    a. 200
    b. 208
    c. 136
    d. cannot be solved

24. 45 60 75
    a. 170
    b. 180
    c. 190
    d. cannot be solved

25. 1000 1090 1180 1270 1360
    a. 6730
    b. 5450
    c. 5900
    d. cannot be solved

26. 100 90 80 79 78
    a. 400
    b. 300
    c. 285
    d. cannot be solved

27. 10,126 10,132 10,138 10,144 10,150
    a. 49,665
    b. 48,680
    c. 50,690
    d. cannot be solved

28. 89 76 63 50 37
    a. 315
    b. 335
    c. 295
    d. cannot be solved

29. 100 - 120
    a. 2130
    b. 2230
    c. 2310
    d. cannot be solved

30. 29 35 36 37
    a. 140
    b. 230
    c. 125
    d. cannot be solved

31. 48 46 44 41 40
    a. 220
    b. 305
    c. 140
    d. cannot be solved

32. 30 24 18 12 6
    a. 85
    b. 70
    c. 90
    d. cannot be solved

33. 121 113 105 98 91
    a. 525
    b. 500
    c. 475
    d. cannot be solved

34. 525 539 553 567 581
    a. 2565
    b. 2765
    c. 2665
    d. cannot be solved

35. 10 8 6 5 4 3 2
    a. 16
    b. 35
    c. 30
    d. cannot be solved

36. 10 20 30 40 50 60 70
    a. 145
    b. 370
    c. 280
    d. cannot be solved

37. 637 630 623
    a. 1890
    b. 1560
    c. 1670
    d. cannot be solved

38. 104 100 97 90 86
    a. 450
    b. 485
    c. 390
    d. cannot be solved

39. 39 44 49 54 59 64 69
    a. 378
    b. 350
    c. 434
    d. cannot be solved

40. 963 966 967 968
    a. 2834
    b. 3569
    c. 3840
    d. cannot be solved

41. 36 40 43 33 23
    a. 200
    b. 230
    c. 215
    d. cannot be solved

42. 89 101 113
    a. 341
    b. 303
    c. 293
    d. cannot be solved

43. 986 993 1000 1007 1014
    a. 5000
    b. 4950
    c. 5010
    d. cannot be solved

44. 433 448
    a. 931
    b. 741
    c. 881
    d. cannot be solved

45. 35 - 41
    a. 270
    b. 560
    c. 266
    d. cannot be solved

46. 403 411 419 427 435
    a. 1939
    b. 2095
    c. 6340
    d. cannot be solved

47. 500 601 702 803 904
    a. 3510
    b. 2560
    c. 3270
    d. cannot be solved

48. 3 - 6
    a. 15
    b. 40
    c. 12
    d. cannot be solved

49. 34 49 64 79 94
    a. 240
    b. 320
    c. 190
    d. cannot be solved

50. 49 59 69
    a. 149
    b. 165
    c. 177
    d. cannot be solved

APPENDIX E

DATA FOR SPEARMAN-BROWN RELIABILITY COEFFICIENT

Number	O	E	O^2	E^2	OE
Grade 5					
001	15	21	225	441	315
002	17	20	289	400	340
003	17	17	289	289	289
004	16	9	256	81	144
005	16	19	256	361	304
006	6	6	36	36	36
007	17	18	289	324	306
008	15	18	225	324	270
009	13	26	169	676	338
010	11	13	121	169	143
011	22	22	484	484	484
012	21	21	441	441	441
013	15	19	225	361	285
014	17	17	289	289	289
015	21	18	441	324	378
016	17	20	289	400	340
017	20	20	400	400	400
018	15	17	225	289	255
019	21	23	441	529	483
020	16	19	256	361	304
021	10	12	100	144	220
022	15	16	225	256	240
023	18	21	324	441	378
024	9	12	81	144	108
025	10	14	100	196	140
026	19	19	361	361	361
027	17	15	289	225	255
028	15	18	225	324	270
029	17	19	289	361	323
030	17	19	289	361	323
031	16	22	256	484	352
032	16	21	256	441	336
033	19	19	361	361	361
034	23	23	529	529	529
035	20	21	400	441	420
036	15	21	225	441	315
037	20	22	400	484	440
038	20	24	400	576	480
039	19	21	361	441	499
040	13	13	169	169	169

Number	O	E	O^2	E^2	OE
Grade 7					
041	18	20	324	400	360
042	23	25	529	625	575
043	20	24	400	576	480
044	16	19	256	361	306
045	18	16	324	256	288
046	17	21	289	441	357
047	15	15	225	225	225
048	17	24	289	576	408
049	8	4	64	16	32
050	17	16	289	324	272
051	24	24	576	576	576
052	23	22	484	529	506
053	20	23	400	529	460
054	22	23	484	529	506
055	17	19	289	361	323
056	21	24	441	576	504
057	19	20	361	400	380
058	16	21	256	441	336
059	21	21	441	441	441
060	19	23	361	529	437
061	17	18	289	324	306
062	15	16	225	256	240
063	20	23	400	529	460
064	17	23	289	529	391
065	15	16	225	256	240
066	9	15	81	225	135
067	17	19	289	361	323
068	20	23	400	529	460
069	19	18	361	324	342
070	19	20	361	400	380
071	21	23	441	529	483
072	17	19	289	361	323
073	16	18	256	324	288
074	19	18	361	324	342
075	22	22	484	484	484
076	17	20	289	400	340
077	18	20	324	400	360
078	16	19	256	361	304
079	19	21	361	441	499
080	22	21	484	441	462

Number	O	E	O^2	E^2	OE
Grade 9					
081	22	25	484	625	550
082	21	22	441	484	462
083	20	23	400	529	460
084	24	23	576	529	552
085	16	18	256	324	288
086	16	23	256	529	368
087	22	20	484	400	440
088	21	21	441	441	441
089	22	24	484	576	528
090	17	20	289	400	340
091	19	21	361	441	399
092	24	24	576	576	576
093	23	25	529	625	575
094	24	23	576	529	552
095	24	23	576	529	552
096	21	25	441	625	525
097	19	21	361	441	399
098	21	23	441	529	483
099	17	18	289	324	306
100	22	24	484	576	528
101	21	21	441	441	441
102	24	22	576	484	528
103	19	19	361	361	361
104	21	25	441	625	525
105	20	20	400	400	400
106	20	24	400	576	480
107	21	23	441	529	483
108	20	24	400	576	480
109	20	19	400	361	380
110	21	21	441	441	441
111	20	25	400	625	500
112	19	20	361	400	380
113	22	25	484	625	550
114	23	24	529	576	552
115	24	25	576	625	600
116	24	24	576	576	576
117	20	20	400	400	400
118	18	20	324	400	360
119	21	23	441	529	483
120	21	24	441	576	504

APPENDIX F

RAW DATA

GRADE 5

Number	School	I.Q.*	Lomarke
ROTE - Lower Socio-Economic Background Status			
001	A	74	36
002	A	90	37
003	A	86	34
004	A	103	25
005	B	113	35
006	B	62	12
007	B	108	35
008	B	102	33
009	B	112	39
010	A	90	24
		Σ 940	Σ 310
		M 94	M 31
ROTE - Middle Socio-Economic Background Status			
011	B	126	44
012	B	122	42
013	B	107	34
014	B	109	34
015	B	118	39
016	B	122	37
017	B	121	40
018	B	115	32
019	B	129	44
020	B	107	35
		Σ 1176	Σ 381
		M 117.6	M 38.10

Number	School	I.Q.	Lomarke
DISCOVERY - Lower Socio-Economic Background Status			
021	A	93	22
022	A	113	31
023	B	110	39
024	B	89	21
025	A	80	24
026	B	113	38
027	A	108	32
028	A	81	33
029	A	102	36
030	B	90	36
		Σ 979	Σ 312
		M 97.900	M 31.2
DISCOVERY - Middle Socio-Economic Background Status			
031	B	123	38
032	B	123	37
033	B	128	38
034	B	132	46
035	B	122	41
036	B	126	36
037	B	118	42
038	B	127	44
039	B	114	40
040	B	127	26
		Σ 1240	Σ 388
		M 124.0	M 38.8

RAW DATA

GRADE 7

Number	School	I.Q.	Lomarke
ROTE - Lower Socio-Economic Background Status			
041	C3	81	38
042	C1	123	48
043	C1	112	44
044	C3	92	35
045	C3	96	34
046	C3	90	38
047	C3	103	30
048	C3	117	41
049	C3	80	12
050	C3	54	33
		Σ948	Σ353
		M 94.8	M 35.3
ROTE - Middle Socio-Economic Background Status			
051	C2	134	48
052	C2	123	45
053	C2	110	43
054	C1	Otis 131	45
055	C1	118	36
056	C1	SRA 117	45
057	C1	SRA 110	39
058	C2	124	37
059	C2	113	42
060	C2	127	42
		Σ1207	Σ422
		M 120.7	M 42.2

Number	School	I.Q.	Lomarke
DISCOVERY - Lower Socio-Economic Background Status			
061	C2	101	35
062	C3	84	31
063	C3	SRA 95	43
064	C3	90	40
065	C3	88	31
066	C3	SRA 77	24
067	C2	117	36
068	C2	113	43
069	C3	101	37
070	C3	91	39
		Σ956	Σ359
		M 95.6	M 35.9
DISCOVERY - Middle Socio-Economic Background Status			
071	C1	121	44
072	C1	117	36
073	C1	129	34
074	C1	123	37
075	C2	119	44
076	C1	131	37
077	C1	108	38
078	C2	122	35
079	C2	106	41
080	C1	123	43
		Σ1199	Σ389
		M 119.9	M 38.9

GRADE 9

Number	School		I.Q.	Lomarke
ROTE - Lower Socio-Economic Background Status				
081	D2		121	47
082	D2		118	43
083	D1	SRA	119	43
084	D2		118	47
085	D1		84	34
086	D3		106	39
087	D2	SRA	101	42
088	D3		124	42
089	D3		117	46
090	D1		96	37
			Σ1104	Σ420
			M 110.4	M 42.0
ROTE - Middle Socio-Economic Background Status				
091	D1		100	41
092	D2	SRA	122	48
093	D2		124	48
094	D1		119	47
095	D2		118	47
096	D2		114	46
097	D3		104	40
098	D3		113	44
099	D3		98	35
100	D3	Thorndike	135	46
			Σ1147	Σ442
			M 114.7	M 44.2

Number	School		I.Q.	Lomarke
DISCOVERY - Lower Socio-Economic Background Status				
101	D2	SRA	107	42
102	D2		108	46
103	D1		97	38
104	D2		107	46
105	D1		105	40
106	D1		101	44
107	D2	SRA	102	44
108	D3		110	44
109	D3		95	39
110	D2	Otis	93	42
			Σ1025	Σ425
			M 102.5	M 42.5
DISCOVERY - Middle Socio-Economic Background Status				
111	D1		124	45
112	D2		111	39
113	D2		129	47
114	D1		115	47
115	D2		132	49
116	D2		116	48
117	D1	Otis	101	40
118	D2	Thorndike	125	36
119	D2		120	44
120	D3		131	45
			1204	442
			X̄ 120.4	X̄ 44.2

*The California Test of Mental Maturity score was used at all grade levels unless otherwise designated.

VITA

2

Joanna May Martin

Candidate for the Degree of

Doctor of Education

Thesis: THE EFFECTS OF ROTE AND DISCOVERY TEACHING METHODS ON FIFTH, SEVENTH, AND NINTH GRADE STUDENTS OF A LOW AND MIDDLE SOCIO-ECONOMIC BACKGROUND

Major Field: Elementary Education

Biographical:

Personal Data: Born in Kansas City, Missouri, August 8, 1938, the daughter of Frances L. and Paul H. Martin.

Education: Attended public school in Kansas City, Missouri; graduated from Central High School, Kansas City, Missouri in 1956; received the Bachelor of Science degree from Central Missouri State College, Warrensburg, Missouri, in 1960, with a major in elementary education; attended University of Kansas City, Kansas City, Missouri, University of Missouri at Kansas City, Kansas City, Missouri, University of California at Riverside, Riverside, California, Central Missouri State College, Warrensburg, Missouri; received the Master of Science degree from Central Missouri State College, Warrensburg, Missouri, in 1967, with a major in classroom teaching; completed the requirements for the Doctor of Education degree at Oklahoma State University, Stillwater, Oklahoma, in July, 1970.

Professional Experience: Elementary teacher at Englewood School, North Kansas City, Missouri, 1960-1962; elementary teacher at Central School, Banning, California, 1962-1963; elementary teacher at Maplewood School, North Kansas City, Missouri, 1963-1966; instructor at Central School, Central Missouri State College, Warrensburg, Missouri, 1966-1968; graduate teaching assistant, College of Education, Oklahoma State University, Stillwater, Oklahoma, 1968-1970.