# A STUDY OF THE SCIENCE ACHIEVEMENT OF EARTH SCIENCE CURRICULUM PROJECT STUDENTS FROM DIFFERENT SOCIOECONOMIC AREAS

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# CHAPTER I

# INTRODUCTION

## The Nature of the Problem

Today, earth science is replacing general science in science education at the junior high school level. Educators have always had the problem of adapting the curriculum to the needs of the children, and most of the experts in science education believe that science programs can be developed to produce a more scientific oriented student who is able to understand the problems of everyday living. At the present time, many new science curricula in the secondary schools endeavor to give the student a basic understanding of science.

The goals and objectives of the Earth Science Curriculum Project (ESCP) are based primarily on the inquiry approach with little consideration devoted to the environmental background of the student. Many of the students who enter a new curriculum may not understand the full meaning of the learning experiences that are involved. Some students may be frustrated because they cannot understand the material, and others may be bored because the material is not challenging. Deutsch (12) states that in an affluent society, lower socioeconomic children start to the goals of success with an assortment of disadvantages. The economic uncertainty and small value given to intellectual activity in their environment are not adequate foundations for achievement (12).

The Biological Science Curriculum Study (BSCS) program encountered similar difficulty early in its beginnings when it was found that some of the students were not understanding some of the BSCS materials (33). As a result, the Special Materials Committee of the BSCS program made a study of the students that were unsuccessful in BSCS (33). The committee recognized that environment was one probable factor which caused the BSCS students to make low achievement scores. In order to improve the situation, BSCS writing teams prepared sets of experimental materials designed for the unsuccessful students in biology. The new materials were based primarily on the BSCS approach.

The science achievement of ESCP students from different social backgrounds is a vital factor in the program's development. The curriculum must be planned to include a breadth of experiences and to develop a high degree of flexibility; it must also be able to adjust to a society of shifting occupations and employment opportunities (48). Despite some changes in the ESCP curriculum, there could be a significant difference in the achievement of ESCP students from different socioeconomic groups.

## Statement of the Problem

The effect of social class as an influencing factor on the science achievement of ninth grade ESCP students was not investigated when the ESCP curriculum was organized. The primary problem of this study was to determine whether or not the ESCP curriculum has class bias.

## Need for the Study

The junior high school science program has probably been the most

neglected area of science education; however, many new science curricula have been introduced to the junior high school in recent years. General science is now being replaced by the Earth Science Curriculum Project (ESCP), Secondary School Science Project (SSSP), and Introductory Physical Science (IPS). The most popular program is ESCP; it is used in over four hundred schools in the nation. Many of these schools have a cross culture of students from different socioeconomic backgrounds. The socioeconomic status of a family may well determine the achievement of the student in an ESCP course. The attitude of the student toward his school work may also be involved in his achievement; attitude may be the factor that contributes the most to achievement. Socioeconomic status probably determines a student's attitude; socioeconomic status may also determine the level of the intelligence of a student.

The growth of the ESCP program may require a study of the science achievement of ESCP students from different socioeconomic areas. ESCP has shown rapid progress in the last five years, creating a demand for trained and qualified earth science teachers (47). During the 1964-65 school year, there were approximately 50,000 students enrolled in the ESCP program. In 1968-69, the enrollment increased to approximately 250,000 students (58). The reason for the rapid increase has been attributed to a general dissatisfaction with general science.

The greatest increase in the ESCP enrollment has probably occurred in the large cities. Havighurst states that the largest increase in school enrollments occurs in the metropolitan areas (22). Many of these urban areas have a differentiation cross culture which the curriculum has to accommodate. The introduction of ESCP into this

situation requires investigation into its appropriate value for students from different socioeconomic areas.

Smith, Stanley, and Shores (48) point out that there is a need to eliminate class bias in the curriculum. The socioeconomic status of students from different environments may be a factor that influences their achievement in the ESCP program. If each social class generates a particular social outlook, then there will probably be different divisions of perspectives in the community. Since social class is primarily based on occupations, such as professional, clerical, skilled, and semiskilled, there can be significant relations to the educational attainment and social positions of individuals (48). Therefore, it is difficult for one curriculum to serve the needs of all social groups. Bruner (6) sheds some light on this situation by stating:

> The construction of curricula proceeds in a world where social, cultural, and political conditions continually alter the surroundings and the goals of schools and their students. We are concerned with curricula designs for Americans and their needs in a complex world. Americans are a changing people; their geographical mobility makes imperative some degree of uniformity among high schools and primary schools. Yet the diversity of American communities and of American life in general makes equally imperative some degree of variety in curricula.

If this is true, then the ESCP program may require a different approach to teaching science to students with different socioeconomic backgrounds. This study will indicate the need for such an approach.

This study attempted to hold ESCP students' prior science achievement, intelligence, and attitude constant in an attempt to determine their science achievement. The students were divided into three socioeconomic groups: upper, middle, and lower. This study proposes to aid in the knowledge of the ESCP program in order that it may be a more effective and viable program.

## Statement of the Hypotheses

The hypotheses to be tested in the null will be the following:

1. There is no significant difference in the mean performance on the STEP Science Achievement Test of three socioeconomic student groups which have been statistically equated with respect to intelligence, attitude, and prior performance.

2. There will be no significant relationship between the ESCP students' intelligence scores and their science achievement scores.

3. There will be no significant relationship between the ESCP students' science achievement and their attitude scaled scores.

## Definition of Terms

ESCP. The Earth Science Curriculum Project was designed primarily for ninth grade earth science students. It uses the observation and inquiry approach as a basis for teaching science. ESCP is primarily concerned with the knowledge of the earth and its environment.

ESCP Students. The students who were enrolled in the Earth Science Curriculum Project during the 1968-69 school year in Oklahoma City Public Schools.

STEP Science Achievement Test. Garrett (20) states that the purpose of the educational achievement test is to discover how much a pupil knows about the subject he is studying or has studied. The science achievement test that was administered to the ESCP students was the Sequential Tests of Educational Progress (STEP) Science Achievement Test. The pre-test was administered at the beginning of the 1968-69 school year; the post-test was administered at the end of the 1968-69 school year.

Intelligence. For most purposes, intelligence may be thought of as tests of general aptitude or scholastic aptitude related to achievement in school. The intelligence test that was used in this study was the Otis Quick Scoring Mental Ability Test. The purpose of this test is to measure mental ability as defined by thinking.

Attitude. Kerlinger (30) defined attitude as "a predisposition to think, feel, perceive, and behave toward a cognitive object." In order to measure the ESCP students' attitude toward science, Osgood's Semantic Differential was administered. In this study, the Semantic Differential attempted to measure the students' attitude toward science by using concepts that pertain primarily to science situations in the ESCP classroom.

Inquiry Method. A teaching method that promotes observation and experimentation in a problem solving situation.

Experiment. A trial to prove or disprove a principle or hypothesis.

Pre-test. The STEP Science Achievement Test was given to the ESCP students at the beginning of the school year. The pre-test was used as a control to enhance the validity of the experiment.

Post-test. The STEP Science Achievement Test was given to the ESCP students at the end of the school year. The post-test was the dependent variable in the study.

Upper Socioeconomic. The upper socioeconomic group is defined as the group of ESCP students whose parents' occupations are classified as nine or ten, according to the Socioeconomic Index for Occupations. The upper socioeconomic group consists primarily of professional and management occupations.

Middle Socioeconomic. The middle socioeconomic group is the group of ESCP students whose parents' occupations are classified as five, six, seven, or eight, according to the scale of the Socioeconomic Index for Occupations. This group is represented primarily by skilled labor.

Lower Socioeconomic. The lower socioeconomic group is the group of ESCP students whose parents' occupations are classified as one, two, three, or four, according to the scale of the Socioeconomic Index for Occupations. This group is represented primarily by semiskilled and unskilled labor.

NORC. NORC is the scale that has ranked occupations in the United States primarily by their prestige. Each occupation is assigned a certain score. The NORC scale was constructed by the National Occupational Research Center.

## Limitations of the Study

There were several factors involved in the study which may have influenced the outcomes.

1. A total of 377 students were tested at the beginning of the study. Due to the incomplete data and the relocation of students, some of the sample was incomplete. The total number of students who completed the study was 318.

2. Since the teachers were teaching in different areas in Oklahoma City, there were probably some differences in the climate of the classroom. There may have been teachers who were reluctant to demonstrate enthusiasm in the course.

3. The study was limited to the Oklahoma City Public Schools. There may be intervening variables in other communities that are not

evident in this study.

4. Although the socioeconomic groups have been separated according to Kahl's plan, some occupations may have been improperly classified in the study.

5. The STEP test may have class bias.

6. The population used for analysis was limited to only ninth grade ESCP students. There is no evidence to indicate that these students are typical of a larger population of ESCP students on a national basis.

## Assumptions of the Study

The following assumptions were made:

1. The instruments used in this study were valid in measuring achievement in order to correctly interpret the experimental data.

2. Intelligence and attitude can be identified and controlled for specific students.

3. The students in the ESCP program had an interest in science.

# CHAPTER II

## REVIEW OF THE LITERATURE

### The ESCP Program

The Earth Science Curriculum Project was established in 1958. The American Geological Institute appointed a committee to organize a six-week teaching resource development conference to prepare earth science materials for elementary and secondary schools. By 1962, the National Science Foundation adopted the program to teach a course in earth science. Under the direction of the American Geological Institute, the first textbook, Investigating the Earth, was prepared in 1964. The text was tested in seventy-seven schools in the United States. After the data was collected from the schools, Thurber (56) reported the following:

1. Sixty percent of the students thought that the mathematics in the text was not too difficult; however, the teachers thought that the mathematics was too advanced.

2. The reading level of the text was too advanced for ninth graders.

In 1965, the studies were evaluated, and the Institute prepared a revision of the text that would be more appropriate for ninth grade students. In 1967, the new edition of Investigating the Earth had lowered the reading level and had revised its approach to the mathematical problems. Eighty percent of the ESCP students questioned in the

study tended to recommend ESCP courses for other students, and seventy percent would have taken the course again if they had a choice (56). Eighty-five percent of the students in the study planned to go to college (56).

ESCP is primarily involved in a program which teaches astronomy, geology, meteorology, oceanography, and geography. When the American Geological Institute organized the ESCP program, it attempted to unify the programs around major themes. Marshall and Burkman (35) stated the following objectives of the program:

1. Science as inquiry. Experimentation and intuition are important in the earth sciences, but ultimately observation of nature is the true basis of all knowledge.

2. Universality of change. The earth is a dynamic planet in which nothing really endures.

3. Flow of energy. The universality of change in earth materials is caused by redistribution of energy.

4. Adaptation to environmental change. There is a goal of equilibrium between opposing forces in the environment.

5. Conservation of mass and energy. The changes in the earth tend to obey the laws of the physical universe.

6. Significance of components and their relationships in space and time. There should be consideration of physical and chemical nature and their relationships to time and space.

7. Uniformitarianism. The past can be interpreted if one understands the present.

8. Comprehension of scale. Earth scientists must think to scale in measurements.

9. Prediction. Prediction of events, processes, and relationships is a goal of most scientific inquiries.

10. Presentation. Presentation of principles and concepts should reflect the historical development of earth science.

Although ESCP is a course in earth science, it has been directly involved in chemistry, physics, and mathematics. The chemical and physical processes are used to understand the forces that affect the rocks and land masses, the oceans, the atmosphere, and the earth in space. Marshall and Burkman (35) were critical of organizing the ESCP subject matter by combining mathematics and physical science in the curriculum. They pointed out that the earth science course is offered at the ninth grade level and tends to precede any presentation of the physical sciences for the students. Marshall and Burkman (35) believe that the ESCP program should be interdisciplinary and emphasize more knowledge of physical science than of earth science. For example, little attention may be given to the principles of forces of mountain building when studying the forces that cause mountain building.

The ESCP program has made progress in the last five years. Schirner (44) has found that ESCP students tend to develop into significantly better critical thinkers than students in non-ESCP courses. His study indicated that the ESCP program tends to help students evaluate their material more closely than the traditional programs.

## Social Class Structure

Social stratification exists in almost every society. Kahl (28) pointed out that stratification is marked by inequality of differences among people that are evaluated as being high or low; however, social

class is differentiated as a large group of families that are approximately equal to each other and clearly differentiated from other families. There seems to be a tendency for people of different occupations to become similar to their fellows and distinct from the members of other types. This pattern has created a social class system in society.

There are two ways that social class is constructed. Kahl (28) points out that one way of constructing social class is by taking into consideration the basic elements of different styles of life which Weber and Marx observed. Another way social class is observed is by describing prestige groups as observed by the informants or peers of the population, which Warner (57) used in his study. Probably, the most widely used rating of social class is the prestige of the occupations by peer groups.

In 1947, the individual evaluations of the prestige status of occupations in America were evaluated by Cecil North and Paul Hatt (42). The study was based on the opinions of 2,920 people as a representative sample of the United States. The study was conducted by the National Opinion Research Center, and ninety occupations were rated in the study. The occupations were ranked in order of general standing or prestige. A recent study of the ranked occupations revealed that opinions of ranked occupations have not changed much in recent years (25).

From the previous studies that have been conducted on social structure, Kahl (28) pointed out three conclusions.

1. In American society today, there is a prestige hierarchy of both persons and occupations.

2. This hierarchy is not divided in the minds of Americans into discrete levels or strata.

3. There is more agreement about ranking than the criteria used in making ranking decisions.

Although there has been no agreement about the divisions between social classes, it has been convenient to make an arbitrary decision about approximate levels of stratification in our society. Warner (57) divided society into six groups according to prestige classes. They are the following:

1. Upper-upper class. This group is the old family elite, based on sufficient wealth to maintain a large house in the best neighborhood. They are professional men or proprietors of large businesses and industrial enterprises.

2. Lower-upper class. This group is slightly richer than the upper-upper class, but their money is newer and manners are not too polished. This group is also primarily business and professional men.

3. Upper-middle class. This group includes moderately successful business and professional men that are less affluent than the lower-upper class but have the education and polish necessary for membership.

4. Lower-middle class. This group includes the businessmen, school teachers, and foremen in industry.

5. Upper-lower class. The members of this class are primarily respectable laboring people.

6. Lower-lower class. The members of this group are either on relief or unskilled laboring people. They are usually vulnerable to police interference.

Since these are groups that have different values, income, and prestige, it can be a convenient way of separating the groups for distinctive studies. However, it must be realized that not all families

can be neatly placed in a niche in social levels.

Havighurst pointed out the existence of socioeconomic stratification in metropolitan areas. He placed occupations in four categories in his stratification scheme: professional and technical, sales and clerical, foremen and craftsmen, and service workers (22).

How does social class structure affect the student? Coleman (9) observed that sixty-nine percent of the lower working class sons had academic averages in the C and D+ range, while upper-middle class sons' averages were B- and C+. The academic achievement of upper-middle class children was one full grade above the grade of the lower-class children. Coleman concluded that the problem is related to rigidity of the curriculum according to social class.

Steinberg (53) concluded that much of our public school education is middle class in origin and that lower-class children may find the material has very little meaning for them. The main problem, according to Steinberg, is that middle-class teachers without special training do not understand lower-class students. As a result, the classrooms in which such attitudes exist are poor places for learning.

## Achievement and Social Background

It has been a well-known fact among teachers that unfavorable environment and socioeconomic conditions tend to hinder students in their academic achievement. Shaw (46) found significant relationships between socioeconomic status of children and their achievement scores. His study revealed that there was a more significant difference between socioeconomic status and achievement test scores than socioeconomic status and intelligence.

Coster (10) studied the successful completion of courses by 900 high school students from three income groups: high, medium, and low. Coster found that the high income pupils responded more favorably than middle and low income pupils with regard to successful completion of courses and continued education. His study revealed that students from low income families do not participate in as many school activities as high income pupils because of possible variation in social values.

Educational attainment and family background has been found to be a vital factor in the progress of students in school achievement. Fraser (19) investigated the home environment of 408 Aberdeen children by visiting their homes. School examination marks and intelligence were used as criteria of educational attainment. After a comparison was made between the environmental factor and achievement, Fraser found a significant relationship between the home environment and school attainment.

Parental attitudes have also been found to influence the academic achievement of students. Drews and Teaman (15) found that mothers of high achievers were more authoritarian and restrictive in the treatment of their children than mothers of low achievers. The parents of high achievers of gifted intelligence also seemed to have more punitive attitudes with respect to child-rearing (15).

Whenever social class is involved in students' achievement, it can be found that there is a positive correlation between social class and academic achievement. Swift (54) found that social class can be an influencing factor in the achievement of students. Swift's study showed that children of middle-class parents had six times as good a chance of making better scores on intelligence and achievement tests than children

from lower class backgrounds (54).

A study by Elder (16) revealed that the relationship between family structure and educational attainment depends heavily on educational opportunity and values. It was found that social class and size and region of birth reflect both educational opportunity and value attached to education; therefore, the effects on achievement are greater (16).

The student's environment can influence his science achievement. Carlson (8) made a study of environment of children and its relationship to their achievement in science. Carlson's study hypothesized that specific dimensions of environment are important in influencing the science achievement of students. They are the following:

1. Achievement press. This is the achievement motive which is exerted on the child by the parents.

2. Warmth and democracy. This is the acceptance, direction of criticism, affectionateness, rapport, and child-centeredness that exist in the home between the child and his family.

3. Language. The language models used in the home are a common form of communication of experience and knowledge.

4. Activities of the family. This involves the use of television, toys and games, use of books, and outings that the family may take.

5. Work methods. This includes the habits and methods that a person takes in solving problems.

Carlson (8) agreed that science achievement is positively affected by these five factors. He stated that breaking down the home environment into these five factors for evaluation may show that they affect the modern process and activity in the science curriculum.

The disadvantaged student's achievement is probably hindered the most. This is because his environment and social background are not conducive to learning. Lisonbee (34) pointed out some characteristics of disadvantaged students that may be the indication of why they do not achieve well in science. They are the following:

1. They are not understood by middle-class teachers.
2. They want to learn but resist the methods of ordinary education.
3. They do not read at or near their grade level.

Lisonbee (34) stated that the higher achievers tend to get an activity program in science, while the less articulate and able do not receive the type of activity in science that is needed to help them. He further stated that low achievers need the appropriate experiences in scientific inquiry provided in the laboratory (34). Lisonbee also noticed that there appeared to be a correlation between the socio-economic background and the quality of the science program. It was observed in the large city school systems, that the more deprived the school community, the lesser the quality of the science program. The possibility of poor science programs in deprived areas could indicate the reason for the low science achievement of the students.

## Intelligence and Social Background

Intelligence and its relationship to social background has been investigated under several studies. A positive correlation between family income and grade placement scores of students was found by Sexton (45) while investigating a large urban school system. Sexton's study revealed that high income families tend to have higher

intelligence scores than low income families.

Murray designed a study to investigate the mean difference between middle and lower class groups of Negro teenagers (37). Murray concluded that the mean intelligence quotient of the middle and upper-lower class group was significantly higher than the lower-lower socioeconomic group.

Anderson examined the relationship between scores on the Lorge-Thorndike Intelligence Test and the social class of fifth and seventh grade pupils (2). The results indicated that the Lorge-Thorndike test scores were related to the social class of the pupil's family. By using a t-test for the comparison of the two socioeconomic groups, it was found that higher social class status is associated with higher mean intelligence scores. However, Anderson indicates that his study did not take into consideration the student's motivation or opportunity for growth of intellectual potential.

Kagan and Freeman (27) conducted a study of the relationship between childhood intelligence and social class to behavior during adolescence. The study indicated that childhood intelligence scores were positively correlated with the educational level and maternal discipline, which predicted the degree of mastery of intellectual tasks during adolescence. Kagan and Freeman stated that the most reasonable interpretation of the association with social class is that parents who value intellectual mastery will reward academic competence and proficiency more than parents who do not value it.

Wiener, Rider, and Oppel (60) correlated the intelligence quotients of students three to five years of age and six to seven years of age with neurological status, socioeconomic background and emotional stability. It was concluded from the study that data regarding changing

intelligence scores appear to be related to social class background. The upper class childrearing practices were more favorable to increasing intelligence scores while lower social class background was associated with declining intelligence scores.

McGehee and Lewis (36) conducted a study of professional parents and unskilled parents and their relationship to superior children. It was found that professional parents produce two-and-one-half times their proportionate share of superior children, while unskilled labor produced only one-third of their quota.

It is evident from reviewing the research that there is a definite relationship between intelligence scores and social class. The intelligence scores of children from different socioeconomic groups can make an appropriate tool in statistics to predict academic and occupational performance. Most of the current intelligence tests may not give an accurate measurement of intelligence from different socioeconomic backgrounds; however, it can be used as a means of adjustment that could equalize the difference.

## The Influence of Social Background on Attitude

Probably, the most quoted definition of attitude comes from Allport (1). Allport defines attitude as "a mental and neural state of readiness organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related." Attitudes are learned and are difficult to distinguish from such attributes as likes, dislikes, opinions, values, and ideals.

Bruner recognized that students' motives as reflected in their

attitudes are an important factor in the learning of school children. Regarding the importance of attitudes in education, Bruner (6) states:

> There will always be, perhaps, mixed motives for learning among school children. There are parents and teachers to be pleased, one's contemporaries to be dealt with, one's sense of mastery to be developed. At the same time, interests are developing, the world opens up. What this amounts to is developing in the child an interest in what he is learning, and with it an appropriate set of attitudes and values about intellectual activity generally.

Wethington (59) designed a study to investigate the relationship between attitude toward English and the variables of intelligence and achievement of students from grade eight to twelve.

Wethington found the following:

1. Students' attitudes toward English change very little from grade eight through twelve.

2. The high school English teacher seems to have no significant effect on the attitude of pupils.

3. There was a positive relationship between attitude toward English and intelligence, English marks, general achievement, and English achievement of students.

In general, the study suggested that attitudes influence the student's achievement.

How does social class affect the student's attitude? Riessman (43) pointed out that the deprived student tends to think that he does not have a good chance of getting much education. He considers that much of the knowledge in school is not useful or pragmatic; therefore, he tends to acquire a negative attitude toward school.

Hill (24) designed an experimental study of upper and lower socio-economic students' attitudes. Hill found that the students' attitudes toward themselves seem to improve with chronological age. This appeared

to be more pronounced among upper socioeconomic groups than among lower socioeconomic groups. Hill stated that as the members of the upper socioeconomic group get older, they tend to feel more adequate than lower socioeconomic students.

Another study of attitudes based on social background was presented by Stauffer, Parsons, and Kluckholm (57). The study, as reported by Warner, revealed that students from upper socioeconomic backgrounds learned attitudes of cooperation better than students from lower socioeconomic backgrounds. As a result, the school performance of the upper socioeconomic students tended to be better. The lower socioeconomic students were taught in the home that education would not be the best for them, and as a result there was an indifference toward school in their attitude. Since attitudes are taught, Warner believes that the determining factor is the parents' attitude regarding educational and occupational success.

Floud (18) also recognized the interaction between environmental conditions and the attitudes of parents and children. Floud pointed out the possibility that environmental factors of students affect their achievement through the mediation of attitudes.

Bingham (3) found that the attitude of science students is an important factor to consider. Bingham stated that the attitude of the educationally deprived students in science should be taken into consideration when teaching science. His study revealed that unless some preferential treatment is given to the economically deprived underachievers, the students will become alienated from their teachers and their school.

## The Semantic Differential

The semantic differential is a method of observing and measuring the psychological meaning of things, usually concepts (30). Osgood (40) constructed the semantic differential in order to get a basic understanding of human behavior. The semantic differential uses concepts to show the extremeness of judgment of individuals. Extremeness is shown by scales, which are adjective pairs that are represented or related to the concept. By using this technique, the attitude of individuals can be predicted.

Kerlinger (30) states that the first step in constructing or selecting a semantic differential for research is to choose the concepts that are going to rate with the bipolar adjectives. A concept is a stimuli that an individual would evaluate, such as science, politics, or education. Each of the concepts has bipolar adjective pairs. The scales or bipolar adjectives can have seven or nine point rating scales which underly the nature of the concept. In other words, the semantic differential tests the relationship between the bipolar adjectives as it pertains to the concept. For instance, if an individual wanted to know the parents' attitude toward sex education, he could construct the following scale:

Sex Education

| | | |
|---|---|---|
| weak | . . . . . . | strong |
| pleasant | . . . . . . | unpleasant |
| slow | . . . . . . | fast |

According to Osgood, each adjective pair may be classified as either evaluative, potency, or activity (39). In order to measure

social attitudes, Osgood recommends that these three factors be present in each concept.

The semantic differential can be applied to a variety of research problems. Kerlinger (30) points out that it can be used to investigate either human values, emotions or attitudes. Since concepts are essential parts of the learning of attitudes, the semantic differential can be used as a generalized attitude measurement technique, provided that evaluative adjective pairs are used (30).

The reliability of the semantic differential has been evaluated by Tannenbaum (55) for the measure of attitude. According to the data collected, it was concluded that the attitude measurement of the semantic differential was high in reliability. The test-retest coefficients of six scales ranged from .87 to .93 with a mean r of .91.

The validity of the semantic differential displays reasonable face validity as a measure of attitude. Osgood reports several studies that indicate validity coefficients as high as .90 or better (40).

Several studies indicated that the semantic differential can be used to measure attitude. Statts and Statts (50) used the semantic differential to measure the attitudes of two groups of subjects. It was found that the conditioning of the students toward certain words tends to be effective in attaching positive and negative evaluative effect to the conditioned words.

Tannenbaum used the semantic differential to examine the amount of change of attitude of an audience (55). Friedman and Gladder found that the semantic differential significantly differentiated the behavior characteristics associated with certain roles (55). Snider used the semantic differential to study the attitudes of ninth grade students in

stereotyping characteristics of other groups of people (55). These studies indicated that the semantic differential has been used in recent research and appeared to be successful.

# CHAPTER III

# DESIGN AND METHODOLOGY

## Subjects

The study consisted of three hundred and seventy-seven ninth grade ESCP students. Due to incomplete information concerning intelligence, attitude, and achievement scores, fifty-nine of the ESCP students were dropped from the study. The remaining ESCP students who completed the study totaled three hundred and eighteen.

The ESCP students came from different socioeconomic areas of the Oklahoma City Public Schools. The students that were selected for the study were enrolled in Eisenhower, Hoover, Jefferson, Kennedy, Moon, and Roosevelt Junior High Schools.

The bases for selecting the students in this study were as follows:

1. The students were all participants in the ESCP program.
2. The students were all ninth grade junior high students.

Therefore, the author cannot claim that his samples met the criterion of an absolute random sample. However, by using the analysis of covariance of the random block design, the groups are held constant to provide an equivalent group design.

## Teachers

A total of six science teachers participated in the program and taught ESCP science to the ninth grade students. The teachers had

previous training in ESCP science and had at least three years of teaching experience. All of the six teachers had been trained in ESCP in-service or summer institutes at universities in the State of Oklahoma. The principals of the schools recommended the teachers according to their teaching experience and ability. All of the teachers agreed to take part in the experiment.

## Instruments

The Sequential Test of Educational Progress (STEP) Science Test for grades seven to nine was used to measure science achievement. The STEP Science Test presented sixty items in seventy minutes. The test was published in 1957, and is administered in two testing sessions, each consisting of thirty questions to be answered in thirty-five minutes. According to the STEP Manual (13), the test was designed to measure six skill categories. They are:

1. Ability to identify and define scientific problems
2. Ability to suggest or screen hypothesis
3. Ability to select valid procedures
4. Ability to interpret data and draw conclusions
5. Ability to evaluate critical claims or statements made by others
6. Ability to reason quantitatively and symbolically

Stecklein reviewed the STEP test for Buros' Sixth Mental Measurement Yearbook (51). Stecklein reported the following:

> The authors of STEP did not intend to imply that factual knowledge of a specific field was irrelevant but that the test would emphasize broad understandings and abilities to utilize learned skills in solving new problems rather than abilities to handle only the facts of lesson materials... The avowed purpose of the test was to measure the student's ability to apply his knowledge to solve problems.

The STEP Science Test was used as a pre-test and post-test because of the following reasons:

1. The items on the test covered most of the material in the ESCP program.

2. The time element provided the experimenter to test within a class period.

3. The test is widely used and accepted in schools in the United States.

The Otis Quick Scoring Mental Ability Test was used to measure the intelligence of the students in the study. The Gamma form of the test was administered because it included grades nine to fourteen. This intelligence test was chosen because of its popularity among high schools and its ease in administering and scoring.

Blosser (5) examined the Otis Quick Scoring Mental Ability Test, the Henmon-Nelson Test of Mental Ability, and the Differential Aptitude Test to see if they were effective devices in locating gifted and superior students in the ninth grade. Blosser concluded that none of the three tests showed definite superiority over the other two as a screening device. Therefore, the Otis test is as effective as the others in the measurement of intelligence.

The semantic differential was used to measure the student's attitude toward science. The concepts that were used attempted to measure the ESCP student's attitude toward school, science, learning earth science, reading earth science, earth science experiments, earth science teacher, and earth science classmates.

Each concept had nine adjective pairs which included three evaluative, three potency, and three activity scales. Each adjective pair

consisted of nine interval semantic spaces. The adjectives that were selected for the concepts were the scales that Osgood used in previous studies (40). The sums of the scales on each concept were used as scores to evaluate the student's attitude. The semantic differential was chosen in this study for the following reasons:

1. The semantic differential can measure attitude because of its close relationship with the evaluative factor.

2. The semantic differential has the capability of being appropriate for cross cultural research.

3. The semantic differential has successive intervals in its semantic space that can be measured.

4. The semantic differential has high validity and reliability and can be applied to a variety of research problems due to its flexibility.

## Population Decile Scale of Social Position

The ESCP students were grouped according to the highest occupation of either parent. Each occupation received a score according to the population decile scale. Those ESCP students whose fathers' occupations were scored nine to ten on the decile scale were placed in the upper socioeconomic group. The occupations with a decile score from five to eight were assigned to the middle socioeconomic group. The occupations with a decile score from one to four were assigned to the lower socioeconomic group. The division between the groups was an abritrary separation but was based on Kahl's separation of social classes (28). See Appendix C for a description of the occupations.

The rationale for separating the social classes according to

occupation in this study is the following:

1. The upper socioeconomic group is represented mostly by professional men and business executives. These are the occupations that Kahl describes as the upper-middle class.

2. The middle socioeconomic group is represented mostly by skilled workers. Kahl describes these occupations as being indicative of the lower-middle class.

3. The lower socioeconomic group is represented mostly by semi-skilled and unskilled workers. Kahl describes this group as upper and lower-lower class.

The social position that individuals hold in a population is a complicated study; however, Reiss pointed out three occupational scales that can be used for satisfying a population (42). One scale is the socioeconomic index which measures socioeconomic status according to income, education, and occupation. This scale was constructed by Duncan. Another useful scale is the NORC scale or prestige ratings by North and Hatt. This scale was developed by a national rating of occupations according to people's opinions. The occupations were scored and then ranked according to prestige.

Another ranking of occupations is the population decile score; it was used for this study because it is easier to understand and is more flexible. The population decile score is also less cumbersome to use because it ranks occupations from one to ten, instead of the one to ninety ranking of the socioeconomic index and the NORC scale. However, all three of these scales can be compared to be approximately the same in ranking occupations.

Reiss (42) pointed out that the socioeconomic index can be compared

to the NORC scale and the population decile scale. Concerning these scales, he wrote:

> Comments on the first draft of this study suggested that there might be a need for less detailed grading of occupations than that provided by the socioeconomic index. An investigator, of course, is at liberty to form class intervals of the index of any degree of courseness that he wishes. It would be particularly simple to use only the first digit of the index as a ten-point scale... Table B-1 [See Appendix A] records the distribution of the socioeconomic index in this population by means of decile scores. Thus, occupations scored "10" include the approximate 10 per cent of this population with the highest-ranking occupations.

## Statistical Treatment

The subjects of this study were classified into three groups for experimental treatment; they were presented as upper, middle, or lower socioeconomic groups. Analysis of differences among the three different groups were completed by one statistical procedure, the analysis of covariance. By using the analysis of covariance, the investigator can examine the science achievement of the three groups while controlling the initial differences with pre-achievement, intelligence, and attitude.

Kerlinger (30) explained this type of study as follows:

> The ex post facto character of such research is clear. The investigator starts with the dependent variable, school achievement and among the many possible influential independent variables he selects social class. Naturally he may pick other independent variables as well, variables such as intelligence and motivation, both of which are also related to school achievement and to social class. This makes no difference. It is not a matter of complexity; it is a matter of control.

After a significant difference was found by the analysis of covariance among the groups, the Duncan's Multiple Range Test was applied to

the three groups in order to find the significant differences between each group.

# CHAPTER IV

## ANALYSIS AND STATISTICAL TREATMENT OF THE DATA

### Introduction

This chapter will present the results of the statistical tests used to determine the significance of the data in the investigation. The .05 level of confidence was used to determine significance on all tests. The results of the science achievement of the three socioeconomic groups will be presented by implementing the analysis of covariance. The analysis of the statistical findings are followed by a summary.

### Analysis of Covariance, Randomized Block Design

The data for the six schools comprising the three socioeconomic groups were analyzed by the Oklahoma State University Computer Center. The calculations were performed on the IBM 360 Model 50 computer.

The analysis of covariance randomized block design was the statistical technique utilized to analyze the data. The computation procedures are similar to those presented in Popham (41) and Steel and Torrie (52). The program used in the computer to analyze the data was the Analysis of Covariance with Multiple Covariates. This program is designed to compute analysis of covariance information for one way analysis of variance variable with multiple covariates and unequal treatment group sizes. The F value is calculated for the adjusted

treatment means while removing the variation from error due to the initial difference in the three groups.

Popham (41) stated the following about the analysis of covariance:

> In brief, analysis of covariance may be used when a relationship is being studied between a dependent variable and two or more groups representing an independent variable. This powerful technique allows the researcher to statistically equate the independent variable groups with respect to one or more variables which are relevant to the dependent variable. To put it another way, analysis of covariance allows the researcher to study the performance of several groups which are unequal with regard to an important variable as though they were equal.

In the analysis the STEP Science Achievement Test, which was administered as a post-test, was used as the Y or dependent variable; and the pre-test science achievement, intelligence, and semantic differential were used as the $X_1$, $X_2$, and $X_3$ variables. The post-test was the dependent variable. The F value was calculated to test the hypothesis that there is no significant difference among the groups in the Y variable (post-test) after adjusting the X variables (pre-test, intelligence, and attitude).

In addition to reporting the summary data for the F test, the Duncan's Multiple Range Test was computed to aid in determining where the significance may be among the three socioeconomic groups (52). The test involves multiple comparisons to compare each treatment mean with every other treatment mean. The IBM 360 computer was also utilized in applying the Duncan's Multiple Range Test in order to identify the groups that were found to be significantly different.

In order to test the hypothesis of no relationship between the post-test and intelligence and between the post-test and attitude, the t-test and multiple correlation tests were implemented. These tests

provide a procedure for quantifying the nature of relationships between the variables.

## Testing the Hypotheses

Hypothesis 1. There is no significant difference in the mean performance on the STEP Science Achievement Test of three socioeconomic student groups which have been statistically equated with respect to intelligence, attitude, and prior performance.

The results of the computed sums of squares for the raw scores and the various crossproducts are presented in Table I. The variables considered to be relevant were the post-test in science achievement, pre-test in science achievement, intelligence, and attitude. The calculations of the crossproducts and raw score squares provide for the calculation of the adjusted total, between groups, and within groups sums of squares. These squares and products are for the entire sample and not for individual groups.

The variable means for each of the socioeconomic groups are reported in Table II. These scores indicate the means for the tests given to the groups without adjustment of the dependent variable. Without the convenience of the adjusted scores, the pre-test and post-test mean scores tend to show that all of the socioeconomic groups made some improvement during the ESCP course. The mean scores also indicate that the upper socioeconomic students have higher scores than middle and lower socioeconomic students. The middle group also has higher mean scores than the lower socioeconomic group.

These scores were controlled by using the analysis of covariance. By using the control variables the possibility of bias in the groups

TABLE I

SUMMARY OF SQUARED RAW SCORES AND CROSSPRODUCTS FOR THE ESCP STUDENTS

| Measure | Symbol | Total For Entire Sample |
|---|---|---|
| Post-test Science Achievement | $\Sigma Y$ | 39135.94 |
| Pre-test Science Achievement | $\Sigma X_1$ | 36711.56 |
| Intelligence | $\Sigma X_2$ | 48137.00 |
| Attitude | $\Sigma X_3$ | 1089520.00 |
| Crossproducts | $\Sigma X_1 Y$ | 32426.94 |
| | $\Sigma X_2 Y$ | 31860.00 |
| | $\Sigma X_3 Y$ | 24644.00 |
| | $\Sigma X_3 X_1$ | 29623.00 |
| | $\Sigma X_2 X_3$ | 17439.00 |
| | $\Sigma X_1 X_2$ | 31632.00 |

was removed. The dependent variable is the score measured by the STEP Science Achievement Test. The information shown in Table II indicates that the groups show some gain in their achievement. The mean I.Q. of the 318 ESCP students was 104.48; the mean attitude score was 380.25, and the mean of the pre-test in science achievement was 36.53.

TABLE II

VARIABLE MEANS FOR THE THREE SOCIOECONOMIC GROUPS OF ESCP STUDENTS

| Groups | n | Post-test Y | Pre-test $X_1$ | Intelligence $X_2$ | Attitude $X_3$ |
|---|---|---|---|---|---|
| Upper Socioeconomic Group | 127 | 45.69 | 43.28 | 112.66 | 386.09 |
| Middle Socioeconomic Group | 100 | 37.84 | 36.95 | 104.18 | 381.58 |
| Lower Socioeconomic Group | 91 | 31.14 | 28.88 | 96.62 | 373.09 |
| Total | 318 | 38.22 | 36.53 | 104.48 | 380.25 |

Table III shows the adjusted means of the three socioeconomic groups according to their science achievement scores after the analysis of covariance was implemented. An inspection indicates that the adjusted means favor the upper socioeconomic group. The middle and lower socioeconomic groups do not tend to show any significant differences.

For example, before the analysis of covariance was performed, the unadjusted or treatment means for the middle or lower socioeconomic groups tend to show a difference, but, after adjustment with the analysis of covariance, the groups do not appear to show any significant difference. The unadjusted means were not subjected to a test of significance as the adjusted means were.

TABLE III

ADJUSTED MEANS AND STANDARD ERRORS OF THE SOCIOECONOMIC GROUPS

| Groups | Treatment Mean | Adjusted Mean | Standard Error Adjusted Mean |
|---|---|---|---|
| Upper Socioeconomic Group | 45.69 | 40.20 | 0.54 |
| Middle Socioeconomic Group | 37.84 | 38.19 | 0.55 |
| Lower Socioeconomic Group | 31.14 | 38.42 | 0.65 |

The analysis indicates that the ESCP students in the upper socioeconomic group made greater increases in their science achievement than the other two socioeconomic groups after the means were adjusted. The unadjusted means also favor the upper socioeconomic group.

The analysis of covariance to test the null hypothesis is represented in Table IV. The residual sums of squares are obtained by

subtracting the within residual sum of squares from the total residual sum of squares. The mean squares are obtained by dividing the degrees of freedom into the sum of squares. The test shows significance among the socioeconomic groups after the regression equations have been calculated and the adjustments have been made in the deviation from the sums of squares. The null hypothesis, which states that there will be no significant difference among the three socioeconomic groups of ESCP students, is assumed to be untenable. The F value of 3.52 is significant at the .05 level of confidence; therefore, the null hypothesis can be rejected. This indicates that there is a significant difference among the socioeconomic groups according to their science achievement in the ESCP course.

Since the F value is significant, further testing is needed to find where the significance may be located.

TABLE IV

ANALYSIS OF COVARIANCE SIGNIFICANCE TEST AMONG THE THREE SOCIOECONOMIC GROUPS

| Source of Variation | Degrees of Freedom | Sum of Squares | Mean Square | F |
|---|---|---|---|---|
| Between | 2 | 215.19 | 107.59 | 3.52 |
| Within | 312 | 9542.61 | 30.59 | |
| Total | 314 | 9757.80 | | |

Table V presents the Duncan's Multiple Range Test. The results of the test indicate where the differences in the three groups are located. There is a significant difference between the upper and lower socioeconomic groups. A significant difference is also shown between the upper and middle socioeconomic groups. There was no significant difference between the middle and lower socioeconomic groups. In other words, Table V indicates the upper socioeconomic group obtained a significantly higher mean STEP science achievement post-test score than did the middle or lower socioeconomic groups.

TABLE V

DUNCAN'S MULTIPLE RANGE TEST FOR COMPARING THE GROUPS FOR SIGNIFICANCE

| Groups | Adjusted Means | Significance |
|---|---|---|
| Upper Socioeconomic Group | 40.20 | |
| and | | Yes |
| Lower Socioeconomic Group | 38.42 | |
| Upper Socioeconomic Group | 40.20 | |
| and | | Yes |
| Middle Socioeconomic Group | 38.19 | |
| Middle Socioeconomic Group | 38.19 | |
| and | | No |
| Lower Socioeconomic Group | 38.42 | |

In order to understand how the covariables influenced the students' achievement, a t-value was calculated in the analysis of covariance. The t-value reported in Table VI indicates the influence of the covariates upon the dependent variable (post-test in science achievement).

Using the .05 level of significance, the t-value for the pre-test indicates that prior science achievement had a direct effect on the post-test scores. The t-value reported for the pre-test was 15.35. The large t-value exceeds the .05 value and indicates a significant relationship between the pre-test and post-test when the analysis of covariance was implemented.

In addition to the t-value given, Table VII indicates a correlation of 0.86 between the pre-test and post-test. The high correlation indicates a high relationship between the post-test scores and the pre-test scores in science achievement.

Hypothesis 2. There will be no significant relationship between the ESCP students' intelligence scores and their science achievement scores.

Table VI shows that the t-value for the students' intelligence scores was 4.18. The t-value indicates that there was a relationship between the dependent variable (post-test) and the covariable of intelligence. The t-test shows that the intelligence scores had an influence on the students' science achievement. In addition, Table VII shows a correlation of 0.73 between the post-test in science achievement and the intelligence scores. This means that there is a strong relationship between the two variables. Therefore, the hypothesis can be rejected.

Hypothesis 3. There will be no significant relationship between the ESCP students' science achievement and their attitude scaled scores.

TABLE VI

A COMPARISON OF THE EFFECT OF THE CONTROL VARIABLES ON THE DEPENDENT VARIABLE BY USING T-VALUES

| Control Variables | Regression Coefficient | Standard Error of Estimate | T-Value |
|---|---|---|---|
| Pre-test | 0.70 | 0.05 | 15.35 |
| Intelligence | 0.17 | 0.04 | 4.18 |
| Attitude | 0.00 | 0.01 | 0.04 |

TABLE VII

INTERCORRELATIONS OF THE DEPENDENT VARIABLE WITH THE CONTROL VARIABLES

| Control Variables | Mean | Standard Deviation | Correlation Coefficient |
|---|---|---|---|
| Pre-test | 37.16 | 10.76 | 0.86 |
| Intelligence | 105.40 | 12.32 | 0.73 |
| Attitude | 380.95 | 58.64 | 0.12 |

The t-value given in Table VI for the student's attitude is 0.04. The very small t-value is not significant at the .05 level of confidence. The correlated value of attitude and post science achievement in Table VII indicates a low correlation between the two. The low r value of 0.12 indicates that attitude may not have affected the student's science achievement. Therefore, the hypothesis is tenable, and

TABLE VIII

SOCIOECONOMIC DISTRIBUTION OF ESCP STUDENTS AMONG THE SCHOOLS ACCORDING TO THE POPULATION DECILE SCALE

| School | Socioeconomic Rank 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Eisenhower | 0 | 8 | 0 | 11 | 4 | 2 | 8 | 9 | 13 | 19 | 74 |
| Hoover | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 3 | 22 | 38 | 66 |
| Jefferson | 0 | 2 | 0 | 5 | 1 | 4 | 10 | 14 | 11 | 7 | 54 |
| Kennedy | 1 | 3 | 1 | 2 | 0 | 5 | 0 | 2 | 0 | 0 | 14 |
| Moon | 7 | 24 | 0 | 4 | 1 | 1 | 0 | 2 | 1 | 0 | 40 |
| Roosevelt | 0 | 8 | 0 | 14 | 3 | 8 | 9 | 12 | 11 | 5 | 70 |
| Total | 8 | 45 | 1 | 37 | 9 | 21 | 28 | 42 | 58 | 69 | 318 |

it can be stated that there is no significant relationship between the ESCP students' science achievement scores and their attitude scores.

Tables VIII and IX express the socioeconomic distribution among the schools used in the study. The socioeconomic scales were taken from the population decile scores that Reiss reported (42). Eisenhower and Roosevelt appear to have the most diverse distribution of social groups. Hoover seems to have students from upper socioeconomic families. Moon shows a large group of students from lower socioeconomic families. The tables also identify the sample of ESCP students tested in the study.

TABLE IX

SOCIOECONOMIC DISTRIBUTION OF ESCP STUDENTS AMONG THE SCHOOLS ACCORDING TO THE SOCIOECONOMIC GROUPS

| School | Lower Socioeconomic Group | Middle Socioeconomic Group | Upper Socioeconomic Group | Total |
|---|---|---|---|---|
| Eisenhower | 19 | 23 | 32 | 74 |
| Hoover | 1 | 5 | 60 | 66 |
| Jefferson | 7 | 29 | 18 | 54 |
| Kennedy | 7 | 7 | 0 | 14 |
| Moon | 35 | 4 | 1 | 40 |
| Roosevelt | 22 | 32 | 16 | 70 |
| Total | 91 | 100 | 127 | 318 |

## Summary

The findings of this study show a difference in the socioeconomic groups in science achievement. The general findings of the analysis of covariance demonstrated there is a significant difference among the three socioeconomic groups of ESCP students. The null hypothesis of no significant difference among the three socioeconomic groups was rejected. The Duncan's Multiple Range Test revealed that significant differences among the three groups were located between the upper and the middle socioeconomic groups and the upper and lower socioeconomic groups. No significant difference in science achievement was found between the lower and middle socioeconomic groups.

Upon examining the relationship of the variables of intelligence and post science achievement, it was discovered that there was a significant relationship between the two variables. The null hypothesis of no significant relationship between intelligence and post science achievement of the ESCP students was rejected.

Finally, it was found that the students' attitude and post science achievement scores showed no significant relationship between the two variables. The null hypothesis of no significant relationship existing between attitude and post science achievement was accepted.

# CHAPTER V

## RESULTS, CONCLUSIONS AND RECOMMENDATIONS

### Summary of the Study

The purpose of this study was to compare the science achievement of ESCP students from different socioeconomic areas. The three socioeconomic groups of ESCP students were classified according to their fathers' occupation. The control variables equated the three socioeconomic group to be tested.

According to the studies conducted by Hollingshead, the experiences in the family and neighborhood mold children into similar social types because their learning in both areas tend to be strongly associated with class (26). For Anderson (2), the intelligence of a student was related to the social class of the student's family. Bruner (6) and Bingham (3) pointed out the importance of attitudes in intellectual activity among different children. These factors appear to play an important role in the student's achievement.

The objective was to determine if there were any significant changes among the three socioeconomic groups in their science achievement, when the pre-test science achievement, intelligence, and attitude were statistically controlled. The secondary objective was to determine if there were any significant relationships between each of the covariables to the dependent variable. The .05 level of confidence was used on all the tests in the study.

## Results

On the basis of this study and within the specified limitations, the following results were found.

1. The upper and lower socioeconomic groups of ESCP students showed improvement in their initial science achievement during the school year. However, the test of significance obtained from the analysis of covariance yielded an F value which was large enough to be significant to reject the null hypothesis of no difference among the three socioeconomic groups. The Duncan's Multiple Range Test revealed a significant difference between the upper and lower socioeconomic groups in science achievement. It appears that the students in the upper socioeconomic group can achieve better in the ESCP curriculum than the students in the lower socioeconomic group.

2. Both the upper and middle socioeconomic groups of ESCP students showed an increase in their initial science achievement during the school year. However, by implementing the analysis of covariance and the Duncan Multiple Range Test, a significant difference was observed between the upper and middle socioeconomic groups in science achievement. Therefore, the upper socioeconomic group of ESCP students appears to show more significant achievement in science than the middle socioeconomic students.

3. The middle and lower socioeconomic groups showed no significant difference between their adjusted mean scores. Therefore, it can be assumed that there is no significant difference in the gains in science achievement between the two ESCP groups when the analysis of covariance is implemented.

4. The t-test and multiple correlation test indicated that intelligence was an influencing variable on the ESCP students' science achievement. The null hypothesis of no significant relationship between the variables of intelligence and science achievement was rejected. Therefore, it was assumed that intelligence could have an effect on the students' science achievement.

5. According to the t-test and the multiple correlation test, the variables of attitude and science achievement showed no significant relationship. The null hypothesis of no significant difference was accepted as tenable. It was assumed that the attitude of the ESCP students toward science was not an influencing factor on their science achievement in this study.

## Conclusions

Before any conclusions can be stated in this study, it should be understood that the socioeconomic groups should not be construed to be a definite demarkation between the occupations of different people. However, the selection of the socioeconomic groups were made according to previous studies conducted on social groups.

There are three conclusions that may be suggested from this investigation.

1. From the results presented in the statisitcs, it can be stated that there is a need for more appropriate curricula and materials for lower socioeconomic ESCP students. It should be recognized that the lower socioeconomic communities are a large and significant part of the population, and their needs should be recognized in the ESCP science program. This study does not suggest that teaching ESCP through the

inquiry or discovery method should be discontinued; however, it appears that the students from lower socioeconomic areas should be presented with more appropriate experiences in the ESCP program.

2. The ESCP students from the middle socioeconomic areas could possibly use modified material, also. This group may require further investigation.

3. The ESCP students from upper socioeconomic areas appear to achieve well in the present ESCP program. Most of the students' intelligence scores were above 110 which indicates that the ESCP program seems to be appropriate as a college preparatory course. However, further investigation into the materials for upper socioeconomic and intelligence groups needs to be conducted.

## Recommendations

The recommendations for strengthening the ESCP program are the following:

1. Special materials and curriculum should be provided for ESCP students from lower socioeconomic areas.

2. Summer institutes and in-service ESCP programs should consider a program to train teachers to teach ESCP in lower socioeconomic areas.

3. Additional research is needed to explore the students' attitudes in the ESCP program.

4. Although the reading level of the ESCP program has been revised, further research is needed to determine its effectiveness with students from lower socioeconomic areas.

5. Administrators should help to provide more opportunities for

ESCP teachers to present better methods and techniques for teaching ESCP science to upper and lower socioeconomic students.

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# APPENDIX A

## OCCUPATIONS USED TO CLASSIFY UPPER, MIDDLE, AND LOWER SOCIOECONOMIC GROUPS OF ESCP STUDENTS

In order to determine the social position of the ESCP students, the highest occupation of either parent in the household was used. The population decile scale of the U. S. Bureau of Census was used as a socioeconomic index for occupations to make the classification of the groups.

Upper Socioeconomic Occupations

Accountants
Architects
Clergymen
College Professor
Dentists
Draftsmen
Engineers
Nurses, student professional
Osteopaths
Pharmacists
Photographers
Physicians
Religious workers
Social Scientist
Teachers
Technicians, testing
Buyers and department heads, store
Inspectors, public
Administration
Postmasters
Managers, official, and
proprietors, salaried
Banking and finance
Insurance agents
Agents
Mail-carriers
Stenographers, typists, and
secretaries
Advertising agents
Stock and bond salesmen
Purchasing agents
Lawyers
Natural Scientist
Electrotypers
Tool and die makers

Middle Socioeconomic Occupations

Superintendents, building

Managers, officials, and proprietors, self employed

Automobile repair services

Personal services

Cashiers

Collectors, bill and account

Shipping clerks

Ticket agents

Clerical workers

Bakers

Brickmasons

Carpenters

Electricians

Engravers

Foremen

Heat treaters

Inspectors, craftsmen

Machinists

Mechanics and repairmen

Plumbers

Pressmen and printers

Tailors

Sheet-metal workers

Bus drivers

Dressmakers

Meat-cutters

Welders

Firemen

Guards and watchmen

Policemen and detectives

Practical nurses

Bartenders

Assistant librarians

Attendants, physician's office

Office-machine operators

Telephone operators

Bookbinders

Cabinetmakers

Cranemen and derrickmen

Furriers

Jewelers

Linemen, telephone

Lens grinders

Piano tuners

Structural-metal workers

Medical technicians

Milliners

Lower Socioeconomic Occupations

Paperhangers

Members of the armed forces

Laundry operatives

Truck drivers

Personal services

Housekeepers and workers

Hospital attendant

Barbers

Cooks

Janitors

Porters

Construction worker

Service workers

Operators, steel workers, and
bakery products

Waiters and waitresses

Elevator operators

Motormen

Laborers, metals, meat products

Painters

# APPENDIX B

## SEMANTIC DIFFERENTIAL ADMINISTERED TO THE ESCP STUDENTS

Name_____ Date of Birth_____

Address_____ Age_____

School_____ Grade_____

Science Teacher_____

Father or Guardian

Name_____ Occupation_____

Check the highest education completed by your father or guardian

1 2 3 4 5 6 7 8 9 10 11 12 College 1 2 3 4 M.S. Ph.D.

Mother or Guardian

Name_____ Occupation_____

Check the highest education completed by your mother or guardian

1 2 3 4 5 6 7 8 9 10 11 12 College 1 2 3 4 M.S. Ph.D.

Directions

In each of the following you are requested to read the word at the heading of the paper. Then check the space between the dots that is appropriate to your feelings about the word. You should check the space that corresponds closest to the strength of your feelings about the subject. You should answer each question as fairly and honestly as possible. This material will be used only for research investigations about science.

Example:

Football

1. Pleasant X : : : : : : : Unpleasant

The person feels that football is very pleasant, so he checks the space closest to pleasant.

2. Deep : : : : X : : : Shallow

He has no definite feelings either way about football being deep or shallow to him, so he checks the middle space.

Proceed with the following. Be sure to check the space between the dots.

School

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Delicate | : | : | : | : | : | : | : | : | Rugged |
| 2. | Pleasant | : | : | : | : | : | : | : | : | Unpleasant |
| 3. | Fast | : | : | : | : | : | : | : | : | Slow |
| 4. | Strong | : | : | : | : | : | : | : | : | Weak |
| 5. | Ugly | : | : | : | : | : | : | : | : | Beautiful |
| 6. | Sharp | : | : | : | : | : | : | : | : | Dull |
| 7. | Deep | : | : | : | : | : | : | : | : | Shallow |
| 8. | Bad | : | : | : | : | : | : | : | : | Good |
| 9. | Passive | : | : | : | : | : | : | : | : | Active |

Science

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Deep | : | : | : | : | : | : | : | : | Shallow |
| 2. | Bad | : | : | : | : | : | : | : | : | Good |
| 3. | Stimulating | : | : | : | : | : | : | : | : | Dull |
| 4. | Ugly | : | : | : | : | : | : | : | : | Beautiful |
| 5. | Fast | : | : | : | : | : | : | : | : | Slow |
| 6. | Strong | : | : | : | : | : | : | : | : | Weak |
| 7. | Important | : | : | : | : | : | : | : | : | Unimportant |
| 8. | Colorful | : | : | : | : | : | : | : | : | Colorless |
| 9. | Interesting | : | : | : | : | : | : | : | : | Uninteresting |

Earth Science Experiments

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Meaningless | : | : | : | : | : | : | : | : | Meaningful |
| 2. | Colorful | : | : | : | : | : | : | : | : | Colorless |
| 3. | Old | : | : | : | : | : | : | : | : | New |
| 4. | Interesting | : | : | : | : | : | : | : | : | Boring |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 5. | Dull | : | : | : | : | : | : | : | Exciting |
| 6. | Free | : | : | : | : | : | : | : | Restricted |
| 7. | Good | : | : | : | : | : | : | : | Bad |
| 8. | Active | : | : | : | : | : | : | : | Idle |
| 9. | Delicate | : | : | : | : | : | : | : | Rugged |

Reading Earth Science

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Shallow | : | : | : | : | : | : | : | Deep |
| 2. | Unpleasant | : | : | : | : | : | : | : | Pleasant |
| 3. | Exciting | : | : | : | : | : | : | : | Monotonous |
| 4. | Light | : | : | : | : | : | : | : | Heavy |
| 5. | Interesting | : | : | : | : | : | : | : | Uninteresting |
| 6. | Colorless | : | : | : | : | : | : | : | Colorful |
| 7. | Simple | : | : | : | : | : | : | : | Complex |
| 8. | Important | : | : | : | : | : | : | : | Unimportant |
| 9. | Dull | : | : | : | : | : | : | : | Sharp |

Learning Earth Science

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Strong | : | : | : | : | : | : | : | Weak |
| 2. | Bad | : | : | : | : | : | : | : | Good |
| 3. | Exciting | : | : | : | : | : | : | : | Boring |
| 4. | Dull | : | : | : | : | : | : | : | Sharp |
| 5. | Beautiful | : | : | : | : | : | : | : | Ugly |
| 6. | Negative | : | : | : | : | : | : | : | Positive |
| 7. | Heavy | : | : | : | : | : | : | : | Light |
| 8. | Understandable | : | : | : | : | : | : | : | Mysterious |
| 9. | Colorful | : | : | : | : | : | : | : | Colorless |

Classmates in Earth Science

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Generous | : | : | : | : | : | : | : | Selfish |
| 2. | Dirty | : | : | : | : | : | : | : | Clean |
| 3. | Friendly | : | : | : | : | : | : | : | Unfriendly |
| 4. | Crooked | : | : | : | : | : | : | : | Straight |
| 5. | Kind | : | : | : | : | : | : | : | Mean |
| 6. | Active | : | : | : | : | : | : | : | Idle |
| 7. | Weak | : | : | : | : | : | : | : | Strong |
| 8. | Good | : | : | : | : | : | : | : | Bad |
| 9. | Loud | : | : | : | : | : | : | : | Soft |

Earth Science Teacher

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Generous | : | : | : | : | : | : | : | Selfish |
| 2. | Responsible | : | : | : | : | : | : | : | Irresponsible |
| 3. | Unfriendly | : | : | : | : | : | : | : | Friendly |
| 4. | Fair | : | : | : | : | : | : | : | Unfair |
| 5. | Fast | : | : | : | : | : | : | : | Slow |
| 6. | Weak | : | : | : | : | : | : | : | Strong |
| 7. | Kind | : | : | : | : | : | : | : | Mean |
| 8. | Positive | : | : | : | : | : | : | : | Negative |
| 9. | Pleasant | : | : | : | : | : | : | : | Unpleasant |

# APPENDIX C

## RAW SCORES OF THE ESCP STUDENTS

Raw Scores of the Upper Socioeconomic ESCP Students

| Student | Post-test | Pre-test | Intelligence | Attitude |
|---|---|---|---|---|
| 2 | 38 | 24 | 104 | 380 |
| 4 | 46 | 39 | 116 | 394 |
| 5 | 49 | 54 | 116 | 456 |
| 7 | 31 | 34 | 105 | 276 |
| 9 | 49 | 49 | 114 | 347 |
| 11 | 40 | 36 | 96 | 436 |
| 12 | 53 | 47 | 105 | 409 |
| 13 | 20 | 28 | 89 | 419 |
| 14 | 25 | 19 | 87 | 475 |
| 17 | 42 | 34 | 96 | 411 |
| 19 | 45 | 45 | 125 | 385 |
| 23 | 37 | 22 | 106 | 328 |
| 26 | 49 | 41 | 114 | 374 |
| 28 | 48 | 44 | 112 | 408 |
| 29 | 46 | 43 | 113 | 333 |
| 31 | 51 | 47 | 116 | 482 |
| 32 | 40 | 42 | 110 | 410 |
| 34 | 40 | 38 | 96 | 415 |
| 35 | 50 | 39 | 101 | 264 |
| 38 | 47 | 40 | 107 | 393 |
| 43 | 52 | 46 | 116 | 492 |
| 47 | 40 | 41 | 115 | 425 |
| 49 | 55 | 50 | 112 | 383 |
| 51 | 37 | 34 | 99 | 388 |
| 56 | 33 | 27 | 93 | 420 |
| 58 | 36 | 37 | 104 | 456 |
| 61 | 41 | 39 | 107 | 465 |
| 63 | 39 | 38 | 104 | 360 |
| 67 | 52 | 52 | 113 | 479 |
| 69 | 55 | 50 | 112 | 379 |
| 71 | 50 | 48 | 119 | 354 |
| 72 | 45 | 40 | 104 | 156 |
| 74 | 51 | 56 | 131 | 291 |
| 75 | 50 | 51 | 124 | 419 |
| 76 | 54 | 51 | 129 | 435 |
| 77 | 57 | 51 | 122 | 438 |
| 78 | 50 | 48 | 119 | 388 |
| 80 | 49 | 50 | 118 | 287 |
| 81 | 49 | 47 | 123 | 388 |
| 82 | 51 | 51 | 105 | 445 |
| 83 | 51 | 53 | 111 | 349 |
| 84 | 36 | 34 | 109 | 382 |
| 85 | 47 | 45 | 121 | 355 |
| 86 | 51 | 42 | 106 | 412 |
| 87 | 51 | 51 | 116 | 370 |
| 88 | 45 | 41 | 107 | 429 |
| 89 | 51 | 49 | 113 | 377 |
| 90 | 48 | 46 | 121 | 368 |

| Student | Post-test | Pre-test | Intelligence | Attitude |
|---|---|---|---|---|
| 91 | 45 | 47 | 104 | 368 |
| 92 | 45 | 44 | 105 | 338 |
| 93 | 53 | 47 | 110 | 423 |
| 94 | 46 | 45 | 96 | 357 |
| 95 | 55 | 52 | 111 | 434 |
| 96 | 54 | 51 | 113 | 342 |
| 97 | 52 | 50 | 123 | 357 |
| 99 | 46 | 39 | 110 | 427 |
| 100 | 50 | 46 | 121 | 389 |
| 101 | 51 | 53 | 109 | 409 |
| 102 | 48 | 44 | 114 | 363 |
| 103 | 47 | 46 | 127 | 349 |
| 104 | 49 | 45 | 132 | 377 |
| 105 | 50 | 53 | 128 | 388 |
| 106 | 54 | 52 | 128 | 315 |
| 107 | 51 | 47 | 123 | 395 |
| 108 | 58 | 47 | 120 | 433 |
| 109 | 51 | 49 | 132 | 384 |
| 111 | 44 | 49 | 115 | 396 |
| 112 | 43 | 47 | 118 | 340 |
| 113 | 53 | 46 | 123 | 431 |
| 114 | 53 | 45 | 122 | 369 |
| 115 | 49 | 46 | 121 | 370 |
| 116 | 48 | 50 | 116 | 361 |
| 117 | 52 | 50 | 128 | 391 |
| 118 | 55 | 50 | 128 | 352 |
| 119 | 50 | 48 | 126 | 357 |
| 120 | 47 | 46 | 104 | 399 |
| 121 | 49 | 45 | 112 | 398 |
| 122 | 52 | 42 | 125 | 249 |
| 123 | 52 | 51 | 122 | 411 |
| 124 | 43 | 35 | 109 | 360 |
| 125 | 48 | 47 | 117 | 363 |
| 126 | 43 | 47 | 135 | 481 |
| 127 | 52 | 52 | 124 | 345 |
| 128 | 46 | 33 | 106 | 309 |
| 129 | 48 | 46 | 116 | 349 |
| 131 | 40 | 37 | 100 | 344 |
| 132 | 33 | 37 | 113 | 319 |
| 133 | 51 | 50 | 118 | 449 |
| 134 | 54 | 56 | 140 | 388 |
| 137 | 49 | 42 | 123 | 353 |
| 138 | 56 | 53 | 108 | 367 |
| 139 | 45 | 43 | 107 | 424 |
| 141 | 49 | 46 | 120 | 326 |
| 145 | 48 | 46 | 103 | 433 |
| 146 | 39 | 34 | 110 | 484 |
| 147 | 37 | 35 | 120 | 306 |
| 148 | 38 | 40 | 117 | 371 |
| 151 | 57 | 56 | 117 | 473 |
| 152 | 55 | 55 | 117 | 406 |

| Student | Post-test | Pre-test | Intelligence | Attitude |
|---|---|---|---|---|
| 153 | 40 | 38 | 99 | 383 |
| 154 | 48 | 43 | 106 | 327 |
| 162 | 45 | 38 | 104 | 411 |
| 164 | 42 | 30 | 100 | 383 |
| 169 | 41 | 32 | 120 | 415 |
| 170 | 38 | 33 | 108 | 426 |
| 171 | 46 | 40 | 114 | 391 |
| 177 | 49 | 45 | 117 | 314 |
| 182 | 45 | 42 | 96 | 318 |
| 189 | 47 | 51 | 112 | 421 |
| 190 | 40 | 31 | 101 | 333 |
| 241 | 35 | 25 | 105 | 380 |
| 249 | 36 | 41 | 97 | 348 |
| 255 | 43 | 30 | 108 | 435 |
| 256 | 47 | 45 | 116 | 437 |
| 261 | 44 | 37 | 111 | 434 |
| 270 | 33 | 42 | 109 | 391 |
| 271 | 21 | 38 | 108 | 462 |
| 280 | 38 | 40 | 112 | 363 |
| 283 | 43 | 51 | 110 | 434 |
| 286 | 24 | 25 | 93 | 405 |
| 287 | 48 | 46 | 114 | 321 |
| 301 | 36 | 37 | 108 | 380 |
| 303 | 48 | 46 | 102 | 423 |
| 304 | 38 | 37 | 102 | 455 |
| 310 | 51 | 51 | 124 | 405 |
| 311 | 45 | 44 | 111 | 355 |
| 313 | 37 | 42 | 113 | 503 |

Raw Scores of the Middle Socioeconomic ESCP Students

| Student | Post-test | Pre-test | Intelligence | Attitude |
|---|---|---|---|---|
| 1 | 48 | 29 | 104 | 416 |
| 6 | 45 | 38 | 115 | 318 |
| 8 | 21 | 33 | 101 | 269 |
| 10 | 39 | 33 | 121 | 426 |
| 16 | 39 | 33 | 100 | 347 |
| 20 | 44 | 49 | 100 | 473 |
| 21 | 24 | 37 | 105 | 430 |
| 22 | 18 | 21 | 88 | 331 |
| 25 | 52 | 48 | 110 | 398 |
| 27 | 48 | 48 | 114 | 428 |
| 33 | 40 | 37 | 104 | 469 |
| 36 | 41 | 40 | 104 | 348 |
| 40 | 51 | 49 | 126 | 393 |
| 42 | 33 | 32 | 100 | 376 |
| 45 | 45 | 43 | 112 | 380 |
| 48 | 35 | 30 | 110 | 365 |
| 52 | 32 | 31 | 106 | 321 |
| 59 | 42 | 40 | 98 | 398 |
| 62 | 47 | 36 | 110 | 341 |
| 65 | 50 | 43 | 111 | 360 |
| 66 | 45 | 46 | 106 | 305 |
| 70 | 26 | 22 | 96 | 422 |
| 79 | 56 | 49 | 109 | 327 |
| 98 | 46 | 42 | 117 | 366 |
| 110 | 47 | 43 | 104 | 298 |
| 130 | 54 | 54 | 125 | 352 |
| 135 | 45 | 47 | 129 | 389 |
| 140 | 31 | 23 | 97 | 206 |
| 142 | 43 | 33 | 106 | 172 |
| 143 | 23 | 23 | 94 | 263 |
| 144 | 30 | 36 | 100 | 250 |
| 149 | 46 | 38 | 93 | 256 |
| 150 | 50 | 46 | 96 | 501 |
| 155 | 51 | 46 | 108 | 345 |
| 156 | 53 | 49 | 119 | 328 |
| 158 | 42 | 42 | 117 | 237 |
| 159 | 38 | 41 | 103 | 214 |
| 163 | 50 | 47 | 85 | 424 |
| 165 | 55 | 48 | 104 | 383 |
| 168 | 41 | 39 | 114 | 412 |
| 172 | 43 | 45 | 106 | 354 |
| 173 | 40 | 53 | 107 | 307 |
| 175 | 49 | 47 | 124 | 426 |
| 176 | 31 | 40 | 101 | 383 |
| 178 | 52 | 47 | 112 | 426 |
| 179 | 42 | 43 | 105 | 334 |
| 180 | 50 | 54 | 115 | 392 |
| 181 | 44 | 44 | 110 | 469 |

| Student | Post-test | Pre-test | Intelligence | Attitude |
|---|---|---|---|---|
| 183 | 39 | 30 | 113 | 385 |
| 184 | 46 | 40 | 102 | 451 |
| 185 | 37 | 36 | 103 | 436 |
| 186 | 25 | 41 | 121 | 353 |
| 187 | 45 | 45 | 122 | 473 |
| 191 | 40 | 37 | 108 | 397 |
| 192 | 34 | 31 | 93 | 328 |
| 193 | 39 | 37 | 95 | 370 |
| 194 | 41 | 40 | 97 | 394 |
| 195 | 20 | 24 | 86 | 380 |
| 196 | 25 | 28 | 97 | 438 |
| 197 | 21 | 23 | 83 | 429 |
| 198 | 18 | 16 | 89 | 426 |
| 202 | 21 | 23 | 91 | 341 |
| 204 | 22 | 23 | 101 | 419 |
| 205 | 26 | 23 | 92 | 348 |
| 219 | 20 | 16 | 90 | 298 |
| 222 | 22 | 31 | 89 | 385 |
| 223 | 34 | 34 | 100 | 377 |
| 236 | 46 | 40 | 121 | 343 |
| 248 | 34 | 30 | 97 | 437 |
| 250 | 50 | 37 | 108 | 455 |
| 251 | 26 | 29 | 104 | 385 |
| 253 | 50 | 48 | 113 | 348 |
| 254 | 50 | 44 | 114 | 421 |
| 258 | 48 | 55 | 114 | 410 |
| 264 | 30 | 26 | 92 | 493 |
| 266 | 31 | 38 | 105 | 458 |
| 272 | 45 | 53 | 113 | 470 |
| 273 | 25 | 26 | 97 | 425 |
| 276 | 28 | 29 | 92 | 467 |
| 278 | 21 | 29 | 89 | 357 |
| 284 | 28 | 27 | 85 | 412 |
| 285 | 29 | 28 | 87 | 382 |
| 288 | 48 | 49 | 106 | 381 |
| 289 | 26 | 24 | 94 | 447 |
| 291 | 30 | 17 | 95 | 403 |
| 292 | 27 | 26 | 86 | 327 |
| 293 | 27 | 40 | 109 | 440 |
| 296 | 43 | 38 | 108 | 414 |
| 297 | 33 | 29 | 108 | 439 |
| 298 | 28 | 31 | 95 | 487 |
| 300 | 44 | 43 | 112 | 419 |
| 302 | 39 | 37 | 100 | 461 |
| 305 | 38 | 25 | 104 | 341 |
| 306 | 37 | 36 | 108 | 411 |
| 307 | 32 | 45 | 125 | 340 |
| 308 | 40 | 35 | 106 | 422 |
| 314 | 28 | 36 | 112 | 345 |
| 315 | 52 | 50 | 101 | 443 |
| 316 | 40 | 42 | 109 | 364 |
| 317 | 39 | 38 | 96 | 393 |

Raw Scores of the Lower Socioeconomic ESCP Students

| Student | Post-test | Pre-test | Intelligence | Attitude |
|---|---|---|---|---|
| 3 | 44 | 38 | 99 | 375 |
| 15 | 35 | 24 | 102 | 440 |
| 18 | 41 | 34 | 110 | 410 |
| 24 | 34 | 32 | 103 | 390 |
| 30 | 36 | 22 | 96 | 353 |
| 37 | 37 | 23 | 103 | 341 |
| 39 | 17 | 27 | 91 | 360 |
| 41 | 45 | 37 | 112 | 354 |
| 44 | 24 | 24 | 89 | 410 |
| 46 | 41 | 38 | 114 | 389 |
| 50 | 28 | 23 | 89 | 356 |
| 53 | 44 | 39 | 111 | 369 |
| 54 | 44 | 44 | 104 | 421 |
| 55 | 32 | 15 | 103 | 352 |
| 57 | 46 | 38 | 104 | 386 |
| 60 | 39 | 25 | 100 | 398 |
| 64 | 34 | 37 | 105 | 453 |
| 68 | 44 | 44 | 95 | 374 |
| 73 | 43 | 38 | 102 | 279 |
| 136 | 42 | 47 | 99 | 348 |
| 157 | 33 | 28 | 106 | 347 |
| 160 | 49 | 51 | 114 | 345 |
| 161 | 54 | 48 | 99 | 455 |
| 166 | 11 | 34 | 109 | 335 |
| 167 | 46 | 42 | 116 | 401 |
| 174 | 49 | 45 | 118 | 166 |
| 188 | 36 | 41 | 80 | 348 |
| 199 | 11 | 11 | 91 | 335 |
| 200 | 34 | 24 | 87 | 383 |
| 201 | 32 | 24 | 94 | 414 |
| 203 | 37 | 36 | 107 | 433 |
| 206 | 13 | 12 | 84 | 366 |
| 207 | 16 | 22 | 88 | 347 |
| 208 | 18 | 12 | 86 | 380 |
| 209 | 37 | 36 | 114 | 379 |
| 210 | 38 | 30 | 106 | 378 |
| 211 | 23 | 18 | 86 | 281 |
| 212 | 26 | 20 | 82 | 201 |
| 213 | 25 | 20 | 101 | 376 |
| 214 | 32 | 27 | 89 | 355 |
| 215 | 27 | 19 | 82 | 412 |
| 216 | 22 | 21 | 87 | 314 |
| 217 | 18 | 18 | 81 | 251 |
| 218 | 26 | 21 | 98 | 312 |
| 220 | 28 | 22 | 88 | 439 |
| 221 | 26 | 21 | 89 | 386 |
| 224 | 33 | 24 | 107 | 423 |
| 225 | 28 | 23 | 81 | 421 |

| Student | Post-test | Pre-test | Intelligence | Attitude |
|---|---|---|---|---|
| 226 | 24 | 28 | 87 | 478 |
| 227 | 17 | 22 | 85 | 318 |
| 228 | 24 | 17 | 79 | 321 |
| 229 | 14 | 17 | 84 | 335 |
| 230 | 17 | 18 | 85 | 297 |
| 231 | 19 | 26 | 76 | 331 |
| 232 | 26 | 28 | 95 | 331 |
| 233 | 26 | 24 | 87 | 400 |
| 234 | 32 | 32 | 107 | 436 |
| 235 | 21 | 24 | 94 | 450 |
| 237 | 31 | 29 | 101 | 306 |
| 238 | 16 | 16 | 81 | 319 |
| 239 | 24 | 21 | 75 | 378 |
| 240 | 20 | 20 | 84 | 364 |
| 242 | 23 | 28 | 91 | 343 |
| 243 | 40 | 28 | 109 | 370 |
| 244 | 23 | 31 | 96 | 324 |
| 245 | 16 | 11 | 79 | 482 |
| 246 | 26 | 21 | 91 | 334 |
| 247 | 21 | 17 | 98 | 295 |
| 252 | 52 | 46 | 112 | 464 |
| 257 | 45 | 43 | 106 | 410 |
| 259 | 16 | 26 | 95 | 457 |
| 260 | 20 | 23 | 80 | 322 |
| 262 | 39 | 39 | 101 | 441 |
| 263 | 42 | 44 | 116 | 468 |
| 265 | 25 | 27 | 92 | 411 |
| 267 | 40 | 32 | 100 | 380 |
| 268 | 20 | 18 | 82 | 337 |
| 269 | 19 | 24 | 94 | 361 |
| 274 | 33 | 27 | 97 | 345 |
| 275 | 46 | 42 | 100 | 454 |
| 277 | 42 | 44 | 111 | 386 |
| 279 | 39 | 21 | 88 | 361 |
| 281 | 21 | 43 | 96 | 410 |
| 282 | 47 | 38 | 113 | 412 |
| 290 | 41 | 48 | 106 | 468 |
| 294 | 28 | 23 | 94 | 427 |
| 295 | 46 | 49 | 115 | 367 |
| 299 | 21 | 11 | 97 | 272 |
| 309 | 39 | 38 | 99 | 399 |
| 312 | 44 | 36 | 114 | 444 |
| 318 | 31 | 29 | 99 | 402 |

VITA

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Biographical:

Personal Data: Born in Pawhuska, Oklahoma, June 4, 1936, the son of Mr. and Mrs. Stanley C. Henson.

Education: Graduated from Pawhuska High School, Pawhuska, Oklahoma, in May, 1955; attended Oklahoma Baptist University 1955 and 1956; attended Oklahoma State University 1956 to 1960; received the Bachelor of Science degree from Oklahoma State University in 1960 with a major in Natural Science; attended National Science Foundation Summer Institute in Biology at Colorado State College in 1962; received the Master of Science degree from Oklahoma State University in 1964 in Secondary Education with a major in Biology; attended National Science Foundation Summer Institute in Physics at New Mexico State University in 1966; attended National Science Foundation Summer Institute in Biochemistry at the University of California in 1967; received Academic Year Institute at Oklahoma State University in Biology in 1967-68; attended National Science Foundation Summer Institute in Earth Science at Oklahoma State University in 1968 and 1969; completed requirements for the Doctor of Education degree at Oklahoma State University in May, 1970.

Professional Experience: Science Teacher, Tulsa Public Schools, 1960-63; Biology and Physical Science Teacher, Oklahoma City Public Schools, 1964-67; Graduate Assistant in Biological Science Department, Oklahoma State University, 1968-70.