Stanford R. Hill, Jr., A STUDY OF THE EFFECTS OF A MODIFIED SCIENCE CURRICULUM AND TEACHING METHODS ON A SELECTED GROUP OF LOW ACADEMIC PERFORMERS. (Under the direction of Charles R. Coble) Department of Science Education, May, 1978.

The purpose of this study was to develop and implement strategies that would help raise the educational motivation in science of students now described as Phase III students or Low Academic Performers. This study attempted to answer the following question.

> Are there any significant differences in the science attitudes and attitudes toward school (specifically the science classroom) between students exposed to specialized activities for Low Academic Performers and a comparable non-treatment group?

The study group consisted of 152 students who were enrolled in Phase III physical science classes during the 1977-78 academic year at Tarboro High School. The general method and instruments employed in this study were:

> Students were pre-tested in August, 1977, for their attitudes toward science and science instruction. Instruments employed were the Instructional Objective Exchange's School Sentiment Index (Intermediate Level), the Instructional Objective Exchange's Self Appraisal Inventory (Intermediate Level) and Moore's Science Attitude Inventory.

The study group was exposed to a series of specialized activities designed to improve their interest and attitudes toward school science. Some of the techniques developed and implemented in science classes for the Low Academic Performers were:

1. classroom debates and student presentations designed to improve the classroom environment by increasing positive involvement of students,

2. focusing on the science topics that interest the students and that seem relevant to their lives,

3. using pre-test team competition and a grading system that reinforces correct responses,

4. posting a top twenty grade board to be used to aid in raising academic incentive,

5. providing extra instruction sessions as a means of corrective education.

Three null hypotheses were tested in this study. Statistical analysis yielded the following results.

1. Using the t-test, there was a significant difference in attitudes toward school (specifically the science classroom) between students exposed to specialized activities for Low Academic Performers and a comparable non-treatment group, as measured by the Instructional Objective Exchange's Self Appraisal Inventory (Intermediate Level).

2. Utilizing chi square, there was a significant difference in attitudes toward science at a 70% criterion level between students exposed to specialized activities for Low Academic Performers and a

comparable non-treatment group, as measured by the Instructional Objective Exchange's School Sentiment Index (Intermediate Level).

3. Using the t-test, no significant difference was found in science attitudes between students exposed to specialized activities for Low Academic Performers and a comparable non-treatment group, as measured by the Moore's Science Attitude Inventory.

A STUDY OF THE EFFECTS OF A MODIFIED SCIENCE CURRICULUM AND TEACHING METHODS ON A SELECTED GROUP OF LOW ACADEMIC PERFORMERS

A Thesis

Presented to

the Faculty of the Department of Science Education

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In Partial Fulfillment

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Master of Arts in Education

by

Stanford R. Hill, Jr.

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A STUDY OF THE EFFECTS OF A MODIFIED SCIENCE CURRICULUM AND TEACHING METHODS ON A SELECTED GROUP OF LOW ACADEMIC PERFORMERS

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To my wife, Debbie, I express my thanks and love for her help, support, and tolerance during the past year.

To my parents, Mr. and Mrs. Stanford Hill, and to my grandparents, Mr. and Mrs. Steve Millas, I dedicate this thesis for their many years of love and guidance and the inner strength that they have instilled in me.

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CHAPTER 1

INTRODUCTION

Defining the Problem

The main purpose of our public schools is to provide students with an education. In order for a student to obtain an education, learning must take place. George B. Leonard feels that the degree of learning depends largely on the quality of the interactions between students, teachers and the general classroom environment.[1] In many of today's science classrooms, this interactive environment is ineffective. The students are missing worthwhile learning experiences and are failing to grasp the important scientific principles. The reasons are many and varied. For example, textbooks more often emphasize the "pure" aspects of science and deal very little with the relationship of science to the daily lives of students. This partially explains why a large percentage of non-achievers or slow learners are being left behind educationally. It is difficult to convince students of the need for a good science background when they are personally unmotivated to learn the subject and do not see how science can play a part in their futures.[2]

Classroom teachers realize these problems, but their remedies are not always effective. One of the first things that is usually done to

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[1]George B. Leonard, Education and Ecstasy (New York, Dell Publishing Co., Inc., 1968), p. 14.

[2]William J. Younie, Instructional Approaches to Slow Learning (Teachers College, Columbia University, New York, Teachers College Press, 1967), pp. 109-113.

improve science instruction is to group students according to academic or achievement levels. This grouping is, perhaps, beneficial to the high achievement students because it allows their classes to move more rapidly and to go into greater depth. However, achievement level grouping is not so beneficial for the low level student. In a crowded class with nothing but slow students, the child lacks any positive interaction with the academically successful student. They become lulled into a sense of false security by the knowledge that their performance is equal to their peers. They become content to withhold themselves and to blend into the group.[3] Other methods for dealing with the underachievers and slow learners as identified by the literature are: environmental modification, curriculum modification, alternative grading methods and corrective education. Each of these methods will be examined in the review of the related literature.

This research focuses on specialized techniques for assisting the slow learners and the underachievers. It would be more ideal to work with each student and his or her individual problems separately, but the high school science teacher is not dealing with an ideal situation. Since the low academic performers are most often grouped together in the same classroom, they must be helped as a group using the strengths of each student to help correct the academic problems of his peers. This research is designed to meet the needs of students in the reality of a typical secondary science program and reality operates on a very low budget in public schools of Eastern North Carolina. The needs of

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[3]Ibid., pp. 44-45.

students must be met by classroom teachers using minimal supplies and materials usually at their disposal.

Purpose of the Research

The purpose of the research is to develop and implement strategies that will help raise the educational motivation in science of students now described as Phase III students or Low Academic Performers. A thorough review of the literature and research related to this study is presented in Chapter II. The major problem areas discussed in the literature review are the relationship of a positive classroom environment in creating academic self-esteem, the role of the subject matter and its presentation in motivating and arousing the interest of students, the relationship of positive reinforcement in grading techniques, and the need for corrective education.

Some of the techniques developed and implemented in science classes for the Low Academic Performers were:

1. classroom debates and student presentations designed to improve the classroom environment by increasing positive involvement of students,
2. focusing on the science topics that interest the students and that seem relevant to their lives,
3. using pre-test team competition and a grading system that reinforces correct responses,
4. posting a top twenty grade board to be used to aid in raising academic incentive,
5. providing extra instruction sessions as a means of corrective

education.

These treatments are described in more detail in Chapter III.

Hypotheses

This study is concerned with three null hypotheses.

1. There is no significant difference in attitudes toward school (specifically the science classroom) between students exposed to specialized activities for Low Academic Performers and a comparable non-treatment group, as measured by the Instructional Objective Exchange's Self Appraisal Inventory (Intermediate Level).

2. There is no significant difference in attitudes toward science between students exposed to specialized activities for Low Academic Performers and a comparable non-treatment group, as measured by the Instructional Objective Exchange's School Sentiment Index (Intermediate Level).

3. There is no significant difference in science attitudes between students exposed to specialized activities for Low Academic Performers and a comparable non-treatment group, as measured by the Moore's Science Attitude Inventory.

Definition of Terms

Low Academic Performers

In this study, Low Academic Performers are introduced as a group of students who are identifiable as slow learners and/or as academic underachievers. They exhibit certain potentials to master the science

curriculum for ninth grade physical science students. For example, some students have extensive capacities for remembering large numbers of facts and can recall very specific data in areas that are of interest to them, such as sports and hobbies. At the same time, they show an inability to retain or recall data of similar difficulty in science.

Phase III

For the Tarboro City School System, Phase III constitutes their lowest curriculum level. Students in this phase are considered below average in areas of academic achievement and motivation.

Delimitations

The methods of classroom treatment were administered during the 1977-78 academic year to physical science students grouped in the Phase III level. Pre-test attitude measures were administered to the study group during the first few days of school. Proposed classroom treatment was utilized with the study group and withheld from the comparison group. Post-test attitude measures were administered during March of 1978 and compared to the pre-test results for both the study group and the comparison group.

Study Variables

The study group and the comparison group were both exposed to physical science instruction in the areas of basic chemistry, physics and future energy sources. Although the individual lesson plans of the two instructors differed, the basic concepts being presented to

the student were the same. Both groups were exposed to fifty-minute periods of instruction during every regular school day during the research study.

The two classrooms involved in the study group and the comparison group were adjoining and were basically identical. They were relatively new and extremely large with extensive window area and lab stations located around the perimeter of the rooms.

The uncontrolled variables pertaining to the study were pupil bias and individual teacher personalities.

Manipulated variables in this study were the author's methods of classroom treatment.

1. Pre-test Team Competition.
2. Classroom Debates.
3. Student Presentations.
4. Top Twenty Board.
5. Positive Reinforcement Grading.
6. Extra Instruction Sessions.

These methods of classroom treatment were not utilized with the comparison group classes.

Data analysis and summary and conclusions are presented in Chapter IV and V respectively.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

Introduction

There is an abundance of educational literature devoted to the slow learner, the mentally retarded slow learner, the culturally-deprived slow learner, and the underachievers. The list is practically endless. Unfortunately, each author has a different criterion for choosing his subjects. Some look at intelligence quotients, some at grade point averages and others at physiological defects; but the one thing that they all have in common is the study of a highly specific group of individuals.

Researchers understandably avoid grouping students with different learning problems into one study group, preferring to study the slow learners and the underachievers separately. However, classrooms are filled with students from various problem groups. Thus, the classroom teacher must utilize methods that are helpful to all and can be accomplished in a typical fifty-minute class period. Their methods must be effective without the aid of psychologists or special group therapy sessions. The classroom teacher must handle the academic, social and behavioral problems alone and usually on a very limited budget.

By attempting to study such a wide range of problem students together, labeled as Low Academic Performers, it is impossible to implement the ideas or conclusions of any one study previously done. This research is an effort to combine the studies that are relevant to

the Low Academic Performers in hopes of incorporating all of their useful aspects into one combined program.

Characteristics of Slow Learners and Underachievers

The impetus for this study originated from a need to improve the science attitudes and achievement of both the slow learner and the underachiever. The characteristics and needs of both groups are examined here.

The Slow Learner

Each author attempting research on the slow learner has developed his own definition of what a slow learner really is. Some define the group as those with intelligence quotients from 75 to 90.[4] Some express the group in terms of decreased learning rates, some use grades, and some employ social and economic status.

In addition to a wide variety of definitions, there are long lists of observable characteristics describing slow learners. Karlan and Berger profile the slow learner as: unable to communicate effectively, lacking experience, lacking motivation, unable to read.[5] Edwin Gaddis summarizes the slow learner as: scoring low on intelligence tests; showing low scholastic achievement on much of their school work; having difficulty with abstract material; showing slow development in areas of basic learning; having psychological or physiological problems including

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[4]Frank B. Weaver, Practical Help for Meeting the Needs of Slow Learners (New York, Vantage Press, 1967), p. 15.

[5]Karlin Muriel Schoenbrun and Regina Berger, Successful Methods for Teaching the Slow Learner (West Nyack, New York, 1969), pp. 2-9.

extreme aggressiveness, a lack of confidence, a lack of cooperation and a dislike for school.[6]

The Underachiever

The term, underachiever, has also been defined in many different ways by various authors. William Younie defines the underachiever as any student who is not reaching his or her full intellectual potential as determined by objective measures of intelligence.[7] Kowitz associates underachievement with a lack of educational motivation. He presents some theories that assume underachieving students are deprived of the opportunity to learn the joys of academic achievement and, therefore, lack inspiration.[8]

Kowitz believes that behavior of underachievers is related to their hierarchy of needs. His theory assumes that the students are not achieving in school due to a deficiency more basic to their needs than academic success.[9] Robert Schwitzgebel presents an unorthodox theory in stating that every organism (including humans) achieves its maximum all of the time and that any outward variations are due to the biological and social determinants serving as the restriction. He assigns any discrepancy between the student's behavior and the teacher's belief of

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[6]Edwin A. Gaddis, Teaching the Slow Learner in the Regular Class-Room (Belmont, California, Lear Siegler, Inc./Fearon Publishers, 1971), pp. 22-23.

[7]Younie, op. cit., p. 6.

[8]Gerald Kowitz, "An Analysis of Underachievement," in Under-achievement, ed. by Milton Kornrich (Springfield, Illinois, Charles C. Thomas, 1965), p. 466.

[9]Ibid., pp. 466-467.

of what his behavior should be as a problem of observer error.[10] This view leaves the schools and the classroom teachers with little direction for a course of action.

One of the more relevant views on causative factors for underachievement is presented by William Younie. He includes the learning environment as a cause for underachievement. Younie believes that underachievement can be due to a failure on the teacher's part to stimulate the student or a failure on the part of the curriculum to present a challenge and sense of excitement in the learning situation. He also recognizes that physical defects such as poor hearing, speech, sight, and other sensory problems can cause poor performance along with various emotional conflicts. Younie feels that in many cases, the underachievement is a result of the student trying to obtain the attention he lacks at home.[11]

Teaching the Slow Learners and Underachievers

As previously discussed, a number of authors attempt to define the slow learner and the underachiever. Most of them provide long lists of symptoms and causative factors. Although they have identified some areas that need modification, few concrete suggestions are provided concerning how to improve the attitude and achievement of slow learners and underachievers. However, the literature seems to focus on four

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[10]Robert Schwitzgebel, "Underachievement: A Common Fallacy," in Underachievement, ed. by Milton Kornrich (Springfield, Illinois, Charles C. Thomas, 1965), pp. 484-485.

[11]Younie, op. cit., pp. 6-7.

major areas of treatment which could prove beneficial for helping Low Academic Performers. These areas are:

1. Environmental Modification,
2. Curriculum Modification,
3. Alternative Grading Methods,
4. Corrective Education.

Environmental Modification

A major controversy in modifying the school environments of slow learners and underachievers is the grouping of the students. Some educators suggest homogeneous grouping of students according to academic ability. Other educators suggest that the slow learners and underachievers are better accommodated in a regular, heterogeneous class.

Edwin Gaddis relates a case where homogeneous grouping was implemented as treatment. The groups were arranged according to ability and were given names, such as: astronauts, pilots, or navigators. However, the kids were not fooled. They realized that the groups were actually, "bright kids, average kids and dumbbells." All students who were considered slow learners or underachievers were placed in an overcrowded "dumbbell" class. The class was given to a new and inexperienced teacher with the best wishes of the faculty. The students in the slow group experienced many problems. Most of them were members of a minority group and came from disadvantaged homes. They received no positive treatment, such as honors or awards; so their feelings of inadequacy were reinforced. The overcrowded conditions

tended to concentrate behavior problems and prevented the teacher from administering any individual instruction.[12]

Younie feels that in order for the homogeneous classes to be an effective aid to the slow learners and underachievers, they must provide an uncrowded atmosphere with an experienced teacher capable of assisting in individual problems. Otherwise, they can easily become a dumping ground where problem kids are lumped into one large group. He observes that many experienced teachers are in favor of the grouping as long as they are not faced with the teaching responsibility. Younie laments that the homogeneous class is usually a place to put all of the problem students so as to make them as little of an annoyance as possible.[13]

The slow learners and underachievers can also be treated in a regular heterogeneous class atmosphere. This exposes the students to a group with a wider range of abilities in hopes that they will receive positive help and influence from the successful students in the class.[14] There are two main problems with this approach. First, there is the possibility that the slow learner will hold back the advancement of the class by requiring more instruction or creating a discipline problem. Secondly, there is also the chance that the slow learning underachiever will become discouraged by his failure if the successful pupils and the slow learners are in the same classroom.[15]

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[12]Gaddis, op. cit., pp. 7-8.

[13]Younie, op. cit., pp. 44-45.

[14]Gaddis, op. cit., p. 28.

[15]Ibid., p. 28.

In summing up the grouping dilemma, Gaddis states his belief that it is what teachers do for the student that matters and not whether they are grouped in a regular or special classroom.[16] Thus, the quality of the teacher-student relationship appears to be a critical variable in helping the students realize their potential for academic success.

Martin Fink's research relates an adequate self concept to high achievement and an inadequate self concept to underachievement.[17] Criticism and a constant approach of negative reactions only lowers the self-esteem of students already aware of their inability to compete. They must be made aware of their ability to compete. Martin believes that the low academic performers must be made aware of their worthiness and must be assured of a sense of belonging in class activities.[18]

According to Gaddis, a major influencing factor on the low academic performer is the teacher-student relationship. The actions of the classroom teacher are a molding influence for the problem student. In order to help, the teacher must get involved in a constructive manner. Self-esteem can be increased by providing instruction that will allow the student to experience success and achievement. Problem students need to identify with an interested

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[16]Ibid., p. 28.

[17]Martin B. Fink, "Self Concept As It Relates to Academic Underachievement," in Underachievement, ed. by Milton Kornrich (Springfield, Illinois, Charles C. Thomas, 1965), p. 73.

[18]Madelyn Martin, "Building the Slow Learner's Self-Esteem," Today's Education, 59, (March, 1970), pp. 46-47.

teacher who provides support and treats them as individuals. Kindness and a complimentary attitude help to restore self-esteem. However, firmness and consistency must be utilized in order to inform the student that help is available, but that he must make an effort.[19]

Some teachers find it difficult to be constructive and complimentary with aggressive and uncooperative students. Personality clashes with students must be avoided. The teacher must overcome frustration and resentment by administering patience, understanding and encouragement. Nothing constructive is accomplished by ridicule or by meeting the student's belligerence with more belligerence.[20] If punishment is necessary, it should be administered fairly and consistently. Students must realize the punishment results when their actions harm themselves and those around them. When students are under the stress of anger, their language may revert to that of their neighborhood. In order to avoid class conflicts, an effective teacher learns to overlook this reaction as much as possible and does not make a great issue of it.[21]

Curriculum Modification

Altering the curriculum is one approach used to improve the motiviation and achievement of the Low Academic Performers. Long-range curriculum goals are important to science, but short-range applications are more important to the learners. Appropriate short-term goals

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[19]Gaddis, op. cit., pp. 3-4.

[20]Regis F. Crowley, "Teaching the Slow Learner," Today's Education, 58, (January, 1969), pp. 48-49.

[21]Gaddis, op. cit., pp. 66-67.

provide the students with frequent experiences of success and thus avoid repeated failures.[22] Brennan feels that educators need to keep in mind the likely personal and social demands that will face the student after school years when developing their curriculum.[23]

One writer, Frank Weaver, suggests a curriculum for the slow learners that involves the predicting of their likely futures. He considers it obvious that slow learners will never occupy highly technical jobs, such as astronomers or physicists. Instead, he recommends that they be channeled into less technical and challenging occupations such as automobile mechanics or cabinet making.[24]

Younie's curriculum approach to science places a great deal of emphasis on the needs of the "slow to average learning underachiever." He places emphasis on arousing creativity, curiosity and imagination in the students. He allows the students to study scientific material that they come in contact with in their daily life. This includes scientific topics stimulated by television and the news media plus the natural phenomena in the students' environment. He attempts to provide students with basic scientific information that will be required in order to function as an effective consumer in today's market places. The main objective is to allow the learner to discover the rewards of

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[22]Gerald Dewitt, "Potential Dropout. Individual Care Produces Results," Clearing House, 42, (March, 1968), pp. 428-430.

[23]W. K. Brennan, Shaping the Education of Slow Learners (London, Routledge & Kegan, Paul, 1974), p. 66.

[24]Weaver, op. cit., p. 16.

intellectual inquiry and incorporate the inquiry process into their daily life.[25]

One of the more recent science curriculums designed for the "educationally unmotivated" is the Ideas and Investigations in Science (IIS) Program developed by Harry Wong. The IIS program attempts to hold the attention of the student through the use of cartoon classmates, vivid illustrations and comic strip cartoons. The text is written in the language of the student with many slang phrases and familiar terms serving as introductory statements rather than the unemotional and technical phrases usually associated with science texts.[26] Wong's materials and activities encourage the student's curiosity and imagination in hopes of motivating him from section to section and from problem to problem. Very little reading is required of the students. They are involved in carrying out activities arranged by the teacher, and answering questions in their own workbooks. However, the students are being exposed to basic scientific principles necessary to solve the problems and answer the questions at the end of each section. Concepts are reviewed at the end of each section. Usually, the science concepts are incorporated so casually that students may not be aware that they are in a learning process. Instead, they are encouraged to look upon the text as an enjoyable experience capable of stimulating their curiosity while also providing the knowledge and skills needed to satisfy their curiosity.[27]

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[25]Younie, op. cit., pp. 109-113.

[26]Marvin S. Dolmatz and Harry K. Wong, Ideas and Investigations in Science - Physical Science (Prentice-Hall, Englewood Cliffs, New Jersey, 1971), pp. 1-258.

[27]Marvin S. Dolmatz and Harry K. Wong, Ideas and Investigations in Science - Teachers Manual (Prentice-Hall, Englewood Cliffs, New Jersey, 1971), pp. 1-17.

Alternative Grading Methods

J. R. Watson's views on the marking of test papers may seem trivial to the classroom teacher, but they could be vital to the low achieving student. He suggests that instead of covering test papers with red marks (thus, emphasizing the student's failures), that teachers mark only the correct responses (thus, emphasizing the positive). By placing instructor attention and emphasis on the correct aspects of the student's performance, the student's attention and emphasis are also channeled in a positive direction. Students learn that their instructors are more interested in their accomplishments than in their failures.[28]

John Marusek developed a progress chart to replace or supplement the traditional gradebook. A gradebook filled with test failures and missed assignments provides no positive incentive for slow, under-achieving students. Marusek's progress chart is posted in the classroom so that the students can constantly monitor their progress. It contains a variety of information from completed homework assignments to daily grades and test scores. By using this chart, students always know their class situation and can visually observe their accomplishments.[29]

Corrective Education

Even with using self-concept building techniques, a relevant curriculum, and a modified grading system, teachers are still faced with the students who cannot perform adequately due to an inadequate background

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[28]J. R. Watson, "I'm Just Plain Dumb! How to Change Negative Self-Concepts in Low Ability Children," Today's Education, 62, (March, 1973), pp. 26-27.

[29]J. Marusek, "Progress Chart For Slow Learners," Clearing House, 45, (January, 1971), pp. 312-313.

from his previous schooling. Students who showed poor achievement early in their academic careers do not develop the basic skills that are needed in the later school subjects. This lack of skill perpetuates poor performance even when the student puts forth effort.[30] Corrective education must be used to compensate for gaps in knowledge and skill which create many learning limitations. This type of education usually involves a patient one-to-one relationship between the deficient student and his teacher. It can be accomplished in extra instruction sessions after or before school. Brennan has pointed out that programs of corrective education require a lot of extra effort both from the teacher and the student. However, he feels it must be accomplished if students deficient in academic skills are ever expected to function effectively in a normal classroom.[31]

This study attempts to synthesize the implications from many of the studies reported in this chapter into a practical program for Low Academic Performers and to study the effects of the program on student attitude.

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[30]Robert M. Roth and H. Arnold Meyersburg, "The Non-Achievement Syndrome," in Underachievement ed. by Milton Kornrich (Springfield, Illinois, Charles C. Thomas, 1965), pp. 279-282.

[31]Brennan, op. cit., pp. 38-40.

CHAPTER III

DESIGN OF THE STUDY

This study was concerned with an analysis of attitude changes of students exposed to a series of specialized activities for low academic performers. The study, conducted during the academic year 1977-78, involved a total of 152 students enrolled in physical science in Tarboro High School. The study was made possible through the cooperation of Mr. E. V. Meadows, principal, and Mrs. Ernestine Smith, physical science teacher, at Tarboro High School.

The Tested Hypothesis

A null hypothesis is generally recognized as the best type of hypothesis to employ in statistical studies. The null hypothesis is defined by Batten (1976) as, "a method used to test the significance of difference. The hypothesis asserts that there is no true difference between the means of the two distributions of scores and that the difference found between sample means (if one) is accidental and unimportant."[32]

This study analyzes the following null hypotheses:

1. There is no significant difference in attitudes toward school (specifically the science classroom) between students exposed to specialized activities for Low Academic Performers and a comparable non-treatment group, as measured by the Instructional Objective

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[32]James W. Batten, Human Procedures in Education Research, Second Edition. Greenville, N.C.: Morgan Printers, Inc., 1976, p. 300.

Exchange's Self Appraisal Inventory (Intermediate Level).

2. There is no significant difference in attitudes toward science between students exposed to specialized activities for Low Academic Performers and a comparable non-treatment group, as measured by the Instructional Objective Exchange's School Sentiment Index (Intermediate Level).

3. There is no significant difference in science attitudes between students exposed to specialized activities for Low Academic Performers and a comparable non-treatment group, as measured by the Moore's Science Attitude Inventory.

Duration of the Study

This study was initiated in August, 1977, and terminated in March, 1978. Students were pre-tested for their attitudes toward science and science instruction in August, 1977, and post-tested using the same measures in March, 1978.

The Study Group

The study group consisted of 152 students who were enrolled in Phase III physical science classes during the 1977-78 academic year at Tarboro High School.

Selection of the Sample

Both the study group and the comparison group were enrolled in low level or Phase III science classes at Tarboro High School during the 1977-78 school year. The study group was composed of three low

level or Phase III classes taught by the investigator. The comparison group was composed of students from three low level or Phase III classes taught by another physical science teacher on the Tarboro High School staff.

Size of the Sample

The Study Group was comprised of three Phase III physical science classes. The data for the Study Group is summarized below.

	August, 1977 Pre	March, 1978 Post
Total Student Population	76	65
Number of Students Responding to the Attitude Inventories	60	54

The Comparison Group was comprised of three Phase III physical science classes. Data for the Comparison Group is summarized below.

	August, 1977 Pre	March, 1978 Post
Total Student Population	76	75
Number of Students Responding to the Attitude Inventories	69	66

Description of the Treatment

Pre-test Team Competition

A. Treatment Objectives

. The students will receive practice in responding quickly and accurately to test questions under a no-fail grading situation.

. The students will become familiar with the type of questions that will be found on their written test and will learn how to respond to these questions in a correct and acceptable manner.

. The students will learn the value of teamwork and cooperation since each team is graded as a unit. The academically successful students learn to help the slow students prepare for the competition.

. The slow students have the possibility of receiving a score that was previously almost impossible for them to achieve and will hopefully develop new incentive and a desire for further success.

. The students will learn to experience academic achievement. Neither team fails or receives a grade less than 80% so the element of inferiority or failure is eliminated and the student's self-esteem is strengthened.

B. Description

Unit tests were given on Thursday and spaced approximately two weeks apart. Prior to each unit test, usually the day before, the class was divided into two teams. This was accomplished by picking two students as team captains and allowing them to pick their own teams or by the instructor assigning students to specific teams. Usually the team captains decided the teams with the Low Academic Performers being equally distributed between the two teams. Each team was then given a name, arbitrarily chosen, such as the "Reds" or the "Blues", etc.

The two teams positioned themselves along opposite sides of the

classroom and formed a single file line facing the chalkboard. Each team sent one representative, the first person in line, to the chalkboard. There, they were asked one question concerning the material studied for the unit test. They were given no more than thirty seconds to respond by writing the correct answer on the chalkboard. The first one to correctly complete the answer, place the chalk in the tray and turn around facing the instructor was the winner of that round and returned to his or her team at the end of the line. An incorrect answer (from one or both students at the chalkboard) resulted in the student returning to his or her seat and being eliminated from the competition. The teams then sent the next person in line to the chalkboard as their representative and the contest continued with another question. The last team with a player left standing was declared the winner.

It was usually more beneficial to select questions from the material that was to appear on the unit test. Short answer objective questions and basic problems worked very well while essay type and subjective questions were too complicated to judge in a team competition. The questions were presented in the same manner as they would appear on the unit test so that the student could become familiar with the type of question and wording of the question.

The team competitions were recorded in the gradebook as a daily grade for the participating students. Each member of the winning team received a daily grade of 100% and each member of the losing team received a daily grade of 80%.

Classroom Debates

A. Treatment Objectives

. The students will be encouraged to pursue science topics that interest them and receive recognition for their efforts.

. The students will be exposed to current science topics that affect them and their daily lives more than the structured text materials which are often content centered and viewed irrelevant to the Low Academic Performers.

. The students will be given more opportunities to direct their own education in science.

. The students will experience an alternative to the ordinary classroom routine and be given an opportunity to voice their opinions with instructor approval.

B. Description

Periodically (such as every other Friday), the students were allowed to debate on a current science topic that interested them. The topics were chosen two weeks before the proposed debate day by a class majority vote. At least two students were selected to represent each side of the debate. The selected students then had two weeks to research and prepare their debate. Strict debating rules were followed including time limits for each presentation, rebuttals, and no outside comments or interruptions permitted by the remainder of the class until the presentations were over. A fifteen-minute classroom discussion followed the debate in order to provide an opportunity for all the other students to voice their opinions on the topic.

Participation in classroom debates was either counted in with the daily grades or it served as an adjusting factor for the six-week averages. It was important that the participating students receive some form of recognition for their efforts.

Student Presentations

A. Treatment Objectives

. The students participating in the presentations become directly involved in the class activities.

. The class is exposed to the science material through peer teaching.

B. Description

Individual students selected science topics that interested them from those being discussed in the classroom or projected for the near future. They prepared background material and class activities. They also assumed the teaching responsibility for their chosen topic. Teacher aid and assistance was given; however, the main ideas discussed originated from the students. Academic recognition was given for student effort.

Top Twenty Board

A. Treatment Objectives

. The students will associate the board with the collegiate top twenty listing in terms of prestige and achievement.

. The students will receive recognition for academic achievement and future incentive for exhibiting good work through the rewards that

accompany the top twenty board.

. The students will receive visual reward for their academic effort along with a continuous record of their progress.

B. Description

This was a classroom listing of the twenty students with the highest point totals for test and daily work. The list was changed or updated after every recorded grade and was displayed in the classroom. Those students on the board received class benefits as incentive, such as: extra privileges, field trips, and periodic classwork exemptions. They were also given the extra responsibility of leading class reviews during the mid-term exams.

Positions from 1 to 20 were arranged on the board with individual tags used to represent the student's name and point total. All of the tags were uniform in size.

The board was limited to twenty students in order to associate it with the United Press International and Associated Press top twenty listing of collegiate football and basketball teams.

Positive Reinforcement Grading

A. Treatment Objectives

. By placing instructor attention and emphasis on the positive aspects of the student's performance, the student's emphasis and attention is also channeled in a positive direction.

. The students will receive more attention and concern for

their accomplishments than their failures.

B. Description

Under this grading approach, the only marks that the instructor placed on the test papers were indications of correct responses. Incorrect and incomplete student responses to test questions were not marked during the grading process. All of the instructor's attention and emphasis was placed on the student's positive remarks. The students were instructed as to how many questions they must answer correctly in order to pass the test instead of how many questions they were allowed to miss and still pass. It was important for the student to understand that his ability to answer correctly was much more important to the instructor than his inability to answer correctly.

Extra-Instruction Sessions

A. Treatment Objectives

. The students learn to seek help on small problems before they grow out of control.

. The students that lack the necessary background skills are given an opportunity for remedial aid.

. The students receive the assurance that the instructor is truly interested and concerned about their education and future.

B. Description

Students with classroom difficulty, such as failing test scores, were encouraged to see the instructor for extra assistance in an attempt

to remedy problems before they resulted in academic failure. These sessions were arranged before school, during the student's lunch period or after school. The instructor provided assistance in subject matter comprehension, note-taking techniques, test-taking techniques, study techniques or any other areas in which the student needed assistance.

These sessions were extremely important in cases where the student lacked the basic skills necessary to complete the assigned material. In the physical science classes, areas of deficiency often included poor mathematical skills along with low reading and inadequate comprehension.

Sources of Data

In order to measure changes in attitude, this study utilizes the I.O.X. School Sentiment Index (Intermediate Level), I.O.X. Self Appraisal Inventory (Intermediate Level) and the Moore's Science Attitude Inventory.

The Instructional Objectives Exchange (I.O.X.) employs a criterion-referenced approach to development of measurement items. Judges are used to determine specific objectives that are clearly stated and important for the learner. Test items are chosen that will measure the student's attainment of the objectives. "The emphasis is on the congruence between a defensible objective and the items used to measure that objective."[33] The criterion-referenced test is designed to detect the status of the selected sample before and after educational treatment.[34]

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[33] Measures of Self Concepts, K-12 (Revised Edition), Instructional Objectives Exchange (Los Angeles, California), 1972, p. iii.

[34] Ibid., pp. iii-v.

I.O.X. School Sentiment Index (Intermediate Level)

The inventory is composed of eighty-one statements pertaining to four aspects of attitude toward school: teacher, learning, peer and general. The statements may be read independently by the students or orally by the teacher. The students respond "true" or "untrue" by each statement to indicate whether the statement is true or untrue about them.

The School Sentiment Index may be administered in three different ways.

1. Use of twenty-five selected statements resulting in a single score and an overall estimate of attitude toward school.

2. Use of all statements with the four aspects (teacher, learning, peer, and general) scored separately and analyzed separately.

3. Use of statements pertaining to a specific aspect of attitude rather than all four aspects, with the specific aspect scored separately.[35]

This study utilized statements pertaining to four aspects: (1) teacher, (2) learning, (3) peer, and (4) general. They resulted in a single score and an overall estimate of attitude toward school. The terms "science teacher" or "science class" were inserted in the wording of the questions in order to solicit a specific response from the sample that was confined to their attitude toward science class.

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[35] Attitude Toward School, K-12, (Revised Edition), Instructional Objectives Exchange (Los Angeles, California), 1972), pp. 78-81.

I.O.X. Self Appraisal Inventory

The inventory is composed of seventy-seven statements pertaining to four aspects of self concept: (1) peer, (2) family, (3) school, and (4) general. The statements may be read independently by the students or orally by the teacher. The students respond by choosing one of four available responses: strongly agree, agree, disagree, or strongly disagree.

The Self Appraisal Inventory may be administered in three different ways.

1. Use of all inventory statements resulting in a single score and an overall estimate of self concept.

2. Use of all statements with the four aspects of self concept (peer, family, school and general) are scored separately and analyzed separately.

3. Use of statements pertaining to a specific aspect of self concept rather than all four aspects, with the specific aspect scored separately.[36]

This study utilized fifteen statements emphasizing the school aspect. All statements presented to the sample population were taken from the school section of self concept. The terms "science class" or "science teacher" were inserted in the wording in order to solicit a specific response from the sample that was confined to their experiences in the science classroom. The questions were answered either "true" or "false".

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[36]Measures of Self Concept, op. cit., pp. 64-67.

Moore's Science Attitude Inventory

This inventory is based on a group of specific attitudes toward science and science teaching. Each item is designed to aid in the assessment of these attitudes. The development of these attitudes was based upon three criteria.

1. The attitudes to be assessed must reflect the concerns of science educators for the objectives of science teaching.

2. Intellectual attitudes toward science and emotional attitudes about science must be assessed.

3. Both positive and negative attitudes must be included in the assessment.[37]

Each attitude is approached in both a positive and a negative manner. They are listed below. The numbers that are followed by the letter "P" are the positive attitude statements, while the numbers that are followed by the letter "N" are the negative attitude statements.

The following attitude statements pertaining to science were utilized in this study:

1-P The laws and/or theories of science are approximations of truth and are subject to change.

1-N The laws and/or theories of science represent unchangeable truths discovered through science.

2-P Observation of natural phenomena is the basis of scientific explanation. Science is limited in that it can only answer

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[37]Richard W. Moore and Frank X. Sutman, "The Development, Field Test and Validation of an Inventory of Scientific Attitudes," Journal of Research in Science Teaching, 7; (1970), pp. 85-94.

questions about natural phenomena and sometimes it is not able to do that.

2-N The basis of scientific explanation is in authority. Science deals with all problems and it can provide correct answers to all questions.

3-P Science is an idea-generating activity. It is devoted to serving mankind. Its value lies in its practical uses.

4-P Progress in science requires public support in this age of science; therefore, the public should be made aware of the nature of science and what it attempts to do. The public can understand science and ultimately benefit from scientific work.

4-N Public understanding of science would contribute nothing to the advancement of science or to human welfare; therefore, the public has no need to understand the nature of science. They cannot understand it, and it does not affect them.[38]

The students responded to the statements by choosing one of four available responses: strongly agree, agree, disagree, or strongly disagree. The statements were scored and analyzed separately according to specific attitudes and also scored together in order to determine an overall view of science attitudes.

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[38]Ibid., pp. 52-54.

Collection of the Data

The pre-test inventories were administered to the members of the study group and the comparison group in August, 1977, during the individual physical science class periods. The inventories were introduced to the students by reading the directions at the top of each questionnaire without any further instructions. The inventories were not administered in any particular order. The students were informed that their participation was entirely voluntary. Time limits were not placed on the completion of any questionnaires and the class period allowed sufficient time for everyone to finish.

The post-test inventories were administered in March, 1978, in the same manner as the pre-test inventories to both the study group and the comparison group. Student instructions and the testing environment were duplicated as closely as possible to the pre-test conditions.

Procedures for Analysis of Data

Student data for all of the inventories were hand-calculated.

t-Test

A *t*-test is used as a test of significance between the means of two groups and is significant if the value obtained is greater than the table value for the corresponding degrees of freedom at the desired level of significance. The table for determining the level of significance of *t*-values in this study was given in Table E of Guilford and Fruchter's text.[39]

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[39] J. P. Guilford and Benjamin Fruchter, Fundamental Statistics in Psychology and Education, Fifth Edition (New York, McGraw-Hill, Inc., 1973), p. 515.

A t-test was used to determine if there were any significant differences in the measurable attitudes between students taught by the study investigator and those taught by another physical science instructor. The t-test was used to analyze data from the Self Appraisal Inventory and Moore's Science Attitude Inventory.

Chi Square

A chi square is used as a test of significance with data in the form of frequencies, or data that can be readily transformed into frequencies and is significant if an obtained chi square value is greater than the table value for the corresponding degrees of freedom at the desired level of significance. The table for determining the level of significance of chi square values in this study was given in Table F of Guilford and Fruchter's text.[40]

A chi square was used to determine if there were any significant differences in students' responses to the School Sentiment Index between students taught by the study investigator and those taught by another physical science instructor.

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[40]Ibid., p. 517.

CHAPTER IV

ANALYSIS OF THE DATA

In order to analyze the effectiveness of the treatment exposure in this study, statements of the problem under investigation were presented in the form of null hypotheses. The investigator was directed in the collection of data appropriate to the problems by the statements of these hypotheses. There are three major hypotheses in the study, all of which are discussed and summarized in this chapter.

Hypothesis Concerning the Attitudes Toward School of Low Academic Performers

Items from the Instructional Objective Exchange's Self Appraisal Inventory were administered prior to and upon completion of the testing period. It was used to test for differences in student attitudes toward science classes between the study and comparison groups.

Hypothesis 1

There is no significant difference in attitudes toward science (specifically the science classroom) between students exposed to specialized activities for Low Academic Performers and a comparable non-treatment group.

Four t-tests were conducted to test this hypothesis. A summary of these analyses are included in Figure 1. (1) A t-test was conducted on the pre-test data for both the study group and the comparison group in order to determine if the entering attitudes of the two groups were

FIGURE 1

t-TEST ANALYSIS OF THE SELF APPRAISAL INVENTORY

Data Analyzed	Calculated t	$t_{(14).05}$
1. Study and Comparison Group Pre-Test Differences	.555	2.145
2. Study Group Pre-Post Test Differences	2.17	2.145
3. Comparison Group Pre-Post Test Differences	-.721	2.145
4. Study and Comparison Group Post-Test Differences	4.44	2.145

different. No significant difference was found. The pre- and post-test changes for both study and comparison groups were also analyzed through the use of a t-test. (2) The study group experienced a significant positive change. (3) The comparison group evidenced no statistically significant change. (4) Finally, a t-test was conducted between post-test scores of the study and comparison groups. A t-value of 4.44 was significant at the .05 level. Based upon this evidence, the null hypothesis was rejected. Specific data analyses are found in Tables 1, 2, 3, and 4 of Appendix A.

Hypotheses Concerning the Science Attitudes of Low Academic Performers

Items from the Instructional Objective Exchange's School Sentiment Index were administered prior to and upon completion of the testing period. In addition, the Moore's Science Attitude Inventory, a standardized test instrument, was utilized to measure the science attitudes of students participating in the study.

Hypothesis 2

There is no significant difference in attitudes toward science between students exposed to specialized activities for Low Academic Performers and a comparable non-treatment group, as measured by the Instructional Objective Exchange's School Sentiment Index (Intermediate Level).

Twenty-five items were selected from the Instructional Objective Exchange's School Sentiment Index to measure the student's attitudes toward science. A 70% criterion level was established as the expected

level of achievement for correct item responses. A summary of the data for both study and comparison groups is included in Table 5 of Appendix A. Table 6 summarizes the items that scored at the 70% achievement level, pre- and post-test, for the study and comparison groups.

A chi square for the pre-test differences in criterion level achievement between the study and comparison groups yielded a score of 0.74 which was not significant at the .05 level (Appendix A, Table 7). This means that no statistically significant difference existed in the achievement of the two groups at the beginning of the study.

A chi square for the post-test differences of the 70% criterion level between the study and comparison groups yielded a score of 4.16, which was greater than the table value of 3.84 at the .05 level of significance (Appendix A, Table 8). The difference favored the study group; therefore, the null hypothesis was rejected.

Hypothesis 3

There is no significant difference in science attitudes between students exposed to specialized activities for Low Academic Performers and a comparable non-treatment group as measured by the Moore's Science Attitude Inventory.

A series of t-tests was conducted between the pre-test data and the post-test data for both study and comparison groups. The t-tests were conducted individually on each sub-scale of the inventory along with a total score analysis. Pre-post differences for both the study and comparison groups failed to achieve statistical significance in any sub-scale or on the total score (Appendix A, Table 9).

A t-test was also conducted on the pre-post differences between the study group and the comparison group. A t-value of 1.00 failed to achieve significance at the .05 level; therefore, the null hypothesis was accepted (Appendix A, Table 10).

Summary of Hypotheses

Hypothesis	Analysis	Results
1. There is no significant difference in attitudes toward school (specifically the science classroom) between students exposed to specialized activities for Low Academic Performers and a comparable non-treatment group, as measured by the Instructional Objective Exchange's Self Appraisal Inventory (Intermediate Level).	t-test	Rejected
2. There is no significant difference in attitudes toward science between students exposed to specialized activities for Low Academic Performers and a comparable non-treatment group, as measured by the Instructional Objective Exchange's School Sentiment Index (Intermediate Level).	Chi Square	Rejected

Hypothesis	Analysis	Results
3. There is no significant difference in science attitudes between students exposed to specialized activities for Low Academic Performers and a comparable non-treatment group, as measured by the Moore's Science Attitude Inventory.	t-test	Accepted

CHAPTER V

SUMMARY, CONCLUSIONS AND IMPLICATIONS

Introduction

One of the continuing concerns in science education is the large percentage of non-achievers and slow learners that are being left behind educationally. They have often been grouped together, and in many cases just forgotten. The majority of the techniques available to the teacher for helping slow learners and underachieving students involve resources beyond those available to most classroom teachers. This study attempts to develop and utilize some strategies consistent with the limited budget realities of most science classrooms in eastern North Carolina.

This study attempted to answer the following question: Does the introduction of a series of specialized activities into the science classroom significantly improve the science attitudes and attitudes toward school science classes of Low Academic Performers?

This study was concerned with answering this question as it related to students enrolled in Phase III physical science classes during the 1977-78 academic year at Tarboro High School.

The procedures followed in this study were (a) reviewing the literature related to helping the Low Academic Performers in the classroom, (b) developing a series of specialized activities to be used in the classroom, (c) designing the study, and (d) analyzing the

data obtained from the design. The significant findings of the study, together with implications related to the findings, are presented in this chapter.

Summary

Literature Review

The major problem areas discussed in the literature were:

1. The relationship of a positive classroom environment in creating academic self-esteem. Gaddis and others state that self-esteem can be increased by providing classroom instruction that will allow the student to experience success and achievement.

2. The role of the subject matter and its presentation in motivating and arousing the interest of students. Younie's curricular approach to science places a great deal of emphasis on the needs of the "slow to average learning underachiever." Wong's text is written in the language of the student and utilized investigations that relate to the daily lives of the students.

3. The relationship of positive reinforcement in grading techniques. Watson suggests that teachers mark only the correct responses (thus emphasizing the positive). This channels the student's attention and emphasis in a positive direction.

4. The need for corrective education. Some students are restricted in their academic achievement due to an inadequate background. This lack of skill perpetuates poor performance and reduces student enthusiasm.

Design of the Study

From this review, a series of specialized activities was developed and implemented in science classes for the Low Academic Performers. These techniques were:

1. classroom debates and student presentations designed to improve the classroom environment by increasing positive involvement of students,

2. focusing on the science topics that interest the students and that seem relevant to their lives,

3. using pre-test team competition and a grading system that reinforces correct responses,

4. posting a top twenty grade board to be used to aid in raising academic incentive,

5. providing extra instruction sessions as a means of corrective education.

Unlike many of the previous methods for dealing with Low Academic Performers, these techniques can be implemented by any science teacher in any classroom without the aid of any outside assistance or funding.

This study involved 152 students enrolled in Phase III physical science classes during the 1977-78 academic year at Tarboro High School.

The study group and the comparison group were administered attitude inventories to measure their attitudes toward science and science classes. The following inventories were given in August, 1977, and again in March, 1978, in order to measure the degree of improvement in their science attitudes:

I.O.X Self Appraisal Inventory,

I.O.X. School Sentiment Index,

Moore's Science Attitude Inventory.

Analysis of the Data

The t-test of significance was employed in order to determine if any significant differences in attitudes toward science could be detected between the study and comparison group, as measured by the I.O.X's Self Appraisal Inventory.

The t-test of significance was employed in order to determine if any significant differences in attitudes toward science could be detected between the study and comparison group, as measured by the Moore's Science Attitude Inventory.

A chi square test of significance was employed in order to determine if any significant differences in attitude toward science could be detected between the study and comparison group, at a 70% criterion level, as measured by the I.O.X.'s School Sentiment Index.

Conclusions

The tests yielded mixed results. No significant difference could be detected by the standardized Moore's Science Attitude Inventory. However, the criterion referenced instruments yielded significant results favoring the study group. The I.O.X. criterion statements were selected as objectives by the study investigator and, thus, were more accurate measures of the expected outcomes of this study than the standardized inventory. The weight of the testing evidence does suggest

that the implementation of a series of specific activities, like those utilized in this study, can improve the science attitudes and attitudes toward school science of students described as Low Academic Performers.

Implications

Overall, the study indicates that specialized activities designed to improve science attitudes can be implemented into the science classroom; and, furthermore, that improved student attitudes will result. The particular specialized activities developed and utilized by this study are not exclusive to the field of science. Therefore, the positive results of these techniques might very well be applicable to other school subjects, science or otherwise.

The mixed testing results of this thesis indicate that more study needs to be done in the area of science attitude improvement for Low Academic Performers.

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APPENDIX A

Table 1

A t-TEST ANALYSIS OF THE
STUDY AND COMPARISON GROUP PRETEST DIFFERENCES
ON THE
SELF-APPRAISAL INVENTORY

$\Sigma D = +0.45$

$\bar{D} = .03$

$\Sigma(D - \bar{D})^2 = 0.657$

$$S_D = \sqrt{\frac{\Sigma(D - \bar{D}^2)}{N - 1}}$$

$S_D = .21$

$$S_{\bar{D}} = \frac{S_D}{\sqrt{N}}$$

$S_{\bar{D}} = .054$

$$t = \frac{\bar{D} - 0}{S_{\bar{D}}}$$

$t = .555$

$t_{(14)}$ .05 = 2.145

Number of Students	Study Group	Comparison Group
Pre-Test	60	69
Post-Test	54	66

Table 2

A t-TEST ANALYSIS OF THE
STUDY GROUP PRE-POST TEST DIFFERENCES
ON THE
SELF-APPRAISAL INVENTORY

$\Sigma D = +0.77$

$\bar{D} = .05$

$\Sigma(D - \bar{D})^2 = 1.12$

$$S_D = \sqrt{\frac{\Sigma(D - \bar{D})^2}{N - 1}}$$

$S_D = .09$

$$S_{\bar{D}} = \frac{S_D}{\sqrt{N}}$$

$S_{\bar{D}} = .023$

$$t = \frac{\bar{D} - 0}{S_{\bar{D}}}$$

$t = 2.17$

$t_{(14)}.05 = 2.145$

Number of Students	Study Group	Comparison Group
Pre-Test	60	69
Post-Test	54	66

Table 3

A t-TEST ANALYSIS OF THE
COMPARISON GROUP PRE-POST TEST DIFFERENCES
ON THE
SELF-APPRAISAL INVENTORY

$\Sigma D = -0.89$

$\bar{D} = -.05$

$\Sigma(D - \bar{D})^2 = 1.03$

$$S_D = \sqrt{\frac{\Sigma(D - \bar{D})^2}{N - 1}}$$

$S_D = .27$

$$S_{\bar{D}} = \frac{S_D}{\sqrt{N}}$$

$S_{\bar{D}} = .069$

$$t = \frac{\bar{D} - 0}{S_{\bar{D}}}$$

$t = -.724$

$t_{(14).05} = 2.145$

Number of Students	Study Group	Comparison Group
Pre-Test	60	69
Post-Test	54	66

Table 4

A t-TEST ANALYSIS OF THE
STUDY AND COMPARISON GROUP POSTTEST DIFFERENCES
ON THE
SELF-APPRAISAL INVENTORY

$\Sigma D = -1.2$

$\bar{D} = -.08$

$\Sigma(D - \bar{D})^2 = 0.761$

$$S_D = \sqrt{\frac{\Sigma(D - \bar{D})^2}{N - 1}}$$

$S_D = .07$

$$S_{\bar{D}} = \frac{S_D}{\sqrt{N}}$$

$S_{\bar{D}} = .018$

$$t = \frac{\bar{D} - 0}{S_{\bar{D}}}$$

$t = 4.44$

$t_{(14)}.05 = 2.145$

Number of Students	Study Group	Comparison Group
Pre-Test	60	69
Post-Test	54	66

TABLE 5

PRE AND POST CORRECT RESPONSE PERCENTAGES
FOR THE IOX SCHOOL SENTIMENT INDEX

	Study Group			Comparison Group		
Item	Pre	Post	Change	Pre	Post	Change
1	43	55	+11	58	53	- 5
2	28	21	- 7	31	21	-10
3	59	61	+ 2	55	39	-16
4	48	63	+15	44	26	-18
5	66	65	- 1	60	62	+ 2
6	68	72	+ 4	77	74	- 3
7	67	73	+ 6	70	67	- 3
8	67	78	+11	76	62	-14
9	64	60	- 4	65	55	-10
10	73	75	+ 2	67	60	- 7
11	80	74	- 6	79	79	0
12	75	79	+ 4	68	70	+ 2
13	70	62	- 8	71	62	- 9
14	62	54	- 8	62	47	-15
15	77	75	- 2	76	68	- 8
16	75	81	+ 6	72	77	+ 5
17	61	77	+16	74	65	- 9
18	80	70	-10	75	82	+ 7
19	61	71	+10	61	52	- 9
20	50	67	+17	78	54	-24
21	74	64	-10	67	52	-15
22	66	62	- 4	70	67	- 3
23	85	83	- 2	79	80	+ 1
24	53	50	- 3	55	35	-20
25	66	76	+10	66	53	-13

TABLE 6

PRE AND POST TEST ITEMS ACHIEVING 70% OR GREATER CORRECT RESPONSES ON THE MODIFIED IOX SCHOOL SENTIMENT INDEX

	Pretest		Posttest	
	Study	Comparison	Study	Comparison
Items	10	6	6	6
	11	7	7	11
	12	8	8	12
	13	11	10	16
	15	13	11	18
	16	15	12	23
	18	16	15	
	21	17	16	
	23	18	17	
		20	18	
		22	19	
		23	23	
			25	
Totals	9	12	13	6

TABLE 7

PRETEST χ^2 FOR 70% CRITERION ACHIEVEMENT
ON SELF APPRAISAL INVENTORY

	fo			fe		fo - fe		$(fo - fe)^2$		$(fo - fe)^2/fe$		
	Study	Comp.	Both	Study	Comp.	Study	Comp.	Study	Comp.	Study	Comp.	Both
>70%	9	12	21	10.5	10.5	-1.5	+1.5	2.25	2.25	0.21	0.21	0.42
<70%	16	13	29	14.5	14.5	+1.5	-1.5	2.25	2.25	0.16	0.16	0.32
Both	25	25	50	25	25	0	0			.37	.37	0.74 = χ^2

$\chi^2(1)$ at .05 = 3.84

Number of Students	Study Group	Comparison Group
Pre-Test	60	69
Post-Test	54	66

TABLE 8

POSTTEST χ^2 FOR 70% CRITERION ACHIEVEMENT
ON SELF APPRAISAL INVENTORY

	fo			fe		fo - fe		$(fo - fe)^2$		$(fo - fe)^2/fe$		
	Study	Comp.	Both	Study	Comp.	Study	Comp.	Study	Comp.	Study	Comp.	Both
>70%	13	6	19	9.5	9.5	+3.5	-3.5	12.25	12.25	1.29	1.29	2.58
<70%	12	19	31	15.5	15.5	-3.5	+3.5	12.25	12.25	.79	.79	1.58
Both	25	25	50	25	25	0	0			2.08	2.08	4.16 = χ^2

$\chi^2_{(1)}$ at .05 = 3.84

Number of Students	Study Group	Comparison Group
Pre-Test	60	69
Post-Test	54	66

TABLE 9

SUB-SCALE t-TEST PRE-POST DATA ANALYSIS
FOR MOORE'S SCIENCE ATTITUDE INVENTORY

	Calculated t-Value		
Moore's Sub-Scale	Study Group	Comparison Group	Table t-Value
1-N	1.50	1.42	2.57
2-N	0.55	0.15	2.57
3-N	1.68	0.50	2.57
4-N	0.01	0.01	2.57
1-P	0.21	0.37	2.57
2-P	1.57	0.66	2.57
3-P	1.85	1.25	2.57
4-P	1.80	1.00	2.57
TOTAL	0.20	1.33	1.95

Number of Students	Study Group	Comparison Group
Pre-Test	60	69
Post-Test	54	66

Table 10

A t-TEST ANALYSIS OF THE
STUDY AND COMPARISON GROUP ANALYSIS OF PRE-POST DIFFERENCES
ON THE
MOORE'S SCIENCE ATTITUDE INVENTORY

$\Sigma D = -2.80$

$\bar{D} = -0.07$

$\Sigma(D - \bar{D})^2 = 7.67$

$$S_D = \sqrt{\frac{\Sigma(D - \bar{D})^2}{N - 1}}$$

$S_D = 0.44$

$$S_{\bar{D}} = \frac{S_D}{\sqrt{N}}$$

$S_{\bar{D}} = .07$

$$t = \frac{\bar{D} - 0}{S_{\bar{D}}}$$

$t = 1.00$

$t_{(39)}.05 = 2.069$

Number of Students	Study Group	Comparison Group
Pre-Test	60	69
Post-Test	54	66

APPENDIX B

SCHOOL SENTIMENT INDEX

Intermediate Level

Directions: On your answer sheet, please show whether each of these sentences is true or untrue for you by marking A (true) if the sentence is true or B (untrue) if it is not true.

For example:

1.	A True ====	B Untrue ====	1. My class is too easy.
2.	A True ====	B Untrue ====	2. I'd like to stay at my school always.

There are no right or wrong answers, so respond to each item as honestly as you can. Do not write your name on your answer sheet.

1. My science teacher always tries to tell me when he (she) is pleased with my work.
2. My science teacher is interested in the things I do outside of school.
3. Each morning I look forward to coming to science class.
4. In my science class, my teacher allows us to make many decisions.
5. My science teacher grades too hard.
6. My science teacher doesn't explain things very well.
7. My science teacher listens to what I have to say.
8. My science teacher tries to make class interesting to me.
9. I don't like having to go to science class.
10. My teacher tries very hard to help me understand hard schoolwork.
11. My science teacher treats me fairly.
12. My science teacher tries to make sure I understand what she wants me to do.
13. I really like working with the other students in my science class.
14. I'm afraid to tell my science teacher when I don't understand something.
15. My science teacher doesn't give fair tests.
16. My science teacher grades me fairly.
17. My science teacher is often too busy to help me when I need help.
18. My science teacher usually doesn't know what to do in class.
19. My science teacher cares about the feelings of the pupils in his (her) class.
20. My science teacher is usually grouchy in class.
21. I like to work with other students on science class projects.
22. Almost everything I learn in science class is dull.
23. I don't care what scores I get on my science work.
24. I'm very happy when I'm in science class.
25. I don't like science because it's too much work.

SELF APPRAISAL INVENTORY

Directions: Please show whether you agree or disagree with each of the statements in this booklet by marking one of the spaces on the answer sheet.

1. if you agree strongly
2. if you agree mildly
3. if you disagree mildly
4. if you disagree strongly

Example: 00. I want to be a movie star

00. 1 ▓ 2 — 3 — 4 —

(The person who marked this example agrees strongly with the statement, "I want to be a movie star.")

There are no right or wrong, so respond to each statement as honestly as you can.

1. I usually like my science teachers.
2. I forget most of what I learn in science.
3. I often volunteer in science class.
4. I am a good science student.
5. I often get discouraged in science class.
6. I am slow in finishing my science work.
7. I can give a good report in front of the class.
8. I am proud of my science schoolwork.
9. I am not doing as well in science as I would like to.
10. I find it hard to talk in front of the science class.
11. I am good in my science work.
12. My science classmates think I am a good student.
13. I like to be called on in science class.
14. I would like to drop out of school.
15. I can disagree with my science teacher.

MOORE'S SCIENCE ATTITUDE INVENTORY (MODIFIED)

There are some statements about science on the next few pages. Some statements are about a person's feelings about science. You may agree with some of the statements and you may disagree with others. That is exactly what you are asked to do. By doing this, you will show your attitudes toward science.

After you have carefully read a statement, decide whether you agree or disagree with it. If you agree, decide whether you agree mildly or strongly. If you disagree, decide whether you disagree mildly or strongly. Then, find the number of that statement on the answer sheet, and blacken the space by the

1 if you agree strongly.

2 if you agree mildly.

3 if you disagree mildly.

4 if you disagree strongly.

Example: 00. I would like to have many friends.

00. I ■ 2 — 3 — 4 —

(The person who marked this example agrees strongly with the statement, "I would like to have many friends.")

Please respond to each statement and blacken only one space for each statement.

Please do not make marks on this test booklet.

WHAT IS YOUR ATTITUDE TOWARD SCIENCE

1. There is no need for the public to understand science in order for scientific progress to occur.
2. Most people are not able to understand the work of science.
3. When something is explained well, there is no reason to look for another explanation.
4. The products of scientific work are mainly useful to scientists; they are not very useful to the average person.
5. A scientist must be imaginative in developing ideas which explain natural events.
6. Some questions cannot be answered by science.
7. Before one can do anything in science, he must study the writings of the great scientists.
8. Rapid progress in science requires public support.
9. Scientists believe that nothing is known to be true with absolute certainty.
10. A major purpose of science is to help man live more comfortably.
11. A new theory may be accepted when it can be shown to explain things as well as another theory.
12. Scientists do not need public support, they can get along quite well without it.
13. Every citizen should understand science because we are living in an age of science.
14. Science is so difficult that only highly trained scientists can understand it.
15. His senses are one of the most important tools a scientist has.
16. Science may be described as being primarily an idea-generating activity.
17. Ideas are one of the more important products of science.
18. Science is pretty easy to understand.
19. The value of science lies in its theoretical products.
20. A major purpose of science is to produce new drugs and save lives.

21. Science is devoted to describing how things happen.

22. Public understanding of science is necessary because scientific research requires financial support through the government.

23. I just never will understand science.

24. People need to understand the nature of science because it has such a great effect upon their lives.

25. Scientists discover laws which tell us exactly what is going on in nature.

26. Scientists believe that they can find explanations for what they observe by looking at natural phenomena.

27. Scientific laws cannot be changed.

28. There are some things which are known by science to be absolutely true.

29. An important purpose of science is to help man live longer.

30. A useful scientific theory may not be entirely correct, but it is the best idea scientists have been able to think up.

31. Today's electric appliances are examples of the really valuable products of science.

32. Scientists are always interested in improving their explanations of natural events.

33. The value of science lies in its usefulness in solving practical problems.

34. Most people are able to understand the work of science.

35. Scientific explanations can be made only by scientists.

36. We can always get answers to our questions by asking scientists.

37. Scientific laws have been proven beyond all possible doubt.

38. Looking at natural phenomena is a most important source of scientific information.

39. If a scientist cannot answer a question, all he has to do is to ask another scientist.

40. Anything we need to know can be found out through science.

41. Scientific ideas may be said to undergo a process of evolution in their development.

42. Scientists cannot always find the answers to their questions.