A STUDY OF THE RELATIONSHIP BETWEEN THE BIOLOGY TEACHERS' ATTITUDE TOWARD THE BSCS BIOLOGY PROGRAM AND THE STUDENTS' PERCEPTION OF THE TYPE OF LABORATORY AND CLASSROOM ACTIVITIES

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PREFACE

This study was performed as one segment of a four part study of biology curriculum practices on the high school level under the direction of Dr. Kenneth Wiggins, Associate Director of the Oklahoma State University Research Foundation.

The other three related studies listed below have been completed and may be found in the Oklahoma State University Library in the near future.

Stephen Hensley has concluded a study of the leader behavior of the principal and of the biology teacher and its effect on the type of biology classroom and laboratory activities.

Virgil Ackerson has completed a study of the organizational climate and the biology students' perception of present biology practices.

Wilford Lee is conducting a study into the leader behavior of the high school principal and his effect on the attitudes of the biology teachers of the school.

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CHAPTER I

THE NATURE OF THE PROBLEM

Introduction

The impact of the Biological Science Curriculum Study on biology in the American secondary schools has led to the renewed interest in approaches to high school biology. The Biological Science Curriculum Study, hereafter referred to as the BSCS, was concerned with biological education at all levels. However, since the BSCS regards the secondary schools as a turning point in American education, they have devoted their attention to biology on the secondary level.

Many publishers of biology texts have incorporated, in their texts, content and laboratory activities similar to the BSCS Biology Program. Thus, the impact of the BSCS Biology Program may be felt in schools that have not adopted the BSCS Biology Program.

The biology program of one school may differ considerably from another in the extent to which the BSCS approach is applied. One school may adopt the BSCS materials and objectives and carry out the BSCS approach to the finest detail, whereas another may adopt the BSCS materials but devote little time in developing the investigatory approach of the BSCS. Some schools may not have adopted the BSCS materials, but have utilized the BSCS approach while others have not used either the materials or the approach of the BSCS.

Research has been done in attempts to determine the effects of open and closed school climates on the BSCS Biology Program, the relationship between organizational climate and the high school biology program, and attempts to determine teacher attitude toward the BSCS Biology Program. Also, the relationship between the leader behavior of the principal in secondary schools and biology teachers' attitudes toward the BSCS Biology Program have been examined.

With this research at hand, it appears that after teacher attitude toward the BSCS approach has been determined, the students' understanding of the type of approach used should be examined.

Do teachers with favorable attitudes toward the BSCS Biology Program use the BSCS inquiry approach in their teaching? If so, do students observe this attitude in the type of laboratory and classroom activities?

Do students recognize teachers with unfavorable attitudes toward the BSCS Biology Program? If so, are these unfavorable attitudes of the teacher expressed in the type of laboratory and classroom activities?

These questions appear to be important if research on variables affecting the teacher's attitude are to be of value.

Significance of the Study

There is a need for further research on the relationship between a teacher's attitudes toward the BSCS Biology Program and the student's understanding of the type of biology laboratory and classroom practices carried out in the secondary schools.

It is hoped that this study will lead to a better understanding of

the relationship between teachers' attitudes toward the BSCS approach to biology and the students' recognition of the type of laboratory and classroom activity.

Secondly, it is hoped that the findings of this study will identify significant variables influencing attitudes toward the BSCS Biology Program, philosophy, methods, and materials.

If a relationship is found between the teachers' attitude and the students' perception, then more attention should be given to developing favorable attitudes in prospective teachers toward the BSCS philosophy, methods, and materials in science education programs.

The lack of a significant relationship between teacher attitude and student recognition of the type of laboratory and classroom activities would lead to further investigation of the reasons for lack of significance.

This study was an attempt to determine the reactions of high school biology teachers to the BSCS Biology Program through use of an Attitude Inventory and questionnaire.

The students of each teacher were tested to determine their recognition of the teacher's attitude. The students' recognition was based on the type of laboratory and classroom activities conducted by the biology teacher.

It is hoped that this study of the relationship between biology teachers' attitude toward the BSCS Biology Program and the students' recognition of this attitude in the type of classroom and laboratory activities will be of assistance in science curriculum development, teacher education programs, and science education programs.

Definition of Terms

Biology Teachers: Full time and/or part time certified secondary school biology teachers.

BSCS Biology Approach: An inquiry approach to teaching biological science with an emphasis on investigatory laboratory work.

BSCS Biology Program: The materials, textbooks, laboratory blocks, laboratory manuals and publications of the BSCS used in teaching the BSCS biology course. The inquiry approach is common to all materials of the BSCS.

Attitude: In this study, attitude is defined as the reaction of the biology teacher to the philosophy, methods, and materials of the Biological Science Curriculum Study's biology program.

Attitude Inventory (A.I.): An instrument, designed by Blankenship (7), consisting of forty-six items designed to determine biology teachers' reactions to the BSCS Biology Program.

Biology Laboratory Activity Checklist (BLAC): An instrument developed by Barnes (3) consisting of sixty items designed to measure the students' recognition of the type of laboratory activities occurring in the biology laboratory.

Biology Classroom Activity Checklist (BCAC): An instrument developed by Kochendorfer (27) consisting of fifty-three items designed to measure the students' recognition of the type of classroom activities occurring in the biology classroom.

Biology Teacher Questionnaire: A questionnaire developed by the author and associates consisting of demographic data and statements

relating to BSCS Biology Program designed to give support to the Attitude Inventory.

Perception: The ability to observe, understand, or recognize.

Statement of the Problem

The major purpose of this study is to determine the relationship of the biology teachers' attitudes toward the BSCS Biology Program and the students' understanding of the type of laboratory and classroom activities performed.

An inquiry into the reasons for teacher reactions to the BSCS Program is also in order. According to Blankenship (6), the results of such an evaluation may prove valuable to those designing curriculums as well as those anticipating revisions and modifications of existing biology programs. The results may also provide guidelines in developing new curricular materials and programs that would be consistent with current knowledge in science that could be used effectively in the secondary classroom.

Assumptions

The following are assumptions of this study: (1) The students' responses to the items on the instruments, the BLAC and the BCAC, are accurate indications of the students' observations of the type of laboratory and classroom activities; (2) The attitude inventory scores accurately reflect the teachers' reactions to the BSCS program and are supported by their responses on the teacher questionnaire.

Statement of Hypotheses

H_1 The type of laboratory activities perceived by the students in the biology laboratory will not differ significantly between teachers demonstrating a favorable attitude toward the BSCS Biology Program and those who expressed an unfavorable attitude.

H_2 The type of classroom activity perceived by the students in the biology classroom will not differ significantly between teachers demonstrating a favorable attitude and an unfavorable attitude toward the BSCS Biology Program.

H_3 There will be no significant difference in biology teachers' mean attitude toward the BSCS Biology Program when teachers are grouped into two groups: those above the median salary range and those below the median salary range.

H_4 There will be no significant difference in biology teachers' mean attitide toward the BSCS Biology Program when teachers are grouped into two groups: those above the median number of years of teaching experience and those below the median number of years of teaching experience.

H_5 There will be no significant difference in biology teachers' mean attitude toward the BSCS Biology Program when teachers are grouped into two groups: those above the median teacher age and those below the median teacher age.

H_6 The biology teachers' attitude toward the BSCS Biology Program will not differ significantly among biology teachers who have never completed a science seminar, workshop, or science course since graduating; those who have completed a science seminar, workshop, or science course five years ago or beyond; and those who have completed a science seminar, workshop, or science course within the last five years.

H_7 There will be no significant difference in biology teachers' mean attitude toward the BSCS Biology Program when teachers are grouped into two groups: those above the median number of preparations and those below the median number of preparations.

H_8 The biology teachers' attitude toward the BSCS Biology Program will not differ significantly between biology teachers who receive training in the BSCS Biology Program and those who did not.

H_9 The biology teachers' attitude toward the BSCS Biology Program will not differ significantly between male and female teachers.

H_{10} There will be no significant difference in biology teachers' mean attitude toward the BSCS Biology Program when teachers are grouped into two groups: those above the median number of hours in zoology and those below the median number of hours in zoology.

H_{11} There will be no significant difference in biology teachers' mean attitude toward the BSCS Biology Program when teachers are grouped into two groups: those above the median number of hours in botany and those below the median number of hours in botany.

H_{12} There will be no significant difference in biology teachers' mean attitude toward the BSCS Biology Program when teachers are grouped into two groups: those above the median number of hours in chemistry and those below the median number of hours in chemistry.

H_{13} The students' perception of the type of laboratory activity will not differ significantly between male and female students.

H_{14} The students' perception of the type of classroom activity will not differ significantly between male and female students.

Limitations of the Study

This study is limited by the inherent weakness of the instruments used in collecting the data, the method of collecting the data, the accuracy of the subjects' individual performance on the Attitude Inventory, Biology Laboratory Activity Checklist, Biology Classroom Activity Checklist, and the number of respondents.

Findings of the study will be limited to the population sampled.

CHAPTER II

SELECTIVE REVIEW OF LITERATURE

Introduction

The literature reviewed in this chapter will be that which the author feels is closely related to the problem. In order to investigate this problem it was necessary to gain an understanding of our existing knowledge concerning the BSCS Biology Program, teachers' attitudes toward the BSCS Biology Program, variables affecting biology teachers' reactions to the BSCS Biology Program, and how students observe such reactions in the laboratory and the classroom activities conducted by the biology teacher. Also, in order to gain a better understanding of teacher attitudes, instruments used in measuring attitude must be reviewed.

The BSCS Biology Program

In 1959, the Biological Sciences Curriculum Study formed the Curriculum Content Committee for the purpose of determining what the average student of biology should know about biology upon graduation from high school. The first actions to be taken by this committee were to outline the biological knowledge recommended for secondary school students and to design a set of criteria that would facilitate the formation of an affective program in biology.

During the summer of 1960, the Steering Committee directed the Curriculum Content Committee to supervise the preparation of materials for a first year high school biology course. The preparations of materials were to begin at a writing conference held in Boulder, Colorado, in July and August of 1960. (23)

The writing conference was to consist of high school biology teachers, university biologists, science supervisors, laboratory associates, educational psychologists, artists, and other specialized personnel. The biological material to be included was organized into various fields of study and a team of high school and university teachers were assigned to areas of their specialty to produce units of study in their respective areas.

At the various meetings, the discussion ranged from a restricted vocabulary for high school students of biology to a curriculum of "biology" rather than "plants plus animals". The goal of the writing conference was to develop a rough draft of separate topics for study. (57)

The aims and objectives of the writers were to prepare high school biology courses for average high schools with average students. These courses were assigned to give the student a basic understanding of science and of scientific processes and to build a scientific literacy to aid the student in becoming a responsible citizen. The writers have stressed concepts and the teaching of science as a means of seeking answers. Through laboratories, the writers have tried to give the students practice in drawing generalizations, in seeking relationships, and in finding their own answers. (1)

The Content Committee further commented that biology is frequently

the only science course taken in high school and that it is necessary to use biological examples to illustrate the scientific method, development of scientific ideas, and the impact of science on the welfare of mankind. (57).

The outcome of the writing conference resulted in three versions of a secondary school course in biology. These three versions are all designed to clarify, in the student's mind, the nature of scientific inquiry, the history of biological concepts, genetic continuity, regulation, complimentarity of structure and function, and many other important biological concepts. The nature of science was to be emphasized by repeating biological concepts with many examples. (50)

The BSCS realized early in the development of their program that the laboratory should play an important role in high school biology. There is a need to lead each investigation in biology to give the conception of biology as a science and as a process of science which is a reliable method of gaining objective information. (50)

Bently Glass, chairman of the BSCS Steering Committee, states that the high school biology laboratory has two functions. The first function is the "illustrative function" consisting of the presentation of evidence from nature which supports biological concepts. The second function, and most important, is that of providing an opportunity for students to investigate firsthand, some problems to which the answer is unknown. This is the investigatory function. Active participation is necessary for understanding the nature of the scientific process, according to Glass.

With the idea that the investigative laboratory is an integral part of the BSCS Program, the Committee on Innovation in Laboratory

Instruction was established under the direction of Addison E. Lee. The task of this committee was to evaluate the existing role of laboratory experiences and produce laboratory instructional materials which would reflect the investigative nature of up-to-date biology. The "Laboratory Block" program consisting of in-depth studies of an area in biological science involving students for a six week period was the outcome of this committee's efforts.

In 1963, after evaluation and revision of the materials, the BSCS materials and texts were released by commercial publishers for general use. Further work of the BSCS led to a second year course in high school biology (5) and a course entitled BSCS Special Materials for use with students who could not successfully use the basic BSCS version texts. (32) Quarterly tests and a final test for each of the three versions have been developed, as well as a Comprehensive Final Examination and a Test on the Processes of Science.

The BSCS course, according to Hurd (26), present science as the scientists see science and in terms of modern concepts and theories. The need for a change in science teaching has been apparent since the early 1940's. Hurd states that most of the traditional courses were too far removed from reality and educational demands of our modern society. Curriculum revision would not accomplish a satisfactory change, so new courses had to be developed.

In teaching the BSCS Biology courses, much attention has been given to the method and manner of teaching. The BSCS courses are successful only when the spirit of inquiry exists. In order for this to occur, the classroom must become a learning laboratory. Hurd feels that science is more berb than noun. Science is based on investigation

and so must be the study of science. The laboratory should be an exercise in disciplined thinking with chance for error. It should acquaint the student with the processes of science. Teaching these courses demands that the teacher be an artist and a scholar rather than a science achievement commentator. (26)

The inquiry approach appears to be the backbone of the BSCS Biology Program and is incorporated through laboratory investigation. What is inquiry? Inquiry has been defined by many authorities. Young (59) defines inquiry as seeking of information by the asking of questions. Dewey (13) supports this by stating the following:

> The mind of man is being habituated to a new method and ideal: There is but one sure road to truth, the road of patient, cooperative inquiry operating by means of observation, experiment, record, and controlled reflection.

It appears as though this is what every good teacher has strived to achieve. Gagne (19) states that most authors who have written on the subject spend most of their time saying what it is not, not what it is. Most proponents of the inquiry approach believe it is the answer to dogmatic teaching in science.

Gagne stated the following as reasons for the necessity of inquiry in science teaching:

1. The need for more scientists. The dogmatic method of science teaching does little to stimulate students and attract them into science.

2. The need for political leaders to understand and discriminate between good and wasteful scientific projects.

3. The need to show the general public through inquiry, that science is not always infallible.

4. Public education serves a variety of ends and, therefore, a need esists to show the broader all encompassing aspects of science. (19)

The immediate future of inquiry lies in the classroom and adjoining laboratory. It is there that the future and present students and teachers will struggle to master the ideas and concepts of inquiry learning. (44)

Concern for the high school biology classroom and laboratory program is not a new endeavor. Rutledge (41) points out that laboratory work has been part of the high school science course for some time, but the specific function the laboratory should provide for the student and what should make up the laboratory work has varied considerably.

Watkins (55) was one of many who put forth objectives of the laboratory. His stated objectives were to: (1) develop laboratory techniques, (2) establish principles for the pupil, and (3) train students in the scientific method and experimental solution of the pupil's own problems. The latter, according to Watkins, is one of the most promising objective for high school biology laboratory and classroom instruction.

As early as 1917, Twiss (53) explained that science implies a systematic orderly study and is a method of solving problems. The laboratory experiment, according to Twiss, devised merely to aid in the memorizing of subject matter and for training in laboratory technique, does not contribute to the power of independent thinking or the love for investigation. Twiss states:

> The true spirit of science grows out of the desire to know truth that may have a useful outcome, and apply it to get results that are felt worthwhile, and hence, this spirit

> can be caught by children only when they investigate, learn, and apply in order to get results that appeal to them personally as worthy of their efforts.

Twiss also pointed out that the true way to acquaint students with the scientific method is to confront them with such problems and guide them in using the scientific method in reaching their solutions. The student should go to the laboratory not to perform experiments, do stunts, or verify laws, but to find out firsthand, through appropriate observations and experimentation, certain essential facts of observation needed in the scientific investigation of a problem.

The idea that a laboratory science course should be taught as a process of doing, increasing proficiency of observation, developing critical thinking, and the gaining of insight into the role of man's progress through the use of the laboratory was expressed by Dewey (14) in 1899, Hunter (26) in 1934, Stolberg (47) in 1953, and Dressel (16) in 1960. This idea was also stated in the 47th Yearbook of the National Society for the Study of Education (46).

Science teaching of recent years has failed to reflect the change in science. Until about 1929, the faculty of universities and colleges played an important role in the development of textbooks. These men were closely associated with the working scientist. However, with the expansion of public schools and the development of professional educators, textbook work passed to the professional educators and school teachers who were further removed from the working scientist. This led to the overlooking of growth and changes in the science fields. Revision of the text materials was slow and lagged far behind development of new knowledge. (44)

The laboratory, according to Schwab, can be easily converted to

the inquiry method. The first step is to make the laboratory the lead phase rather than the lag phase. Secondly, the demonstrative purpose of the laboratory should not be overemphasized.

In the BSCS Approach, the writers have stressed the teaching of science as a way of thinking; a method of seeking answers. Student work is centered in the laboratory where practice is given in seeking relationships, drawing generalizations, and finding answers or solutions to problems. One major variation from the traditional biology program is the emphasis on laboratory work that is less illustrative and more investigative. (44)

The BSCS Program differs from previous attempts to improve the science curriculum in that: (1) research scientists of colleges and universities worked in cooperation with high school teachers to develop a new outlook and perspective that is current, (2) for the first time the nature of understanding scientific inquiry and scientific enterprise is placed above the acquisition of scientific information and concepts. (21)

Blankenship (6) in 1965 expressed two major goals of the new science curriculum as identified by the scientists and teachers involved in this new curriculum: (1) development of materials and equipment that are consistent with the current knowledge in science, and (2) to provide the student with a knowledge of the processes of science through the development of curricular materials and science programs. Blankenship states further:

> The BSCS fully recognizes that merely providing new curricular materials, however good they may be, will not necessarily result in improved biology teaching in the secondary schools. It may facilitate improved teaching, but the teacher remains the key.

Grobman (22) points out that improved curricular materials alone will not automatically improve science teaching. The key to improved biology teaching is the teacher who has an understanding of the purpose of the BSCS Biology Program and is competent in his subject matter.

Teacher Attitude

With the advent of new curricular materials which incorporate the inquiry method, dogmatic teaching of science can be reduced. However, according to Mill (34), director of psychological services at the Department of Mental Hygiene and Hospitals of Richmond, Virginia, "Both teacher and pupil must examine their attitudes before learning can improve."

Dressel (16), after indicating that student activity is necessary in learning, also stresses the importance of the teacher's attitude in influencing such learning activities. Since the teacher plays an important part in inaugurating programs of a problem-solving nature or the inquiry approach, his attitude toward the new materials seems important.

Attitude, seemingly an illusive term, has been defined in many ways. Chien's (10) conception of an attitude is that it is a disposition to evaluate certain objectives, actions, and situations in certain ways.

Dobbs' definition of an attitude is that it is an implicit response which is both anticipatory and mediating in reference to patterns of overt responses, which is evoked by a variety of stimulus patterns as a result of previous learning or of gradients or generalization and discrimination, which is itself cue- and drive-producing, and which is

considered socially significant in the individual's society. (14)

Both Chien and Doobs agree that a person is not born with attitudes and that the learning process plays a major role in attitudes. Attitudes involve problems of perception and motivation. As a result of a certain attitude, a person may be more likely to perceive certain objects than others. However, specific behaviors cannot be safely predicted from knowledge of attitudes alone and people may not react in accordance with their attitudes at all times.

Krech (29), in his study of attitudes, identifies three characteristics of attitudes: the integrative aspects, the responsiveness of attitudes to experience, and the regarding of attitudes as a problem solving attempt.

Weiss (56) states that many schools are teaching science and many are not. Those that aren't may be teaching the facts of science which are important, but not the methods of science. Teachers, according to Weiss, are so concerned with providing answers that they minimize the importance of questioning.

If this is the case, then the attitude of the teacher toward facts and methods is important. If the BSCS Biology Program is based on inquiry and methods of finding answers, then the attitudes of teachers toward this approach must be improved if the BSCS Approach is to be successful.

Weiss (56) continues,

> A long hard look at our attitudes toward science and science teaching may not only increase the amount of these subjects taught, but may encourage teachers to try new methodology. There is a need for those who know the answers and an even greater need for those who know the proper questions to ask.

In teaching BSCS Biology, Weiss feels it can be taught by allowing questions to be asked, structuring questions in such a way that they admit to an answer, developing a series of hypotheses, controlling variables, collecting data, checking tenative conclusions, and asking more questions.

The chief problem facing investigators in the area of teacher attitudes is that of objective measurement of attitudes. One tentative solution to this problem has been obtained through the development of attitude measures designed for general use with teachers. Designing instruments for various subgroups of the teacher population may also serve as another possible solution.

Getzels and Jackson (20), in a study of teacher characteristics, reported the use of the Minnesota Teacher Attitude Inventory which has been utilized in more than fifty research studies reported in the literature. The manual (11) accompanying the inventory states that the attitudes measured by the Minnesota Teacher Attitude Inventory are those of teachers toward children and schoolwork. This inventory has been used when information concerning changes in attitudes, comparing scores of prospective teachers with those of experienced teachers, and evaluation of the teacher's competence have been sought.

Popham and Trimble (37), using the Minnesota Teacher Attitude Inventory, concluded from their findings that it could be used as an indication of the type of social atmosphere maintained by the teachers in the classroom.

Instruments other than the widely used Minnesota Teacher Attitude Inventory have also been used to assess teachers' attitude. Among these is the Teacher Characteristic Schedule that was developed and

used by Ryans (42) and his co-workers in the Teachers Characteristic Study. Certain dimensions of teachers' attitudes, verbal understandings, educational viewpoints, and emotional stability were investigated by using the Teacher Characteristic Schedule. Among the trends in the data it was found that the attitudes of elementary school teachers toward pupils, administrators, and fellow teachers were more favorable than were similar attitudes of secondary teachers. The actual pupils' behavior in the classroom, based upon observers' assessments, did not appear to be related to the attitudes held by teachers. Also, the educational viewpoints expressed by secondary teachers were more traditional than those of elementary teachers.

Leaders in science education stress the importance of concept generalizations, methods, and attitudes in science teaching. In a study by Dutton and Stephens (17) on teacher attitude toward elementary science, a Science Attitudinal Scale was developed for measurement of these attitudes. Two hundred teachers wrote short statements expressing their feeling toward science. Of these statements, fifty were selected for the attitude scale. These fifty statements were then submitted to prospective elementary science teachers to indicate their like or dislike for some aspects of elementary science on a continuum from one to eleven. The reliability of this scale according to the test-retest method was 0.93.

Tuppen (52) in 1966 found in his study that a teacher's effectiveness depends at least as much upon his attitude as upon his length of experience or other qualifications. Attitudes measured in this study pertained to types of organization in junior schools. The study was carried out in questionnaire form and was found to have a reliability

factor of 0.90.

In another study designed to determine the opinions of teachers about the objectives of biology, Amos (2) in 1968, found that length of teaching experience had considerable bearing upon the opinions expressed. This study, handled with the use of a questionnaire, also tested teachers' reactions to difficulties in teaching the scientific method.

Taylor (48), in a study of sixteen fourth grade teachers in Virginia, found that teacher attitudes toward programmed science materials were significantly related to student achievement. Teacher attitude was found to have contributed 18% of the variance in pupil final achievement while using programmed materials. The implication proposed is that in-serivce training should be employed to minimize and remove any apprehensions teachers have regarding new materials.

In a study carried out by Yager on the teacher effects upon science instruction, it was found that the teacher affects the degree of content, achievement, and growth of specific skills of the student. Yager points out that specific traits of teachers should be studied further in order to establish patterns causing particular student outcomes. (58)

Few would argue with the assertion that the professor has a difficult task in changing prospective teachers' skills and attitudes toward the instructional act. In Popham's study (40), the relationship of prospective student teachers' scores on an attitude inventory concerning instructional procedures and prospective teachers' teaching behavior was determined. A positive relationship was detected between prospective student teachers' scores on the Instructional Procedures Preferred Inventory Test and the teachers' use of instructional principles.

Schwirian (45) states that reforms in elementary school science are noticeably fashionable, often well financed and too often unsuccessful. Schwirian feels that the major problem lies in the attitudinal set of the classroom teacher. If the teacher does not see the relevance of the processes of science he is not likely to devote much time or energy to it.

Studies regarding the attitudes of secondary science teachers are practically nonexistent. Blankenship (6) studied biology teachers and their attitudes toward the BSCS Biology Program in order to determine their reactions to the BSCS Program. The Biology Teacher Attitude Inventory was developed for use in this study which involved a sample of 55 science teachers. Analysis of the data revealed that, in general, teachers who ranked higher in capacity for independent thought and action, and who had taught biology for three years or less reacted favorably to the BSCS Biology Program. Those teachers who ranked lower on independent thought and had been teaching high school biology for more than three years reacted unfavorably to the BSCS Biology Program.

Hoy and Blankenship (24) found that some teachers' attitudes toward the BSCS Biology Program changed after teaching biology for a period of time.

Flanders indicates that the behavior of the teacher, more than any other individual, sets the climate of the class (18) and Medley (33) states that if a teacher has any impact on the pupils' classroom learning, it will be through his behavior in the classroom. Corey (12) states that the importance of this concept lies in the fact that any change in teacher behavior must be preceded by a corresponding change

in teacher attitude. This change would have a determining influence in the classroom.

Victor (54) found that elementary teachers were sometimes afraid to teach science because of unfamiliarity with the subject and equipment. They lacked confidence in handling and manipulating materials used in scientific experimental activities. If this is true for elementary teachers, it would seem plausible that this may also have an effect on the secondary teacher's attitude toward the BSCS materials which are highly laboratory orientated.

Factors Related to Teacher Attitude

It has been demonstrated in research studies that the attitude of the teacher does influence the learning process. With this being the case, it would appear that studying variables that may affect the teachers' attitude would be of value in training teachers and bringing about the desired attitudes for new science programs.

There have been several attempts to pinpoint factors related to teacher attitude. One attempt (6) mentioned previously, found that capacity for independent thought and less than three years of teaching experience produced a more favorable reaction to the BSCS Biology Program. It was also found by Blankenship (6) that special training in the use of BSCS materials did not necessarily guarantee a more favorable attitude toward the BSCS materials.

Schwirian (45) tested three variables related to the attitude of the teacher. These were age, amount of higher education experienced by the teacher, and amount of college course work completed.

It was found that the effects of "amount of higher education", "years of teaching experience", and "nature of teaching experience", when examined were, in fact, effects of age.

LaBue (30) states that the attitudes of a person toward objects, persons, and processes have been shown to be dependent upon the amount and quality of information he possesses with respect to them.

Butler (9), in an analysis of academic preparation for high school biology teachers, studied the distribution of courses in science and mathematics between science teachers who demonstrated a more favorable attitude toward BSCS Biology and those who expressed an unfavorable attitude toward BSCS Biology. To make his problem more manageable, Butler reduced science and math courses to 19 subject matter areas or variables. It was found that completion or lack of completion of some subjects appeared to be related to the biology teachers' attitudes toward the BSCS Program.

Of the 19 subject matter areas, three subject areas had a significant effect on the attitudes of teachers toward the BSCS Biology Program. Completion of a course in ecology, a course in teaching of secondary science, and the completion of at least 14 courses which were accompanied by laboratory work were found to be significant. A greater number of teachers who demonstrated a favorable attitude toward BSCS Biology had completed courses in these three areas than did those who expressed unfavorable attitudes.

Student Perception

Educators generally concede that the attitudes of teachers influence the attitudes of their pupils. The question arises as to what is

more important in influencing attitudes and behavior--the actual attitudes of the teachers or the attitudes which pupils perceive teachers to hold?

It was found in the study of Torrance (51), through correlation analysis, that there was a significant correlation between instructor attitude perceived by the subjects and as expressed by the instructors. It was also found that verbalized attitudes may follow more closely an individual's recognition of instructor attitude than the real reaction.

Torrance feels that his research has implication for teacher education institutions and in-service training of teachers. He suggests that teacher education institutions need to develop, in their student teachers, those attitudes which teachers are expected to develop in their students. When administrators ask teachers to develop in their pupils certain attitudes, they should first seek to develop these attitudes in the teachers.

Teachers may express favorable attitudes through what they say and do. Students may also feel that the teachers have favorable attitudes. However, the teachers' real attitudes may show through and affect the behavior and emotional reactions of the students. (51)

The teachers' attitudes, as observed by the students, would appear to be as equally important as the teachers' attitude itself. However, there have been few studies in regard to student understanding or recognition of teacher attitude.

In a study by Kochendorfer (28) of the relationship between teacher attitudes and students' recognition of classroom practices, a significant correlation was found. In general the teacher's attitudes

toward the BSCS Biology Program in this study agreed with his classroom practices.

Barnes (4), in a similar study regarding the teacher's attitudes in relation to laboratory practices, found a significant relationship. Thus, a teacher who reacts favorably to the BSCS Biology Program involves his students in laboratory practices to a greater extent than do teachers who are less favorable to the BSCS Program.

It was found, however, in both studies that there are some teachers who are less favorable toward the BSCS Program who do carry out BSCS objectives in both laboratory and classroom practices. Also, there are those who indicate favorable attitudes toward the BSCS Program, but who do not carry out the BSCS objectives in either laboratory or classroom practices.

In a study on sex differences of students in high school biology, Northby (36) found that academic performance of girls is superior to that of boys throughout all grade levels. This, according to Northby, may imply that the perception of boys and girls may vary.

Sex differences in school learning has been well established. In general, it is found that boys are behind girls in a number of areas of study. Boys, however, have the edge in other areas. (40)

Rowland (40) in 1965 studied sex differences of 144 boys and 144 girls using the Science Background Experimental Scale which he developed. It was found that sex differences proved to be the greatest factor determining science background experience. Sex difference in science background appeared to be clearly established with boys having a definite lead.

On standardized educational achievement tests sex differences are

small but their directions are consistent from one study to another. Girls typically excel in English, spelling, and writing; boys excel in mathematical reasoning, history, geography, and science. (40)

Lance (31), in a comparison of gain in achievement made by students in BSCS Biology and students of a conventional course in biology, found that "for both the BSCS and 'traditional' groups, boys outperformed girls." Moore (35), in evaluating the effectiveness of BSCS Biology to high ability ninth grade students, found that "in all subgroups in all tests, the boys out-scored the girls."

In summary, motivational and achievement differences between the sexes may affect the student's knowledge of the biological curriculum practices.

Summary

In this chapter the author has tried to describe the BSCS Biology Program development, the inquiry approach as employed by the BSCS, the literature related to the attitude of the teacher, and factors which may be related to the attitude of the teacher toward BSCS Biology.

The teacher's attitude, as illusive as it may seem, has been the object of many studies. Most studies have employed the use of inventories such as the Minnesota Teacher Attitude Inventory (11), Teacher Characteristic Schedule (42), Science Attitudinal Scale (17), Blankenship's Biology Teacher Attitude Inventory (7). Of these inventories, only Blankenship's was designed specifically for use in determining the attitude of the teacher toward the BSCS Biology Program.

There is a general concensus of opinion that teachers' attitudes play an important role in the teaching/learning process. Tuppen (52),

Dressel (16), Taylor (48), Yager (58), Flanders (18), and Victor (54), indicate this is the result of their studies regarding attitudes.

Attempts have been made in order to determine reasons for the existence of certain attitudes. Butler (4) studied subject matter areas as possible factors that may influence the instructors' attitudes toward the BSCS Biology Program. He found that courses in Science Education, Ecology, and 14 or more courses accompanied with laboratories did have an effect on teacher attitude.

Blankenship (6) found that capacity for independent thought and less than three years of teaching experience led to a more favorable attitude toward the BSCS Program while special training in the BSCS Program did not necessarily guarantee a more favorable attitude. Blankenship indicated a need for additional studies relating to teacher reactions toward the new curriculum programs.

Schwirian (45) found that positive attitudes toward science were inversely related to age. In fact, it was found that the amount of higher education, years of teaching experience, and nature of teaching experience were actually effects of age.

Since the sex of the student appears to influence a student's attitude according to Northby (36), Rowland (40), and Terman (49), it seems plausible that the sex of the instructor may also affect the teacher's attitude.

In the area of student recognition of teacher attitude, little has been done. Torrance (51) has studied student recognition of teacher attitude and feels it has many implications for teacher education and in-service programs. Torrance found that there was a significant correlation between instructors' attitude and that observed by students.

The findings of Kochendorfer (28) and Barnes (4) support this idea.

Since attitudes can be assumed to be important factors contributing to the success of an inquiry approach to science, such as the BSCS Biology Program, it appears that it is as equally important that we study whether or not students recognize the attitudes of the instructors. If the teacher's attitudes are recognized by the students then attitudes would seem especially important. If they are not observed by the students, then we might reconsider our efforts put forth in determining teacher attitudes.

The major purpose of this paper is to determine the relationship between the teacher's attitude toward the BSCS Biology Program and the student's recognition of this attitude in the type of laboratory and classroom activities. It is also important that variables affecting the teacher's attitudes be studied.

CHAPTER III

PROCEDURES

Instrumentation

The Attitude Inventory--This instrument, developed by Blankenship, (7) is designed to measure teachers' reactions to the BSCS biology program.

The Attitude Inventory consists of forty-six concise statements of which half reflect the opinions and attitudes held by those who designed the BSCS biology program and half reflect the attitudes and opinions held by those in favor of the traditional biology program.

An individual's score on the Attitude Inventory is determined by computing the number of responses favorable to the BSCS biology program minus the number of responses in opposition to the BSCS objectives. To avoid the use of negative numbers, twenty-three points were added to each score. This action would produce a possible range of scores of zero to forty-six.

In determining the effectiveness of the Attitude Inventory, Blankenship compared its identification of attitudes with the identification of the same attitudes by three other methods. The data collected was obtained following a summer institute involving fifty-five biology teachers who were thoroughly acquainted with content, philosophy, and methods of BSCS biology. (8)

A description of the three methods follows:

Peer Rating: At the end of the training period each of the fifty-five teachers were to compare their own attitudes toward BSCS biology with the attitude they perceived the others as having. The Peer Rating score was determined by the relative position of each member in the group as seen by all other group members.

Instructor's Rating: This is the teacher's perception of the individual's reaction to the BSCS biology program at the end of the summer institute. This rating was based on comments made by the individuals which, in the opinion of the instructor, placed the individual in the favorable or unfavorable toward BSCS biology attitude category.

The Follow-Up Questionnaire: After the teachers of the summer institute returned to their respective schools and after a period of adjustment, each teacher was mailed a questionnaire.

The sample of teachers were classified into three categories,

1. Those with favorable attitudes toward the BSCS biology program.
2. Those who demonstrated an unfavorable attitude toward the BSCS biology program.
3. Those who could not be clearly identified as favorable or unfavorable in their attitudes toward the BSCS biology program.

Teachers placed in the favorable category possessed at least one of the following characteristics:

1. A score in the top quarter of the Peer Rating.
2. A rating in the top quarter of the Attitude Inventory.
3. An indication that the science teacher was currently teaching BSCS biology, was satisfied with the program, and anticipated its continued use.

In addition, the teacher must not have received an unfavorable attitude rating from the instructor rating.

The teacher classified as having an unfavorable attitude toward BSCS biology must possess any one or more of the following characteristics:

1. A score in the bottom quarter of the Attitude Inventory.
2. A rating in the bottom quarter of the Peer Rating.
3. An indication that the teacher was not teaching BSCS biology, did not anticipate its use, and did not prefer to teach BSCS biology if the opportunity arose.
4. An unfavorable attitude rating from the instructor.

Only two of the fourteen identified in the upper quarter by the Attitude Inventory were ruled out by the use of the other three measures. The Attitude Inventory and Peer Rating were equal in correctly identifying attitudes toward BSCS biology, while the Instructor Rating was the poorest. (8)

Biology Laboratory Activities Checklist (BLAC)--This instrument was used to determine the students' perception or understanding of the type of biology laboratory activities conducted in the sample schools.

The BLAC was developed by Lehman W. Barnes (3) as a checklist of items consisting of laboratory practices consistent with BSCS objectives and laboratory practices and those opposing the BSCS objectives and laboratory practices.

After submitting the checklist to a panel of judges familiar with the BSCS objectives, laboratories, and rationale; it was revised to sixty items. Thirty of these items conform to the BSCS objectives and thirty do not conform to their objectives.

The validity of the BLAC is based on two points: (1) each item originated from statements of individuals participating in the development of the BSCS Biology Program, (2) each item was verified by a panel of judges who were thoroughly familiar with the BSCS Biology Programs.

To check the reliability of the BLAC, two classes each of five teachers were tested. A t-test was used to compare the BLAC data from the two classes of each teacher. The results indicated no significant difference between the two classes of each of the five teachers in their recognition of the type of laboratory activity. This would mean that according to the BLAC there was no disagreement between the two classes on the type of laboratory activities.

Scores on the checklist are determined by adding the positive responses to the BSCS items that conform to the BSCS objectives and laboratory practices and the negative responses to items that do not conform to the BSCS objectives and laboratories. The range of these scores will be from zero to sixty, with a high score indicating close conformity to the BSCS laboratories and objectives.

Biology Classroom Activities Checklist (BCAC)--This instrument, developed by Kochendorfer (27) is used to determine the students' perception or understanding of the biology classroom activities, as they relate to the philosophy and rationale of the BSCS Program in the schools sampled.

The BCAC was developed by forming a list of teaching practices that were judged to support BSCS objectives. The checklist in the final form consists of fifty-three items, twenty-six of the items described classroom practices which contribute favorably to the attainment of BSCS objectives and twenty-seven which described practices

which were negative to attainment of BSCS objectives.

The fifty-three items were organized into seven sections: (1) role of the teacher in the classroom, (2) student classroom participation, (3) use of textbook reference materials, (4) design and use of tests, (5) laboratory preparation, (6) type of laboratory activities, (7) laboratory follow-up activities

The items were then submitted to a panel of five judges who were familiar with the BSCS philosophy as a member of a BSCS writing team, committee, or staff consultant. Reliability coefficients between the judges' opinions and the author's opinions (Korchendorfer) as to whether or not the classroom practices contribute positively, negatively or not at all ranged from +.95 to +.88. The correlation coefficient among the judges was +.84.

Reliability and validity was based on the results of administration of the checklist to over one thousand students of sixty-four teachers. The reliability coefficient was +.96 and the validity coefficient was +.84.

In scoring the checklist, the number of positive responses supporting the BSCS philosophy in classroom activity and the number of negative responses to items unfavorable to the BSCS philosophy will be added. The range of scores is zero to fifty-three, with a high score indicating use of classroom activities which support the BSCS philosophy and objectives.

Biology Teacher Questionnaire--This instrument, devised by the author and associates, was designed to collect personal data on the teachers of the sample and factors which may have some effect or influence on their reactions to the BSCS biology program.

The instrument consists of twenty-one items including several items which call for a positive or negative response regarding the BSCS biology program. Through questions such as these it is hoped that a better picture of teachers' attitudes toward BSCS biology can be developed. The instrument will be used to give support to the Attitude Inventory as developed by Blankenship.

The Population Sampled

The population to be used for sample selection consists of all the high schools within an approximate radius of eighty miles from Oklahoma State University, Stillwater, Oklahoma. The schools used in the population were from municipalities of not less than one thousand residents and not more than fifty thousand residents according to the 1960 census. The schools eliminated from the population were those of Tulsa and Oklahoma City as well as schools that did not offer a sophomore level biology course.

The biology instructor or instructors and two classes of students from each instructor were administered the instruments described previously for later assessment.

The 30 high schools randomly selected were contacted by phone to request permission for a conference. The purpose of this conference was to explain the study to the high school principal and arrange a time for testing the biology teachers and their students.

Of the 30 high schools selected, two declined permission by phone and one declined permission following the explanation of the study during a conference. These were replaced through random selection.

There were 32 biology teachers and 1,323 students involved in the

study. No attempt was made to collect data from students who were absent on the day of testing.

Through the use of the interview, the author and associates explained the study and requested permission to use two classes of each biology teacher of the school. Upon receiving permission of the administrator and biology instructor, a date was selected for administration of the Attitude Inventory, Biology Teacher Questionnaire, BLAC and BCAC. The author and associates returned on the selected date to administer the instruments. If only one class of biology students was available, both the BCAC and the BLAC were given to that class. If two classes were available, one class was administered the BCAC and the other the BLAC.

While the BCAC and BLAC were given to the biology classes, the biology teacher was instructed to complete the Attitude Inventory and the teacher questionnaire. If the teacher did not complete the A. I. or questionnaire, a self-addressed stamped envelope was left for mailing at a later date.

It was felt that the personal contact with the biology teachers and administrators of the sample contributed greatly to the success of the data collection.

Treatment of Data

The students' responses to items on the BLAC and the BCAC were hand scored and rechecked for accuracy by the author and associates according to the instructions of the authors of the instruments.

The teachers' responses to the Attitude Inventory were hand scored and double checked by the author in accordance with the author of the

instrument. Scores were adjusted by adding twenty-three to each score to avoid negative numbers. This produced a range of scores from zero to forty-six.

The responses to the items of the biology teachers' personal data sheet were compiled by the author by hand.

A single classification one-way analysis of variance was used in testing the two major and twelve minor hypotheses of this study.

CHAPTER IV

PRESENTATION AND ANALYSIS OF THE DATA

Introduction

The instruments used in this study, the Biology Laboratory Activity Checklist and Attitude Inventory were administered to thirty-two biology classes and their instructors in the sample of thirty schools. The Biology Classroom Activity Checklist was administered to twenty-eight classes of the thirty schools sampled. The data collected, by the use of the instruments mentioned above, are presented and analyzed in this chapter. The first part of the chapter contains the major hypotheses and an analysis of the data pertaining to the hypotheses. The second part of the chapter includes hypotheses related to variables affecting teacher attitude and an analysis of these variables.

Hypotheses Tested

The two major hypotheses of this study were tested with the use of single classification analysis of variance (38). The hypotheses in this study are stated in the null form.

> H_1 The type of laboratory activities perceived by the students in the biology laboratory will not differ significantly between teachers demonstrating a favorable attitude toward the BSCS Biology Program and those who expressed an unfavorable attitude.

TABLE I

ANALYSIS OF VARIANCE DATA FOR THE RELATIONSHIP OF TEACHER ATTITUDE AND STUDENT PERCEPTION OF THE TYPE OF BIOLOGY LABORATORY ACTIVITY

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Between Groups	1	11.52	11.52	.94 N.S.
Within Groups	30	336.11	12.20	
Total	31	347.63		

Table F = 4.17 at .05 level

The analysis of variance for this hypotheses yielded an F-value of 0.94. With 1 and 30 degrees of freedom, this value was not found to be significant at the .05 level. An F-value of 4.17 is required to reject the null hypothesis at the .05 level. Therefore, the hypothesis must be accepted that there is no difference in the type of laboratory activity perceived by students under teachers favorable or unfavorable to the BSCS Biology Program. A summary of the analysis of variance data is presented in Table I.

> H_2 The type of classroom activity perceived by the students in the biology classroom will not differ significantly between teachers demonstrating a favorable attitude and an unfavorable attitude toward the BSCS Biology Program.

An analysis of variance used in testing this hypothesis yielded an F-value of 4.80 which was found to be significant at the .05 level. The table value of F = 4.22 or greater is required to reject the hypothesis at the .05 level. Thus the hypothesis was rejected. It can be stated that in this sample there was a significant difference in the

students' understanding of classroom activities between students of teachers with favorable and unfavorable attitudes toward the BSCS Biology Program. A summary of the analysis of variance data is found in Table II.

TABLE II

ANALYSIS OF VARIANCE DATA FOR THE RELATIONSHIP OF TEACHER ATTITUDE AND STUDENT PERCEPTION OF THE TYPE OF BIOLOGY CLASSROOM ACTIVITY

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Between Groups	1	39.85	39.85	4.80*
Within Groups	26	215.73	8.29	
Total	27	255.58		

*Significant at the .05 level.
Table F = 4.22 at .05 level

It was assumed, upon review of the litarature, that teacher attitude is important in the teaching-learning process. It seems logical that if the attitude of the teacher is perceived by students, then attitudes must be considered when studying the teaching-learning situation. Therefore, the following hypotheses were written to determine possible factors which may affect the teacher's attitude toward the BSCS Biology Program.

H_3 There will be no significant difference in biology teachers' mean attitude toward the BSCS Biology Program when teachers are grouped into two groups; those above the median salary range and those below the median salary range.

The median salary range for this sample of high school biology teachers was $7,000-$7,499.

An analysis of variance was used to test the hypothesis in which an F-value of 0.02 was obtained. With 1 and 30 degrees of freedom this value was not significant at the .05 level. The hypothesis could not be rejected regarding salary as a factor affecting teacher attitude. See Table III.

TABLE III

ANALYSIS OF VARIANCE DATA FOR TEACHER SALARY AND TEACHER ATTITUDE

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Between Groups	1	1.12	1.12	.020 N.S.
Within Groups	30	1784.88	55.78	
Total	31	1786.00		

Table F = 4.17 at .05 level

H_4 There will be no significant difference in biology teachers' mean attitude toward the BSCS Biology Program when teachers are grouped into two groups: those above the median number of years of teaching experience and those below the median number of years of teaching experience.

TABLE IV

ANALYSIS OF VARIANCE DATA FOR TEACHER EXPERIENCE AND TEACHER ATTITUDE

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Between Groups	1	.50	.50	.0084 N.S.
Within Groups	30	1785.50	59.52	
Total	31	1786.00		

Table F = 4.47 at .05 level

The median number of years teaching experience of the teachers in this sample was 11 years.

The calculated F-value of .0084 was obtained with 1 and 30 degrees of freedom. This value was not found to be significant at the .05 level and the hypothesis could not be rejected.

> H_5 There will be no significant difference in biology teachers' mean attitude toward the BSCS Biology Program when teachers are grouped into two groups: those above the median teacher age and those below the median teacher age.

The calculated F-value of 1.1198 was obtained from the comparison of teachers above and below the median age. With 1 and 24 degrees of freedom this value was not significant at the .05 level. The hypothesis could not be rejected. (See Table V)

The median age was 35.5 years, with six subjects not responding.

> H_6 The biology teachers' attitude toward the BSCS Biology Program will not differ significantly among biology teachers who have never completed a science seminar, workshop, or science course since graduating; those who have completed a science seminar, workshop, or science course

5 years ago or beyond; and those who have completed a science seminar, workshop, or science course within the last 5 years.

TABLE V

ANALYSIS OF VARIANCE DATA FOR TEACHER AGE AND TEACHER ATTITUDE

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Between Groups	1	71.72	71.72	1.1198 N.S.
Within Groups	24	1524.23	63.51	
Total	25	1595.95		

Table F = 4.26 at .05 level

The comparison of the three groups of teachers in regard to the recency of enrollment in a science course, science seminar or science workshop yielded an F-value of 0.3265. With 2 and 29 degrees of freedom this value was not found to be significant at the .05 level. The hypothesis could not be rejected. (See Table VI)

H_7 There will be no significant difference in biology teachers' mean attitude toward the BSCS Biology Program when teachers are grouped into two groups: those above the median number of preparations and those below the median number of preparations.

In comparing those biology teachers above and below the median number of classroom preparations an F-value of .336 was obtained. This value was not significant at the .05 level with 1 and 30 degrees of Freedom. The hypothesis could not be rejected. (See Table VII).

TABLE VI

ANALYSIS OF VARIANCE DATA COMPARING TEACHER ATTITUDE AND RECENCY OF ENROLLMENT IN A SCIENCE SEMINAR, SCIENCE WORKSHOP, OR SCIENCE COURSE

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Between Groups	2	32.35	16.175	.3265 N.S.
Within Groups	29	1436.87	49.55	
Total	31	1469.22		

Table F = 3.33 at .05 level

TABLE VII

ANALYSIS OF VARIANCE DATA FOR TEACHER ATTITUDE AND NUMBER OF CLASSROOM PREPARATIONS

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Between Groups	1	21.13	21.13	.336 N.S.
Within Groups	30	1884.75	62.83	
Total	31	1905.88		

Table F = 4.17 at .05 level

TABLE VIII

ANALYSIS OF VARIANCE DATA FOR TRAINING IN THE BSCS BIOLOGY PROGRAM AND TEACHER ATTITUDE

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Between Groups	1	68.17	68.17	1.173 N.S.
Within Groups	30	1717.83	57.26	
Total	31	1786.00		

Table F = 4.17 at .05 level

H_8 The biology teachers' attitude toward the BSCS Biology Program will not differ significantly between biology teachers who received training in the BSCS Biology Program and those who did not.

In comparing the two groups, an F-value of 1.173 was obtained. With 1 and 30 degrees of freedom this value was not significant at the .05 level. The hypothesis could not be rejected.

H_9 The biology teachers' attitude toward the BSCS Biology Program will not differ significantly between male and female teachers.

An F-value of .3054 was obtained which was not significant at the .05 level with 1 and 30 degrees of freedom. The hypothesis could not be rejected.

In a study by Butler (9) academic preparation in specific areas of science were studied in relationship to the teachers' attitudes toward the BSCS Biology Program. It was felt that academic preparation may be an important variable in this study, also. The following hypotheses were tested in order to determine the significance of academic

preparation in botany, zoology, and chemistry on the teachers' attitudes toward the BSCS Biology Program.

TABLE IX

ANALYSIS OF VARIANCE DATA FOR TEACHER ATTITUDE AND THE SEX OF THE TEACHER

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Between Groups	1	18.00	18.00	.3054 N.S.
Within Groups	30	1768.00	58.93	
Total	31	1786.00		

Table F = 4.17 at .05 level

H_{10} There will be no significant difference in biology teachers' mean attitude toward the BSCS Biology Program when teachers are grouped into two groups: those above the median number of hours in zoology and those below the median number of hours in zoology.

The analysis of variance yielded an F-value of 0.2712 which is not significant at the .05 level with 1 and 30 degrees of freedom. The hypothesis could not be rejected.

The median number of hours in zoology in this sample was 18.5.

H_{11} There will be no significant difference in biology teachers' mean attitude toward the BSCS Biology Program when teachers are grouped into two groups: those above the median number of hours in botany and those below the median number of hours in botany.

TABLE X

ANALYSIS OF VARIANCE DATA FOR TEACHER ATTITUDE IN RELATION TO NUMBER OF HOURS OF ZOOLOGY

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Between Groups	1	16.00	16.00	.2712 N.S.
Within Groups	30	1770.00	59.00	
Total	31	1786.00		

Table F = 4.17 at .05 level

TABLE XI

ANALYSIS OF VARIANCE DATA FOR TEACHER ATTITUDE IN RELATION TO NUMBER OF HOURS OF BOTANY

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Between Groups	1	32.00	32.00	.596 N.S.
Within Groups	28	1501.00	53.61	
Total	29	1533.00		

Table F = 4.20 at .05 level

An F-value of .596 was obtained which was not significant with 1 and 28 degrees of freedom. The hypothesis could not be rejected.

The median number of hours in botany was 10.5 for the sample in this study.

H_{12} There will be no significant difference in biology teachers' mean attitude toward the BSCS Biology Program when teachers are grouped into two groups: those above the median number of hours in chemistry and those below the median number of hours in chemistry.

An F-value of .1031 was obtained from the analysis of variance. With 1 and 30 degrees of freedom the hypothesis could not be rejected at the .05 level. (See Table XII)

TABLE XII

ANALYSIS OF VARIANCE DATA FOR TEACHER ATTITUDE IN RELATION TO THE NUMBER OF HOURS OF CHEMISTRY

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Between Groups	1	6.12	6.12	.1031 N.S.
Within Groups	30	1779.88	59.34	
Total	31	1786.00		

Table F = 4.17 at .05 level

According to the literature, male and female students may perceive activities in the classroom and the laboratory differently. To test this assumption, an analysis of variance was used.

H_{13} The students' perception of the type of laboratory activity will not differ significantly between male and female students.

TABLE XIII

ANALYSIS OF VARIANCE DATA FOR COMPARING MALE AND FEMALE STUDENTS PERCEPTION OF THE LABORATORY ACTIVITIES

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Between Groups	1	30.65	30.65	2.40
Within Groups	64	817.57	12.77	
Total	65	848.22		

Table F = 3.99 at .05 level

An F-value of 2.40 was obtained from the analysis of variance. With 1 and 64 degrees of freedom, the null hypothesis could not be rejected at the .05 level. Males and females of this study did not perceive the type of laboratory activity differently.

H_{14} The students' perception of the type of classroom activity will not differ significantly between male and female students.

An F-value of 1.113 was obtained from the analysis of variance. With 1 and 58 degrees of freedom the null hypothesis could not be rejected.

TABLE XIV

ANALYSIS OF VARIANCE DATA FOR COMPARING MALE AND FEMALE STUDENTS' PERCEPTION OF THE CLASSROOM ACTIVITY

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
Between Groups	1	12.70	12.70	1.113 N.S.
Within Groups	56	638.74	11.41	
Total	57	651.44		

Table F = 3.99 at .05 level

Summary

The two major and twelve minor hypotheses regarding variables thought to affect teacher attitude were tested and summarized in this chapter.

All but the second hypothesis had to be accepted at the .05 level of significance. The second major hypothesis was rejected at the .05 level of significance. This hypothesis stated that there would be no significant relationship between biology teachers' attitude toward the BSCS Biology Program and students' perception of the type of classroom activities.

CHAPTER V

SUMMARY OF FINDINGS AND IMPLICATIONS

Introduction

The major purpose of this study was to test whether or not there was a relationship between the teacher's attitude toward the BSCS Biology Program and the students' perception of the type of classroom and laboratory practices. The teacher's attitude was determined by the Attitude Inventory and the student's perception of the type of classroom and laboratory activity by the BCAC and the BLAC respectively.

Summary of Findings

The two major hypotheses and twelve minor hypotheses were subjected to a single classification analysis of variance for test of significance. Popham (39) stated that this test can be used when comparing two groups.

Teachers were divided into two groups using the median as the point of division.

Of the hypotheses tested, number two was the only hypothesis to be rejected at the .05 level of significance. Hypothesis number two stated that there will be no significant relationship between teacher attitude toward the BSCS Biology Program and student perception of the type of classroom activity. It appears that, in this study, students did

recognize the type of classroom activity in relation to the teachers' attitude toward the BSCS Biology Program. This is in agreement with the findings of Barnes (4).

The first major hypothesis regarding the relationship between the teachers' attitude toward the BSCS Biology Program and the students' perception of the type of laboratory activity could not be rejected. This would mean that the BSCS approach, which stresses laboratory activity and inquiry, was not being recognized by students regardless of whether or not teachers expressed a favorable opinion of the BSCS Biology Program (above the median on the Attitude Inventory) or an unfavorable opinion of the program (below the median on the Attitude Inventory).

This is not in agreement with Kochendorfer's findings which indicated a relationship between a teacher's attitude toward the BSCS Biology Program and the students' recognition of the type of laboratory activity.

The following are thought by the author to be possible reasons for the lack of significance in the hypothesis regarding teacher attitude and student perception:

1. In the items of the Attitude Inventory developed by Blankenship (7) reference was made to the BSCS Biology Program which may have influenced the response of the teachers.

2. The content of the BSCS Biology Textbooks has been incorporated into a majority of the high school biology texts currently on the market.

3. Observations during data collection at the various schools revealed that a majority of the schools were not using the inquiry type

of laboratory activity.

4. Limited facilities and equipment may have reduced the amount of laboratory work being carried out by the biology teacher.

It was thought that by studying variables which may affect the teacher's attitude toward the BSCS Biology Program that further insight could be gained as to why there was or was not a relationship between teacher attitude and student perception. The ten hypotheses regarding factors thought to have an affect on the biology teachers attitude toward the BSCS Biology Program were not found to be significant.

These factors were as follows: (1) sex of the teacher, (2) age of the teacher, (3) teacher's salary, (4) number of years of teaching experience, (5) number of classroom preparations, (6) enrollment in a science course, workshop, or seminar, (7) training in BSCS Biology, and (8) number of hours completed in zoology, botany, and chemistry.

It was also found that male and female students do not perceive the teachers' attitude toward the BSCS Biology Program differently.

After examining the results of the questions posed in regard to factors affecting teacher attitude, it appears that there must be some factors that contribute to teacher attitude that have been overlooked or that are undetermined in this study. Several possible factors were suggested on page 51 of this paper.

After examining the teacher questionnaire, it was felt that some of the comments made by biology teachers in the study regarding the BSCS Biology Program may provide a better understanding of the problem. Not all teachers commented, however, the following are the ideas expressed by those who did comment:

Four of the teachers in the study stated that lack of equipment

and laboratory space prohibited the use of BSCS Laboratory materials and the BSCS Program. It was not possible to determine statistically if this had any bearing on teacher attitude toward the BSCS Biology Program because of incomplete data regarding finances for equipment, materials, and books.

Several teachers expressed the opinion that the BSCS Biology Program was too narrow in scope for students, too complex for non-college students, and did not fill the needs of rural students.

Others stated that although they favored the BSCS Biology Program, the adoption of the present text they were using limited them to that text for several years to come.

It was interesting to note that one instructor expressed a concern for the emphasis placed on evolution by the BSCS Biology Program.

Others felt that their preparation limited them in the use of BSCS materials. To illustrate this point one biology instructor stated that his preparation for teaching biology was comparable to "entering a jackass in the Kentucky Derby". Although there was concern for preparation, there was no significant difference between those who have completed a science course, workshop, or seminar, and those teachers who had not.

When asked to describe their present teaching situation, four teachers stated that they were presently teaching BSCS Biology, would prefer to continue teaching it. Twelve teachers stated that they were not presently teaching BSCS Biology, but would prefer it if their situation permitted it. Fifteen teachers who were not teaching BSCS Biology did not prefer to teach it, regardless of their situation.

Those teachers who were not teaching BSCS Biology were asked to

indicate reasons for not teaching it.

Eight of these teachers felt that the BSCS Program was not an improvement over the conventional biology course they were using. Fifteen teachers did not think the BSCS Program fulfilled their local needs. Thirteen teachers stated that textbooks and related materials were not available while sixteen did not feel they had adequate laboratory space. Nine teachers felt they lacked adequate preparation to teach BSCS Biology. Four teachers stated that the BSCS Biology Program required too much extra work. Two stated the administration did not favor use of the BSCS Biology Program and one stated that fellow biology teachers did not favor its use.

Implications for Further Study

It should be evident from this study that questions asked regarding factors which may affect teacher attitude toward the BSCS Biology Program remain unanswered. However, it is felt that further investigation of the problem of teacher attitude is necessary when we have fifteen out of thirty-one biology teachers who do not prefer to teach the widespread BSCS Biology Program which has been so widely publicized by scientists and educators as an exemplary program of modern biological science.

The biology teachers' reactions to the BSCS Program are evidently recognized by students in the type of classroom activities. However, students in this study did not perceive the teachers' reaction to the BSCS Biology Program in the type of laboratory activity.

Since the laboratory and inquiry approach are the backbone of the BSCS Program, it would seem more likely that students would have a

greater understanding of the teachers' attitudes through the type of laboratory activities demonstrated by the biology teachers. This was not the case, which is in conflict with the findings of an earlier study by Kochendorfer (28). The question of whether or not the teacher's attitude toward the BSCS Biology Program is perceived by students in the type of laboratory activity remains unresolved. Further investigation appears to be in order.

It is realized that this study was limited by the inherent weaknesses of the instruments and the individuals response to the items in the instruments. Further studies in the development of instruments to measure teachers' reactions to the BSCS Biology Program are necessary if we are to improve the preparation of secondary biology teachers.

It is possible that the BSCS Biology Program itself should be examined to see if changes could be made that would increase the acceptance of that program among biology teachers. This is assuming, however, that the BSCS Biology Program merits the consideration and support given it in the literature.

I would also suggest further studies of attitudes and expression of these attitudes by the teachers. Do teachers hold one attitude but relay another to students in the type of laboratory activities used?

Recommendations

The following are recommendations for further study based on the results of this study:

1. The development of an attitude inventory which does not make reference to the BSCS Biology Program.
2. An in-depth study of finances appropriated to the biology program in high schools.

3. A study of the resources, equipment, and space available for use by the biology classes.

4. A study or analysis of the BSCS Biology Program to determine the content and methodology which invokes an unfavorable attitude in the teacher.

5. A study relating to the biology teacher's understanding of the philosophy, methods, and materials of the BSCS Biology Program.

These are but a few areas open to further study.

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APPENDIX A

INSTRUMENTS

STUDY OF TEACHER REACTIONS TO BSCS PROGRAM
ATTITUDE INVENTORY

INSTRUCTIONS

Attached are statements pertaining to the high school biology programs with which you are acquainted. These statements reflect a wide range of attitudes concerning these biology programs.

We would like for you to read each statement carefully and ask yourself whether you agree or disagree with the statement. If you do not agree with the statement, leave the space provided blank.

Remember: Place a check mark only by those statements with which you definitely agree.

_____1. Laboratory work in high school biology should be more integrated with the text material.
_____2. The high school biology program should be designed and controlled only by high school biology teachers.
_____3. The high school biology laboratory work would be more interesting if the nature of laboratory work were more investigative.
_____4. Demonstrations are not as effective as student participation type laboratory work.
_____5. Students gain more scientific knowledge by participation in BSCS-type laboratory work than they do in the conventionally patterned laboratory work.
_____6. It would be difficult, if not impossible, to teach the BSCS biology course in its present form.
_____7. It is not necessary that a student actually perform laboratory work in order to understand the principles of scientific investigation.
_____8. The BSCS biology program reflects the current trend in the biological sciences.
_____9. The situations which students are exposed to in BSCS biology are similar to those situations faced by a scientist in his everyday work.
____10. The BSCS biology program has failed to provide for some of the most important aspects of the high school biology course.
____11. A practical biology course that has immediately usable information for the student is what is needed in the high school.
____12. BSCS biology adequately provides for differences in student ability.
____13. The major emphasis in high school biology should be the structure and function of organs and tissues.
____14. Well-prepared motion pictures could be substituted for all high school biology laboratory work.
____15. Our knowledge in the life sciences has been derived from limited observations.
____16. A slight modification of the existing high school biology program is all that is needed to provide an effective high school biology program.
____17. BSCS biology would enable the student to understand better the ways in which hypotheses are developed and tested.
____18. Students come to understand science through participating in laboratory work rather than by reading about science and watching demonstrations.
____19. Accurate evaluation of a student's achievement in a laboratory orientated course such as the BSCS course, would be impossible.

____20. At the present time, there is no need for a major revision of the high school biology program.
____21. The use of six weeks of concentrated laboratory work in one area of biology is justifiable.
____22. College bound students would profit more from the conventional type of biology course than they would from the BSCS biology program.
____23. In high school biology, major emphasis should be placed on the molecular, cellular, and community aspects of biology.
____24. In considering the high school biology program as a whole, it appears that the existing program is adequate.
____25. Biological laws are only summations of experiences, consequently, in the future one may expect these laws to become modified or even discarded.
____26. The BSCS biology program seems designed exclusively for the above-average student.
____27. It is only by engaging in the steps of scientific inquiry that a student becomes able to discern the difference between experimentation and complex instrumentation.
____28. Actually, the so-called conventional high school biology course and the recommended BSCS biology course are quite similar.
____29. The biology textbooks and laboratory manuals currently in use in the high schools are adequate.
____30. The study of science as enquiry should be one of the major objectives of high school biology.
____31. The benefits that a student derives from actual first-hand laboratory experimentation cannot be justified in terms of the amount of teacher time and materials required.
____32. Laboratory investigations and open-ended experiments are excellent means for conveying an understanding of science.
____33. Demonstrations performed by the science teacher are just as effective as student-performed laboratory experiments.
____34. It is more important for the average student to understand the purpose and method of science than for him to be acquainted with the latest theory of the universe or the newest hormone.
____35. BSCS biology could be taught just as effectively without the extensive laboratory investigations suggested.
____36. Laboratory exercises should stress the names of structures and processes.
____37. The traditional biology course offered in the high school is no longer adequate.
____38. The need for the students to acquire factual information is greater than the need for them to understand the ways in which hypotheses are developed.
____39. Research biologists should be involved with others in designing the high school biology curriculum.
____40. Biology should be taught as a body of factual information.
____41. The BSCS biology program reflects careful planning of a practicable course.
____42. In high school biology, student work should be centered in the laboratory where real problems are explored.
____43. It is doubtful that the BSCS approach to teaching high school biology would result in the student's acquiring a better understanding of the true work of the scientist.
____44. The amount of time suggested for laboratory investigation in the BSCS biology program is excessive.
____45. A student comes to understand science through participating in science, rather than by serving as a bystander who only reads about science.
____46. Wholesale revision of the conventional high school biology course is imperative if a modern curriculum is to be developed.

FORM IV

INSTRUCTIONS:

The purpose of this checklist is to determine how well you know what is going on in your biology class. Each statement describes some laboratory activity. The activities are not judged as either good or bad. Therefore, this checklist is not a test and is not designed to grade either you or your teacher. You are to read each statement and decide if it describes the activities in your class. All answers should be recorded on the answer sheet. NO MARKS should be made in this booklet.

Sample Question: Answer Sheet

1. My teacher often takes class attendance. 1. T F

If the statement describes what occurs in your classroom, cross out the T (True) on the answer sheet; if it does not, cross out the F (False).

1. My teacher usually tells us step-by-step what we are to do in the laboratory.

2. We spend some time before every laboratory in determining the purpose of the experiment.

3. We often cannot finish our experiments because it takes so long to gather equipment and prepare solutions.

4. The laboratory meets on a regularly scheduled basis (such as every Friday).

5. We often use the laboratory to investigate a problem that comes up in class.

6. The laboratory usually comes before we talk about the specific topic in class.

7. Often our laboratory work is not related to the topic that we are studying in class.

8. We usually know the answer to a laboratory problem that we are investigating before we begin the experiment.

9. Members of our class are able to help in the preparation of upcoming laboratory exercises.

10. Our teacher usually explains what results we should expect from an investigation.

11. We are encouraged to read up on an experiment before we do it with hope of finding the answer.

12. Many of the experiments that are in the laboratory manual are done by the teacher or other students while the class watches.

13. The data that I collect are often different from data that are collected by the other students.

14. Our teacher is often busy grading papers or doing some other personal work while we are working in the laboratory.

15. During an experiment we record our data at the time we make our observations.

16. We are sometimes asked to design our own experiment to answer a question that puzzles us.

17. We often ask the teacher if we are doing the right thing in our experiments.

18. The teacher answers most of our questions about the laboratory work by asking us questions.

19. We spend less than one-fourth of our time in biology doing laboratory work.

20. We spend at least half of our time in biology doing laboratory work.

21. We never have the chance to try our own ways of doing the laboratory work.

22. Very little of our laboratory time is spent in the classification of specimens.

23. We work with a variety of equipment and materials in our laboratory activities.

24. Plastic (plaster, wood, etc.) models and wall charts are often used in our laboratory exercises.

25. We work with a variety of living plants, animals, and microbes.

26. We can usually answer most of our laboratory work questions by finding the answers in the textbook.

27. Our laboratory work consists primarily of the identification of the structures of various organisms.

28. The laboratory provides many opportunities in identifying and defining problems to be investigated.

29. Our experiments can almost always be completed in a single laboratory period.

30. The laboratory includes many activities that make it possible for us to discover things for ourselves.

31. Our laboratory often consists of thoroughly learning the names of structures and their parts.

32. We work a great deal with a variety of preserved specimens and prepared slides.

33. We are able to set our own pace when doing a laboratory investigation.

34. We construct many tables, charts, and graphs in our laboratory notebooks.

35. We spend practically no laboratory time on definitions of biological terms and the learning of these definitions.

36. We spend more laboratory time making dissections of preserved organisms than studying live ones.

37. Our laboratory work consists primarily of making drawings of specimens and labeling them.

38. The equipment that we use is often too complex for most high school students to work with.

39. We talk about what we have observed in the laboratory within a day or two after every session.

40. After every laboratory session we compare the data that we have collected with the data of other individuals or groups.

41. Our teacher often grades our data books for neatness.

42. We are required to copy the purpose, materials, and procedures used in our experiments from the laboratory manual.

43. We are allowed to go beyond the regular laboratory exercise and do some experimenting on our own.

44. We have a chance to analyze the conclusions that we have drawn in the laboratory.

45. The class is able to explain all unusual data that are collected in the laboratory.

46. When analyzing data from one of our experiments, we are usually asked to make predictions about what might happen in related experiments.

47. We spend very little time in the interpretation of graphs and tables of the data that we collect.

48. We do not usually get the chance to repeat an experiment even when our first attempts were careless and sloppy.

49. We often make tables and draw graphs of data that we collect in our investigations.

50. We sometimes have to repeat an experiment in order to get the expected results.

51. We often present to the class our results and conclusions from an investigation.

52. We sometimes do an additional experiment because the data previously collected suggest a new question to us.

53. Our tests include many questions based on things that we have learned in the laboratory.

54. I feel that I gain a better understanding of the nature of scientific investigation as a result of the teacher's lectures than when I do experiments.

55. In many of our laboratory activities I do not actually feel that I am participating in real scientific investigations.

56. Our teacher feels that the laboratory is the most important part of our biology course.

57. I feel that I gain a better understanding of the nature of scientific investigation as a result of class discussions.

58. The students in our class feel that the laboratory is the most important part of our biology course.

59. I feel that I gain a better understanding of the nature of science because of my own investigations.

60. I feel that I gain a better understanding of the nature of science primarily as a result of classroom demonstrations by the teacher.

Biology Laboratory Activity Checklist

ANSWER SHEET

Form IV

Name of Teacher Being Described_____

Name of Class Which He Teaches_____

T--True F--False

1.	T	F	21.	T	F	41.	T	F
2.	T	F	22.	T	F	42.	T	F
3.	T	F	23.	T	F	43.	T	F
4.	T	F	24.	T	F	44.	T	F
5.	T	F	25.	T	F	45.	T	F
6.	T	F	26.	T	F	46.	T	F
7.	T	F	27.	T	F	47.	T	F
8.	T	F	28.	T	F	48.	T	F
9.	T	F	29.	T	F	49.	T	F
10.	T	F	30.	T	F	50.	T	F
11.	T	F	31.	T	F	51.	T	F
12.	T	F	32.	T	F	52.	T	F
13.	T	F	33.	T	F	53.	T	F
14.	T	F	34.	T	F	54.	T	F
15.	T	F	35.	T	F	55.	T	F
16.	T	F	36.	T	F	56.	T	F
17.	T	F	37.	T	F	57.	T	F
18.	T	F	38.	T	F	58.	T	F
19.	T	F	39.	T	F	59.	T	F
20.	T	F	40.	T	F	60.	T	F

FORM V

INSTRUCTIONS:

The purpose of this checklist is to determine how well you know what is going on in your biology class. Each statement describes some classroom activity. The activities are not judged as either good or bad. Therefore, this checklist is not a test and is not designed to grade either you or your teacher. You are to read each statement and decide if it describes the activities in your class. All answers should be recorded on the answer sheet. NO MARKS should be made in this booklet.

Sample Question	Answer Sheet
1. My teacher often takes class attendance	1. T F

If the statement describes what occurs in your classroom, cross out the T (True) on the answer sheet; if it does not, cross out the F (False).

---

1. Much of our class time is spent listening to our teacher tell us about biology.
2. My teacher doesn't like to admit his mistakes.
3. If there is a discussion among students, the teacher usually tells us who is right.
4. My teacher often repeats almost exactly what the textbook says.
5. My teacher often asks us to explain the meaning of certain things in the text.
6. My teacher shows us that biology has almost all of the answers to questions about living things.
7. My teacher asks questions that cause us to think about things that we have learned in other chapters.
8. My teacher often asks questions that cause us to think about the evidence that is behind statements that are made in the textbook.
9. My job is to copy down and memorize what the teacher tells us.
10. We students are often allowed time in class to talk among ourselves about ideas in biology.
11. Much of our class time is spent in answering orally or in writing questions that are written in the textbook or on study guides.
12. Classroom demonstrations are usually done by students rather than by the teacher.

13. We seldom or never discuss the problems faced by scientists in the discovery of a scientific principle.

14. If I don't agree with what my teacher says, he wants me to say so.

15. Most of the questions that we ask in class are to clear up what the teacher or text has told us.

16. We often talk about the kind of evidence that is behind a scientist's conclusion.

17. When reading the text, we are expected to learn most of the details that are stated there.

18. We frequently are required to write out definitions to word lists.

19. When reading the textbook, we are always expected to look for the main problems and for the evidence that supports them.

20. Our teacher has tried to teach us how to ask questions of the text.

21. The textbook and the teacher's notes are about the only sources of biological knowledge that are discussed in class.

22. We sometimes read the original writings of scientists.

23. We are seldom or never required to outline sections of the textbook.

24. Our tests include many questions based on things that we have learned in the laboratory.

25. Our tests often ask us to write out definitions of terms.

26. Our tests often ask us to relate things we have learned at different times.

27. Our tests often ask us to figure out answers to new problems.

28. Our tests often give us new data and ask us to draw conclusions from these data.

29. Our tests often ask us to put labels on drawings.

30. My teacher usually tells us step-by-step what we are to do in the laboratory.

31. We spend some time before every laboratory in determining the purpose of the experiment.

32. We often cannot finish our experiments because it takes so long to gather equipment and prepare solutions.

33. The laboratory meets on a regularly scheduled basis (such as every Friday).

34. We often use the laboratory to investigate a problem that comes up in class.

35. The laboratory usually comes before we talk about the specific topic in class.

36. Often our laboratory work is not related to the topic that we are studying in class.

37. We usually know the answer to a laboratory problem that we are investigating before we begin the experiment.

38. Many of the experiments that are in the laboratory manual are done by the teacher or other students while the class watches.

39. The data that I collect are often different from data that are collected by the other students.

40. Our teacher is often busy grading papers or doing some other personal work while we are working in the laboratory.

41. During an experiment we record our data at the time we make our observations.

42. We are sometimes asked to design our own experiment to answer a question that puzzles us.

43. We often ask the teacher if we are doing the right thing in our experiments.

44. The teacher answers most of our questions about the laboratory work by asking us the questions.

45. We spend less than one-fourth of our time in biology doing laboratory work.

46. We never have the chance to try our own ways of doing the laboratory work.

47. We talk about what we have observed in the laboratory within a day or two after every session.

48. After every laboratory session, we compare the data that we have collected with the data of other individuals or groups.

49. Our teacher often grades our data books for neatness.

50. We are required to copy the purpose, materials, and procedure used in our experiments from the laboratory manual.

51. We are allowed to go beyond the regular laboratory exercise and do some experimenting on our own.

52. We have a chance to analyze the conclusions that we have drawn in the laboratory.

53. The class is able to explain all unusual data that are collected in the laboratory.

BIOLOGY CLASSROOM ACTIVITY CHECKLIST

ANSWER SHEET

Form V

Name of Teacher Being Described_____

Name of Class Which He Teaches_____

T--True F--False

1.	T	F	21.	T	F	41.	T	F
2.	T	F	22.	T	F	42.	T	F
3.	T	F	23.	T	F	43.	T	F
4.	T	F	24.	T	F	44.	T	F
5.	T	F	25.	T	F	45.	T	F
6.	T	F	26.	T	F	46.	T	F
7.	T	F	27.	T	F	47.	T	F
8.	T	F	28.	T	F	48.	T	F
9.	T	F	29.	T	F	49.	T	F
10.	T	F	30.	T	F	50.	T	F
11.	T	F	31.	T	F	51.	T	F
12.	T	F	32.	T	F	52.	T	F
13.	T	F	33.	T	F	53.	T	F
14.	T	F	34.	T	F			
15.	T	F	35.	T	F			
16.	T	F	36.	T	F			
17.	T	F	37.	T	F			
18.	T	F	38.	T	F			
19.	T	F	39.	T	F			
20.	T	F	40.	T	F			

APPENDIX B

DEMOGRAPHIC DATA

BIOLOGY TEACHERS' DATA SHEET

Please check the boxes or fill in the blanks. All information is confidential.

1. Marital Status: ( ) single ( ) married ( ) widowed ( ) divorced

2. Sex: ( ) male ( ) female Age: _____

3. Primary Teaching Area: #1 _____ #2_____

4. Teaching Experience: 1. (total) _____ 2. (at this school) _____
   3. (in present teaching area) _____ 4. (under present principal)_____

5. Average Class Size: (use laboratory enrollment if separate from lecture)
   ( ) less than 15 ____ ( ) 16-20 ( ) 21-25 ( ) 26-30 ( ) greater than 30 ____

6. Degrees: ( ) BS or BA ( ) BS or BA + 15 hrs. ( ) masters
   ( ) masters + 15 hrs. ( ) masters + 30 hrs. ( ) EdS ( ) EdD or PhD
   ( ) other (explain) _____

7. College Semester Hours in Science (approximate):

	Zoology	Botany	Physics	Earth Sci.	Inorganic Chemistry	Organic Chemistry	Biochem.
1. Undergraduate	___	___	___	___	___	___	___
2. Graduate	___	___	___	___	___	___	___

8. Membership in Professional Organizations: (in order of preference)

_____

9. If you are a biology teacher, have you attended any biology institutes in the past ten years? If so, list and indicate if BSCS orientated.

_____

10. When did you last participate in the following? (state the year)
    _____Science Seminar _____Science Workshop _____Science course

11. Class Schedule: (at present time)
    Sec. 1 _____ Sec. 2 _____ Sec. 3 _____
    Sec. 4 _____ Sec. 5 _____ Sec. 6 _____

12. Have you taught BSCS Biology prior to this school year? ( ) Yes ( ) No

13. Are you planning to teach BSCS Biology during the next school year? ( ) Yes ( ) No

14. If you are teaching BSCS Biology and you are using or will use a laboratory block, please specify the block involved.

_____

15. If you are teaching BSCS Biology, please check the version that you are using.
    ( ) Blue ( ) Green ( ) Yellow

16. Annual Salary in Your Present Position: (Check the range that includes your salary)
    ( ) $5000-$5499 ( ) $5500-$5999 ( ) $6000-$6499 ( ) $6500-$6999
    ( ) $7000-$7499 ( ) $7500-$7999 ( ) $8000-$8499 ( ) $8500-$8999
    $ _____Salary other than above. (Please state the range)

17. Funds appropriated or budgeted for the biology program in your school. (State amount)
    $_____Textbooks $_____Materials $_____Equipment

18. Textbook you are now using:

Title: _____

Author_____

19. If you are not teaching BSCS Biology, please check the reason or reasons below, indicating why you are not. (Check all reasons that apply.)

( ) I do not think the program is an improvement over the conventional biology course that we are using.
( ) I do not think the program fulfills our local needs.

( ) Textbooks and related materials are not available.

( ) Adequate laboratory space is not available.

( ) I do not feel that I have adequate preparation and training to teach BSCS Biology.

( ) Too much extra work is required of the teacher when teaching BSCS Biology.

( ) The local school administration does not favor use of the BSCS program.

( ) Fellow biology teachers do not favor use of the BSCS program.

( ) Other Reasons (Please specify) _____

_____

20. Please check only one of the following four statements. Check the one statement that most nearly describes your situation.

( ) I am currently teaching BSCS Biology and I prefer to continue teaching it.

( ) I am currently teaching BSCS Biology but I do not prefer it and would rather teach the conventional course.

( ) I am not currently teaching BSCS Biology but I prefer the program and I would teach it if the situation permitted it.

( ) I am not currently teaching BSCS Biology and I do not prefer to teach it.

21. Comments: (If you are not teaching BSCS Biology, but you are using some of the BSCS ideas, e. g., lab blocks, please comment on this. Also, feel free to explain any of the responses made above.)

_____

_____

_____

_____

_____

_____

APPENDIX C

ATTITUDE INVENTORY, BLAC, BCAC SCORES

ATTITUDE INVENTORY, BLAC, AND BCAC SCORES
FOR INDIVIDUAL TEACHERS

TEACHER NUMBER	ATTITUDE INVENTORY	BLAC	BCAC
1	25	31.96	- - -*
2	23	29.73	25.53
3	39	26.47	26.69
4	17	32.22	- - -*
5	37	37.54	31.79
6	23	25.59	23.50
7	18	30.65	27.55
8	26	27.79	23.77
9	38	38.65	36.14
10	38	28.62	26.52
11	29	29.56	26.03
12	12	30.30	- - -*
13	34	29.82	28.85
14	28	28.04	25.29
15	40	28.81	25.29
16	35	25.96	23.57
17	30	28.30	24.71
18	31	28.44	24.00
19	34	37.48	32.00
20	27	33.41	29.30
21	32	29.96	26.26
22	20	29.78	25.46
23	32	26.91	28.28
24	37	29.63	27.78
25	37	31.97	30.63
26	35	26.55	23.11
27	29	29.70	27.40
28	15	30.27	29.00
29	33	35.50	31.16
30	37	30.71	26.64
31	38	28.17	29.33
32	31	27.82	- - -*

*BCAC was not administered to the classes of these teachers.

VITA

Terry Scott McNeill

Candidate for the Degree of

Doctor of Education

Thesis: A STUDY OF THE RELATIONSHIP BETWEEN THE BIOLOGY TEACHERS' ATTITUDE TOWARD THE BSCS BIOLOGY PROGRAM AND THE STUDENTS' PERCEPTION OF THE TYPE OF LABORATORY AND CLASSROOM ACTIVITIES

Major Field: Higher Education

Biographical:

Personal Data: Born in Buffalo, Minnesota, November 17, 1941, the son of Mr. and Mrs. William McNeill.

Education: Graduated from Bonilla High School, Bonilla, South Dakota in 1959; received the Bachelor of Science Degree in Secondary Education from Northern State College, Aberdeen, South Dakota with majors in Biology and Business Education in May, 1963; attended the University of Oregon and Portland State College in 1964; awarded an NSF Summer Institute at Arizona State University in 1966; awarded NSF Academic Year Institute at Oklahoma State University, 1968 and 1969, completed the Master of Science Degree in Natural Science, Oklahoma State University, 1969; completed requirements for the Doctor of Education Degree at Oklahoma State University in July, 1971.

Professional Experience: Instructor of Biology, General Science, and Business Education at Marshfield Senior High School, Coos Bay, Oregon, 1963-67; Biology Teacher, Stillwater Junior High School, Stillwater, Oklahoma, 1968; Graduate Assistant in Biological Sciences, Oklahoma State University, 1969-70; Full Time Instructor of Biological Sciences, Oklahoma State University, Stillwater, Oklahoma, 1970-71.