AN INVESTIGATION OF ATTITUDES AND OPINIONS REGARDING THE UNDERGRADUATE PREPARATION OF BIOLOGY TEACHERS

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in partial fulfillment of the requirements
for the Degree of
DOCTOR OF EDUCATION
May, 1972

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ACKNOWLEDGMENTS

The writer wishes to express his deep appreciation to each member of the dissertation committee: Dr. Kenneth E. Wiggins for serving as chairman and for his continued interest, guidance, and assistance during all phases of the research; Dr. William D. Frazier, Dr. Troy C. Dorris, Dr. Herbert Bruneau, and Dr. Robert Alciatore, members of the committee, who provided constructive criticism and valuable suggestions.

Finally, special gratitude is extended to my wife, Dorothy, for the understanding, encouragement, and patience she has exhibited throughout my graduate work.

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CHAPTER I

INTRODUCTION

During the past decade many changes have occurred in the field of biological education. One of the most significant catalyst that produced these changes is the development of new curricular materials for use in the secondary schools. The success of these new materials has created widespread concern in educational circles and has directed the attention of college teachers, high school teachers, and administrators alike to a reappraisal of the educational program (28).

The increased emphasis on biological science curriculum as a prerequisite for entrance into the teaching profession demands the need for more and better instructional methodology including the use of media.

Oklahoma's six state "teacher" colleges account for a large and important part of the state's teacher education programs. Even though they are moving from a single-purpose orientation toward a more broadened set of functions, their chief activity is still the production of teachers (24). Recommendations of the Oklahoma Regents for Higher Education (27) states that,

> In teacher education particularly state colleges should turn their attention from quantity to quality. The outcome of such programs could provide Oklahoma with infinitely better schools in the future.

Such changing concepts as to the role of state colleges can be recognized as but reflections of the many changes which have occurred at

an accelerated pace during the past decade. Some of the more dramatic changes include the following:

a. There are signs that the continuing shortage of teachers since the 1950's is gone and that there will be a national surplus in the 1970's (25).

b. Oklahoma is turning out teachers at twice the rate of the nation as a whole and employing teachers at the same rate as the nation as a whole (59).

The magnitude of these changes gives added emphasis to the importance of providing the teachers in biology with the very best possible educational opportunities not only to acquire the new techniques, skills, abilities, and knowledge so essential to quality teaching needed in this state but also to acquire those skills and abilities needed to relate to young high school students. Biological education is an integral part of the total education program for secondary schools.

This study was undertaken to determine a set of attitude statements which when validated would serve as principles for biological methods. The assumption is made that attitudes expressed by educational leaders which appear in the literature are often the principles which guide and shape educational decisions. The major purposes of the study are:

1. To identify from the literature statements of attitudes concerning subject matter that should be included in a biology methods course.

2. To seek validation of these selected statements.

3. To determine the degree of agreement or disagreement between the groups to be investigated regarding these selected statements.

Statement of the Problem

Oklahoma state colleges are charged with the primary responsibility for providing learning experiences for beginning teachers in their

respective fields. The success of these educational endeavors is dependent upon the foresight of the educational leaders and their ability to organize, implement, and maintain comprehensive learning experiences. To maintain such a program requires the orientation of all faculty members toward common accepted goals and objectives. How to maintain a vital biological methods program is the problem. The education faculty, the biology faculty, the recent graduates, and the high school principals must have a knowledge of the problems facing biology teachers, must be cognizant of trends in curriculum development, and must be acquainted with policies regulating biology education at the state level.

At the colleges and at the local level all four groups must recognize the existing problems and conditions and must initiate programs that will tend to alleviate undesirable conditions which may presently exist. No published account has recorded the opinion of these four groups regarding the goals and objectives of the biological methods course.

Importance of the Study

Additional research in the area of attitudes toward the biology methods program is needed for at least three reasons. First, previous studies have not attempted to describe biology methods within the state college system from opinions of biology faculty, education faculty, high school teachers, and administrators. Second, previous studies have been limited in scope and centered around the opinion of science educators in relationship to their individual campuses. Third, the researcher has been unable to find studies that attempted to

identify some of the major attitudes toward the total biology methods program as expressed by both college educators and high school educators.

It is not the intention of this study to point out the shortcomings in the preparation of future biology teachers. Rather, it is hoped that agreement among the respondents will reveal some experiences necessary for more effective teaching. Also, it is hoped that this agreement will reveal experiences of a practical nature. Programs of teacher education have reached a degree of stability and any change which might be suggested here will have to come within the existing framework. Biology methods courses do exist. The problem is a lack of any clear-cut definition of the components of an acceptable program.

The survey concerning the content of a biology methods course has been divided into six categories of suggestions or statements. These are:

1. Laboratory portion of the methods course.
2. Professional preparation.
3. Techniques of teaching.
4. Electronic teaching aids.
5. Evaluation in the methods class.
6. Management of students.

This study will attempt to determine by use of appropriate statistical methods the significant differences of opinions of college educators and high school educators toward selected statements concerning the biology methods program.

Assumptions

1. An assumption basic to this study is that there is a relationship between teaching efficiency and preparation in a quality biology methods course.

2. The responses of the samples will be honest expressions of their attitudes and opinions. It may be possible that the subject may be consciously or unconsciously concealing his true attitude. In measuring the attitude expressed, this fact must be considered.

3. The sample selected truly represented the population.

4. The questionnaire will provide an adequate means for collecting data relative to the study.

5. The six categories of activities can be structured to aid individual learning.

Delimitations

The four populations of the study will be limited to: the education and biology faculties of Oklahoma's six state colleges, randomly selected principals of Oklahoma high schools, and recent graduates of biology teacher education programs in Oklahoma's six state colleges.

Definition of Terms

In order to aid in understanding and to avoid confusion, several terms should be identified, defined, and explained at this point. Therefore, the following terms and their definitions have been included in this section of the study.

Biology Methods Course. These are the courses that are concerned with the study of the objectives, methods, classroom techniques,

selection, and use of materials and related activities of teaching biology in the senior high schools. These courses may include individual laboratory and demonstration of specimens and materials commonly used by teachers. For the purposes of this study, these courses at six state colleges of Oklahoma will be investigated.

Attitude. An emotionalized tendency, organized through experience, to react positively or negatively toward a psychological object. Attitudes are, irrevocably, linked to emotions and may be roughly defined as the response to a statement on the questionnaire.

State College. For the purposes of this study "state college" refers to the following colleges in Oklahoma.

Central State College at Edmond
East Central State College at Ada
Northeastern State College at Tahlequah
Northwestern State College at Alva
Southeastern State College at Durant
Southwestern State College at Weatherford

Methods Activities. These are activities not a part of the formal curriculum. For the purposes of this study, the categories of activities to be investigated have been divided into six groups.

Methods student, Teacher-in-Training, and Pre-Service Teacher. These three terms are used synonomously throughout the study and refer to students enrolled in the biology methods course for teachers.

Overview of the Study

Chapter I has included a rationale for the study, a statement of the problem, definitions, importance of the study, and a brief description of the procedures. In Chapter II a review of related literature is presented. A detailed description of the procedure for the study is presented in Chapter III. A detailed summary of the findings of the

study will be presented in Chapter IV. Chapter V contains the investigator's findings and their implications for a biological science methods course.

CHAPTER II

REVIEW OF LITERATURE

The roles of Oklahoma's former "teacher" colleges have changed considerably during the past decade. This is particularly true with regard to recognized responsibilities in assisting beginning teachers to meet the challenge caused by scientific advances in society. With tremendous increases in enrollment, the value and necessity of placing increased emphasis upon education is recognized generally in todays society. A great many of educations needs can best be met through continuous re-examination of our teacher preparation programs.

For years all states have attempted to improve the quality of education by improving the programs of teacher training by assuming the authority for accrediting teacher education institutions and by imposing more demanding certificate requirements on the college (11). In the past decade it has become increasingly apparent that minimal requirements set by accrediting agencies and minimal certificate requirements have been ineffective in the preparation of the modern biology teacher (11). With signs that there will be a national surplus of teachers in the 1970's (25), the future demands new emphasis in teacher education.

Although there is some difference of opinion concerning the details of a total educational program for teachers, there is agreement that it should include:

1. a general-liberal background education

2. specialized subject matter

3. courses in professional education

The literature reviewed in this chapter will be that which is directly related to professional education, specifically the biology methods course. While the academic education of a teacher includes general and specialized courses is basic, it is not the whole of the teachers' essential preparation. Much of the professional knowledge and skill that is necessary for starting to teach must be acquired in professional courses given in college. In developing a background for the problem of concern in this study, material from the fields of higher education and secondary education is used as a frame of reference for the validity of proposed suggestions and solutions to the biology methods problem. This material establishes the need for information regarding the background of the pre-service teacher.

A major purpose of this review of the literature will be to describe topologically the various areas of research. The major difficulty of this approach is that the majority of the authors include several topics in their reports. In this review the research has been placed in six general categories with the same research contributing to several categories in some instances. These categories are: professional preparation, management of students, techniques of teaching, electronic teaching aids, evaluation in the methods class, and the laboratory portion of the methods class.

Topological Review

The introduction to this chapter stated that the categorization of the topics would reveal that each of several studies contributed to more

than one category. A second problem that must be realized is that one category may be directly related to another of the categories. For example: Professional preparation in BSCS biology could have an effect on the teaching technique of a beginning teacher, or individualized instruction might include electronic teaching aids. Therefore, the interrelationship of the categories must be considered to obtain an overall view of the biological science methods course. The attempt has been made to include this aspect in the following categories.

Professional Preparation

The basic problems and issues of educating science teachers must be faced if we are to meet the challenge of curricular changes within our schools. Schlessinger (46) lists several problems we must solve and a number of issues with which we must come to grips. They are:

1. Who should be involved in planning programs for the education of science teachers in our colleges and universities?
2. How may we raise the level of competence of our pre-service science teachers?
3. How may we improve the professional status of teacher education?
4. Who shall determine certification standards for beginning science teachers?
5. What are the academic competencies we seek for pre-service science teachers?
6. How can pre-service science teachers be prepared to teach the so-called "new curricula" in our secondary schools?

There is sufficient evidence in the research literature on science methods to indicate the need not only for fresh approaches to the teaching of biology in the secondary school, but also for new and

different ways of preparing the secondary teacher to teach science. Undoubtedly, the new secondary school biology curriculum (BSCS) has increased the demand for better teachers. Such pressures are often transmitted by secondary school administrators.

There is considerable controversy concerning the content of preservice science methods courses. Anderson (3) maintains that science methods instructors should provide an intricate balance between preparation for the past and future. He lists twenty-nine objectives which he believes to be attainable for both a theoretical section and a laboratory section of a methods course. Anderson (3) and Brehm (8) would agree that the role of the methods instructor is to select content and experiences that are worthwhile. Brehm (8) identified four possible roles of methods instructors as follows:

1. to provide a model for the student of an alternative form of teaching behavior
2. to prompt the teacher-in-training to try out new behaviors that reflect the mode of inquiry which the new science promotes
3. to involve the teacher in training in identifying and developing skills, both intellectual and manual, which are exemplified in science education
4. to emphasize the unique contribution of the scientific discipline

If we accept the premise that a methods course should be a preparation for the future, then there is some evidence that deficiencies exist. Hurd (28) suggested that the quality of science methods courses given to teachers are at fault. His reasons include:

1. Less than half of the biology teachers have had a course in methods and techniques of teaching science.

2. Teachers of biology are simply not up-to-date in their field.

In defense of these two statements, he states that "hundreds of institute programs have been developed to bring them up to date." Grobman (23) also takes this view when she states, "at least half the biology teachers in the United States have attended an institute or inservice program in the last half dozen years." Both Hurd and Grobman suggest that skills needed by teachers should be developed in the college where high school teachers are educated.

Science education is rapidly expanding with an unprecedented amount of new information. It is becoming obvious that colleges cannot teach everything that is available. Nanney (35) stated that what we teach may be less important than our approach to our discipline. He believes that we should abandon the idea that biology is a body of knowledge in favor of the idea that biology is a cultural activity (a process). Ginsburg (22) supports this view when he states that the knowledge explosion in science has dramatized the need for continuous revision of curricula and teaching materials.

Hawaii has a unique science intern teacher program (63). Once a week, the interns meet with the supervisor to share their problems and solutions. This college seminar enables the coordinator to:

1. bring the latest scientific and educational research to the attention of the interns

2. encourage other intern teachers to exchange their success and failures in science teaching

3. stimulate the interns to recognize their individual problems such as teaching science to the slow learner, vocabulary disabilities, economical use of scientific equipment, evaluation of science learning, case studies, research, and other appropriate instructional materials

4. know where to seek additional knowledge in the teaching of science

5. bring in a few outside specialists on discipline if the need arises

Ginsburg (22) also found the seminar effective in various approaches, including programmed laboratory units, the use of original papers, an evaluation of existing visual aid material, available texts and laboratory manuals, are all examined and evaluated in a spirit of inquiry.

Hurd (28) states that the professional phase of teacher education in biology needs to be re-examined. He feels that the general methods course in the professional sequence is inadequate for the prospective teacher of biology. Hurd would agree with the National Association of State Directors of Teacher Education and Certification (36) which lists eight guidelines for a program of teacher education in biology. Guideline VII states: "The program should include preparation in the methods especially appropriate to the subject to be taught."

The literature seems to indicate the need for studying the whole process of professional education so that our programs may become realistic in their content and experiences. Further, we must discover what parts of educational theory are needed by beginning teachers.

Electronic Teaching Aids

Advances in teaching technology such as programmed learning, audio-tutorial laboratories, television, video-tape, motion pictures, tape recorders, radio, overhead projectors and film loops have opened up vast possibilities for disseminating and storing information usable in teaching and testing situations. Numerous challenges face methods educators, with electronic teaching devices. The challenge lies in

finding ways and means of applying the new advances (43).

One of the more promising of recent approaches to the problem of technology in the methods course is micro-teaching, a technique using the video-tape machine, which was developed at Stanford University by Dwight W. Allen. Micro-teaching as developed at Stanford has several characteristics (7,1).

1. First, a set of specific teaching skills is studied by the intern.

2. Then, the intern attempts to apply the skills in a short lesson, usually five to ten minutes, with four of five pupils.

3. This lesson is recorded on video-tape and immediately after its completion, the intern watches a replay of the lesson.

4. During the replay a specially trained supervisor gives the intern specific feedback on his performance in the skills.

5. The intern then replans the lesson and reteaches it to another group of four or five pupils.

Research evidence indicates that skills learned in the micro-teaching format transfer to a significant degree to the teachers behavior in his regular classroom and persist with little or no regression for a period of several months (7). There is also some evidence to indicate that microteaching achieves changes in teacher behavior much more rapidly than student teaching or intern teaching (1). In addition, research would seem to indicate that the video-tape training process is economically, technically, and pedagogically sound. Mackey (32) concludes that the method is revolutionizing our teacher training when he states:

> . . . video-tape makes it possible for anyone to observe a lesson anytime and anywhere, to see it again and again for purposes of analysis either by the observers or by the very teacher who taught

> the lesson. Indeed, this self-analysis, this possibility of watching oneself teach, of stopping ones movements in order to listen to comments of more experienced teachers is one of the most significant developments in the technology of teacher training.

Clayton (13) also emphasized the personal and individualized nature of the video-tape media. He states that no other medium has quite the intimacy for self-analysis that video-tape, used in particular ways, can have.

Most important in the use of the new electronic teaching devices is an awareness of the right audiovisual aid for the right tasks (2). Effective teachers know that there is no method of teaching that is best for all learners, for all teachers, or for use in all situations. A pre-service teacher should be introduced to the wide variety of media which may be used in providing classroom instruction. Knowing these media and their characteristics would permit the pre-service teacher to select those that may be used to best advantage and to plan how they may be used to secure the desired results (30).

New methods of instruction are essential in the training of new teachers because traditional methods do not meet present needs. Lewis (30) states that new methods which have resulted from technological developments are needed because of the ever increasing amount of information to be learned.

Some disciplines, notably foreign languages, have been making use of audio-tapes for some time. Postlethwait (42) provided instruction by audio-tape for a botany class at Purdue University. This systems approach involved four phases of instruction weekly:

1. one hour of large-lecture instruction

2. one hour of small group assembly of approximately thirty students

3. independent home study

4. approximately four hours of supervised study with audio-tape and laboratory materials

According to Postlethwait:

> The use of audio-tape to program laboratory study can provide many of the advantages contributed by such devices as TV and still retain the personal contact which is so important to the student. Uniform instruction for large numbers of students can be made available on an individual basis so that the student can study at a pace and time most convenient for him.

Richason (45) developed the Audio-Visual-Tutorial (AVT) system as a method of independent study in geography. The AVT system consists of an individualized study booth, a tape player, and a 35 mm slide projector. Students could work independently on an unscheduled basis, and could repeat any portion as often as desired. Syrocki, Thomas, and Fairchild (50) adopted an AVT approach for college biology class to encourage the student to work independently, at the convenience of the student, and at the pace the student wishes.

The widespread fusion of technology and education is rapidly becoming more the rule than the exception in our Nation's schools and colleges. Innovative practices which employ with considerable sophistication the use of television and other technologies are to be found in increasing numbers at all levels of education (66).

Unquestionably, television, micro-teaching, AVT, and other electronic teaching aids will play an expanding role in education in the years ahead. The use of these aids, however, will remain only as creative as the imagination of the faculty which uses them. There is now considerable evidence to document that these and other electronic

teaching aids can be used with great effectiveness in the pre-service education of teachers.

Teaching Techniques

There is considerable controversy concerning the content of pre-service science methods courses. This review of the literature, however, did reveal discernible consensus on many major points concerning what a methods course should be. For example, the inquiry approach stressing the "process" received strong support and the need was expressed for more of this in our lectures, presentations and course materials.

Montean (34) reported the results of a regional training conference which enrolled approximately 100 science educators across the country in the summer of 1968. In his analysis of the conference he states immediate attention should be given to the development of inquiry-oriented teaching models for our pre-service and inservice methods classes. Schwab (47) says the essence of teaching science as inquiry is to show conclusions in the framework of the way they arise and are tested. Anderson (4), in a discussion of teaching the nature of science, also emphasizes the aims and methods employed by the scientist. Gagne (20) states that inquiry is a set of activities characterized by a problem-solving approach. It would appear that much emphasis has recently been placed on inquiry as an outcome of instruction in biology.

There has been a renewed interest in the past few years concerning the concept of educational objectives. Bloom (6), Mager (33), Gagne (20), and others have redefined the rules and principles governing the structure of educational objectives. They have described a rationale

for applying these rules to a design of instructional situations in which student learning is both predictable and measurable. Eisner (17) list three rules which maintain that:

a. Educational objectives should describe pupil behavior, not teacher behavior.

b. Objectives should describe the pupil behavior in a subject matter context.

c. Objective behavior should be described at a level of specificity that makes possible an empirical test of its occurrence.

Cleaver (14) suggests some advantages of specifying behavioral objectives in terms of pupil behavior:

1. It forces one to decide what is significant and crucial in selecting priorities for learning and instruction.

2. It compels one to look for cause-and-effect relationships in learning and instruction and to place responsibility for failure to learn where it most frequently belongs: on the instruction, not the learner.

3. It provides a substantive basis upon which the logic of analysis and of sequencing can be applied to the selection of both content and instructional methodology, rather than content alone.

4. It provides the means by which evaluation can be made more precise; that is, one can look for specific behaviors as indicators of whether the goals of instruction have been achieved.

In concluding, Cleaver (14) states that:

> The establishment of a set of behavioral objectives such as these, reflecting the character and concerns of a discipline that is constantly seeking to acquire and evaluate new information, is a major educational achievement.

Management of Students

It is not the intent of the writer to make an exhaustive review of the literature involving various teaching methods of pupil control. In this section, the writer is particularly interested in studies which provide for individualization in education. The student unrest era of the 1960's saw the youth calling for relevance and individualization in education (27). Management of students when viewed in this perspective, is a means of providing for the individual. Quality education has directed much of its attention to this concern, the individualization of education.

The past decade has seen a large number of journal articles, books and projects stressing the concern to individualize education (5,10,18, 27). Two major research centers, (American Institute for Research and the University of Pittsburgh's Learning Branch and Development Center) have been developed to seek means of implementing the individualizing of education. The modern approach utilizes technological innovations which have led to the development of several new instructional methods. Among those mentioned earlier in this chapter are micro-teaching (1), audio-tape (42), and audio-visual-tutorial (45). Advances in technology might also include programmed instruction, teaching machines, and television instruction.

Towle (51) suggested that we need more emphasis on the humanistic approach to education. His view of a good teacher is one that can communicate with each student, one that maintains class control, and one that takes into account the social and cultural background, the ability level, interests and previous educational experiences of students. In discussing the qualities of a teacher, Ginsburg (22)

states: "he must have certain perceptive insights that permit him to relate to the needs of the students." The importance of considering the characteristics of the learner are also emphasized by Pella (39). If we can agree to these attributes of a good teacher, how can we promote them in education and methods courses? Washton (63) suggests that the methods instructor should be a former science teacher with many years of experience teaching and supervising at the secondary and college levels. Washton also suggested a method for educating the science intern teacher. Once a week, all interns meet with the instructor to share their problems and their solutions.

Anderson (3) at Indiana University and Druger (15) at Syracuse University reported similar science methods courses. Both programs included:

1. Preparing behavioral objectives according to Mager (33).
2. Evaluating test items according to the criteria discussed in Bloom's Taxonomy (6).
3. Developing skills in utilizing the interaction analysis systems of Flanders (19).

The highly variable background each individual student has in the realm of biological skills and techniques suggests an approach to teaching that provides maximum individualization of instruction.

Evaluation

Fletcher Watson, speaking before the National Science Teachers Association Convention on April 1, 1966, stated:

> Unhappily, there is relatively little to report in terms of empirical studies on the degree to which methods courses in science teaching achieve any sorts of ends (64).

Fortunately, such questions are now being investigated and the value of science methods courses are being realized. One such study done by William H. Leonard (29) resulted in a new instrument for the evaluation of student teachers of science. His instrument consisted of a series of graded scales, each scale based upon a single objective of the methods course. Orlich and Seeling (38) in their study of Idaho biology teacher preparation, stated that evaluation of biology teacher efficiency means consideration of more factors than academic science preparation alone. They suggest that techniques of instruction, personality, classroom management, and daily preparation are but a few of the important factors used in evaluating teacher efficiency.

Smith (49) pointed out that practice should follow validated research and that research should not merely serve to evaluate practice. In reviewing the literature concerning evaluation of methods students and methods courses, the researcher found a comparative lack of rigorous evaluative studies that suggested sound modifications of present practice. Leonard (29) in his analysis of a science teaching methods course suggested that the method of assigning grades should be continually re-evaluated in terms of the objectives of the course. He also states that a great deal more research needs to be done in measurement of the long range effects of college science teaching methods courses.

Recent developments in science education require a second look at testing techniques used in assessing the objectives of secondary school science. Advances in electronics and teaching technology mentioned earlier in this chapter have opened up vast possibilities for disseminating and storing information usable in testing situations. In meeting the challenge of recent developments Reiner (43) states:

1. A basic requirement in testing is the accurate statement of objectives.

2. Tests of understanding rather than factual recall need to be developed.

3. Testing techniques need to be devised to assess concept formation.

4. The challenge lies in finding ways and means of applying new technological advances.

Recent curriculum revisions have introduced innovations in goals, methods, and learning materials thus challenging test makers to meet the needs implicit in the new approaches. Also, curriculum revisions and technology will continue to present challenges in evaluating methods students and methods programs.

Laboratory Methods

An article by Smith (49) which focused on the preparation of biology teachers stated that laboratory work of an appropriate type would surely characterize any modern program of preparation. Washton (62) found that science teachers need confidence in handling and manipulating materials that are used in scientific experiments and demonstrations. When the teachers were given such opportunities to develop these skills in the course, they acquired confidence and improved techniques. In his methods course each student performed either an experiment or a demonstration in class in order to become familiar with materials and the skill in performing demonstrations. Wytiaz (67) obtained results that were congruent with the previously cited studies. He stated, "The methods course should include learning to do experiments and learning to construct simple scientific equipment."

Further support of the previous findings relative to the laboratory

portion of the methods course was revealed in a study by Verduin (68). He reported that the practical experience of constructing models, working with tools, examining, understanding, and utilizing scientific equipment, and building and maintaining science projects were not receiving attention in science methods courses. He also stated that beginning teachers need an exposure to different types of free and inexpensive materials. Another positive report of the laboratory approach was made by Pike, Jordan, and Konzal (40). For the first three or four weeks of each semester, the instructors demonstrated different methods, techniques, and laboratory investigations which they considered essential to the successful teaching of a modern high school biology program.

The increasing importance of laboratory work requires special tests, not necessarily the pencil and paper variety. Reiner (43) stated:

> The emphasis on pupil laboratory experiences which are self directed, open-ended, and which build skill in the process of inquiry presents a challenge to test writers, both specialists and classroom teachers.

Voelker (61) probably sums up the laboratory portion of the methods course when he states:

> A laboratory activity presents a prospective teacher with the opportunity to learn and practice a basic instructional technique, while at the same time providing the type of input that will help him develop a philosophy of science teaching.

Summary and Conclusions

The preceeding pages discuss the importance of the biological methods program and would seem to indicate:

a. that it is proper to examine the state of undergraduate science instruction.

b. that there is a close relationship between the undergraduate science curriculum and the quality of teacher preparation for secondary schools.

c. and that there is a need for improved teaching techniques and more imaginative approaches to instruction at the biology methods level.

d. that courses must be planned and taught by competent educators with a continuing commitment to teacher education.

The chief conclusions that can be drawn from the literature on the biology methods program are:

1. The literature on the subject of the biology methods programs is sparse, with the principal source being articles in professional journals.

2. Many of the articles were based on the opinion and observation of experts in the field, rather than scientific investigation.

3. Many of the studies used samples that were not selected in a random manner and contained possible bias resulting from "volunteer" or selected groups.

4. Many of the studies did not focus on one aspect of the biology methods program, but attempted to collect data for a variety of purposes.

5. Colleges should seek to establish an integrated, well-balanced program designed to introduce prospective biology teachers to laboratory oriented processes and to the latest methods of teaching science.

The literature previously reviewed served as a background for the present study. An understanding of the areas investigated prevents duplication of effort, but many studies did provide information for the

purpose of developing the questionnaire used in the present study. Further, it appeared to emphasize that research should be directed toward discovering an effective combination of educational techniques that would lead the student to maximum understanding.

CHAPTER III

DESIGN OF THE STUDY

The purpose of this study is to present the general conditions under which the present research was done and the procedures employed. A complete listing of hypotheses tested has been made, a description of the populations has been made, and the methods used in obtaining data presented.

Description of the Sample

The random sample for this study consisted of four categories of Oklahoma educators employed during the academic year, 1970-71. These categories are:

1. Education faculty of six Oklahoma state colleges
2. Biology faculty of six Oklahoma state colleges
3. Oklahoma high school principals
4. Oklahoma high school biology teachers who have graduated from one of the six state colleges and who have been certified to teach biology during the years 1968-70.

It was determined prior to the selection of the random sample that the number of potential respondees would be 50 persons in each of the four categories. Table I tabulates the population Oklahoma educators, population in each of the four previously described categories, the obtained sample, the percentage of the population each sample represents, and the percentage of the population the total sample represents

during the academic year, 1970-71.

TABLE I

A COMPARISON OF THE OBTAINED SAMPLE AND POPULATION OF OKLAHOMA EDUCATORS EMPLOYED DURING THE ACADEMIC YEAR 1970-71

	RESPONSE CATEGORIES				
	State College Faculty		High School Educators		
	Education Department	Biology Department	Principals	Biology Teachers	Total
Obtained Sample	40	44	43	40	167
Population	122	55	485	211	873
Percent	32.7	80.0	8.8	18.9	19.1

A 70 percent return was established as minimum for the study. Two weeks after sending out the questionnaire this percentage had not been reached. A follow-up letter (Appendix A) and questionnaire (Appendix B) to all persons who had not returned the questionnaire resulted in bringing the number of returns up to and in excess of the required percentage. The effort to contact all persons in the sample who did not send back the completed questionnaire was made to obtain a maximum return.

Table II shows the percentage of the number of potential respondees in each education category that the obtained sample represents.

TABLE II

PERCENT OF RETURN

Education Categories	Potential Respondees	Obtained Sample	Percent
College Education faculty	50	40	80.0
College biology faculty	50	44	88.0
High school principals	50	43	86.0
High school biology teachers	50	40	80.0
Total	200	167	83.5

Rational of the Populations

I. Oklahoma High School Principals. Within the framework of our public schools, the high school principal has the responsibility to work with local colleges and classroom teachers to refine, innovate, implement, and accept curriculum changes that have validity (31). As a result of this emerging emphasis, it becomes important that the principal participate extensively in educational research in order to keep his program up to date. The emphasis on participation was stressed by Turner (52) when he stated:

> It has been pointed out that the building principal must become an active participant in education research or he will find himself bypassed. Because of greatly increased research activity in the public schools, it has become more imperative than ever before the principal be a knowledgeable student of research method.

II and III. Education and Biology Faculties of Oklahoma State Colleges. East Central State College is typical of the six state colleges in its purposes, functions, and objectives. The following functions, with respective aims are listed in its college bulletin for 1970-71 (54).

> Professional orientation: To acquaint students with the duties, opportunities, and responsibilities of teachers and supervisors in the elementary and secondary schools. To help them determine for themselves whether or not their personal qualifications give prospect of success in the teaching profession and encourage those whose prospects are favorable.
>
> Understanding of principles of effective teaching: To provide students with the information, methods, and attitudes needed by the effective teacher and supervisor; . . . .
>
> Provision for laboratory experiences in teaching: To provide selected students with opportunities for directed observation, participation, and actual teaching experience under the guidance of competent supervisors; . . . .
>
> Stimulation of professional growth: To assist teachers in their own professional growth after they leave the college, and to acquaint them with findings of recent experimentation and research.

In the accomplishment of these objectives, both the Education department and the Biology department must be actively involved in the teacher education programs. It is with these objectives in mind that the researcher included these two departments of Oklahoma's six state colleges for an attitude and opinion survey.

IV. Recent Biology Education Graduates of Oklahoma's Six State Colleges. The fourth population is the recent graduate of the state college (12,65). This group was included in the study for two reasons. First, being recent graduates, there is a professional awareness of the immediate needs of beginning teachers. Second, they may play a

partnership role with the colleges to allow both parties to function in the development of a good methods program.

Hypotheses Tested

The hypotheses tested in this study were formulated as null hypotheses.

A. Hypotheses regarding the professional preparation in biology methods is formulated as follows:

> Significant differences do not exist between college education faculty, college biology faculty, high school principals, and high school biology teachers in their attitudes and opinions of professional preparation in biology methods as measured by their response to the following items.
>
> 1. The use of BSCS materials.
> 2. The development and use of curriculum guides and resource units.
> 3. The inclusion of a required biology methods course.
> 4. Meeting students needs by providing a set of teaching experiences.
> 5. Need to provide sourcebooks for free materials.
> 6. Development of short and long term science budgets.

B. Hypotheses regarding the beginning teachers' management of students is formulated as follows:

> Significant differences do not exist between college education faculty, college biology faculty, high school principals, and high school biology teachers in their attitudes and opinions concerning methods of student management as measured by their response to the following items.
>
> 1. Handling problems of pupil control and discipline.

2. Methods of motivating pupil interest and response.

3. The methods instructor having public school experience.

4. Methods students being able to design activities related to scientific method and processes of science.

5. Methods students ability to design and carry out a strategy which will develop student interaction.

6. Problems related to ability levels and individualized instruction.

C. Hypotheses regarding the techniques of teaching portion of the methods course is formulated as follows:

Significant differences do not exist between college education faculty, college biology faculty, high school principals, and high school biology teachers in their attitudes and opinions concerning techniques of teaching as measured by their response to the following items.

1. Emphasis on the inquiry approach and techniques of structuring inquiry.

2. Techniques of writing course and behavioral objectives.

3. The investigation of motivational techniques.

4. The development of a style of teaching that focuses on concepts and principles.

5. The development of a modern concept of science as a process and as a mode of inquiry.

6. Techniques of developing discovery questioning skills.

D. Hypotheses regarding electronic teaching aids portion of the methods course is formulated as follows:

Significant differences do not exist between college education faculty, college biology faculty, high school principals, and high school biology teachers in their attitudes and opinions concerning electronic

teaching aids as measured by their response to the following items.

1. Fundamentals of audio-tutorial instruction.
2. The use of videotape and microteaching techniques.
3. The use of teaching machines.
4. Utilization of audio-visual equipment.
5. The use of the film loop projector.
6. Techniques of operating a motion picture camera.

E. Hypotheses regarding evaluation in the methods course is formulated as follows:

Significant differences do not exist between college education faculty, college biology faculty, high school principals, and high school biology teachers in their attitudes and opinions concerning methods of evaluation as measured by their response to the following items.

1. The need for evaluation of biology methods course.
2. Assigning grades in a biology methods course.
3. Maintaining minimum objectives to aid in evaluation of methods students.
4. Content of the methods course being based on occupational analysis.
5. Follow-up studies to determine the teaching value of topics in the methods course.
6. Testing and grading in biology.

F. Hypotheses regarding the laboratory portion of the methods course is formulated as follows:

Significant differences do not exist between college education faculty, college biology faculty, high school principals, and high school biology teachers in their attitudes and opinions concerning the laboratory methods as measured by their response to

the following items.

1. Emphasis on the utilization of common tools for making materials.

2. The construction of housing units, and the feeding and care of common animals.

3. The utilization of simple scientific apparatus.

4. Experience in ordering chemicals and supplies.

5. Utilization of plastic embedding and animal mounting.

6. The instructional use of the field trip and possible locations.

Procedure for Collection of Data

The investigator accomplished the following steps in the process of developing the dissertation problem, collecting and analyzing the data, and writing the dissertation:

A. Reviewed literature pertaining to this study in biological methods education and related areas.

B. Prior to 1960 very little research was done in biology science methods (28). Having reviewed the literature since 1960, certain trends have been identified by individuals and study groups concerning the content of biology methods courses. Based on the recommendations of these individuals and study groups, six general areas were selected in biology methods education as a basis for determining verbally expressed reactions to selected statements. The areas selected are:

1. Professional preparation

2. Management of students

3. Techniques of teaching biology

4. Electronic teaching aids

5. Evaluation

6. Laboratory facilities, equipment, and management

C. Selected a jury of 12 educators in biology, psychology, and education approved by his major adviser. Prepared a list of 72 statements as a pre-test and submitted it to the jury of educators.

D. Gave pre-test statements to jury members seeking their opinions as to the pertinence of the statements, clarity and brevity, and general understanding of the statements. This pre-test was also designed to measure content validity.

E. Selected a list of 36 statements from the pre-test comments of the jury members. Six statements were selected for each of the six general areas surveyed based upon the comments of the jury members.

F. The reliability of the instrument was determined by a pilot study composed of 20 members of the second semester (1971) Science Seminar class at Oklahoma State University. Test-retest reliability was the concern of this procedure. The questionnaire was given to the pilot group, and after a period of two weeks had elapsed, the process was repeated. The reliability of the pilot study was determined by tallying the responses as "same" or "different" for each subject from the test to the retest. Then the percentage of "same" responses was calculated. It was established before the pilot study was started that an 85 or higher percentage of "same" responses be required for the pilot to be reliable. Seventeen of the subjects had a percentage of "same" responses at the level of 89 percent or higher, the other three were between 85 and 89 percent.

G. A membership directory of high school principals in Oklahoma was used for the random selection of principals (37). Recent biology graduates of Oklahoma's six state colleges were obtained from the State Department of Education for the random selection of high school teachers (12,65). The education and biology faculty of Oklahoma's six state colleges were taken from 1970-71 college bulletins (53,58). Initial letters from the researcher and his major adviser were mailed one week before the questionnaire was mailed. A questionnaire was mailed to each educator selected with a self-addressed, stamped envelope for return to the researcher. A cover letter from the researcher accompanied each questionnaire stating the significance of the study.

H. Questionnaires were mailed to the educators selected from Stillwater, Oklahoma, on April 23, 1971.

I. Tabulation of results began on May 23, 1971, with returns from 40 education faculty, 44 biology faculty, 43 high school principals and 40 high school biology teachers or 83.5% of the mailed questionnaires. Responses received after May 23, 1971, are not included in this study.

J. Data were classified, and an analysis of the data was made using Single-Classification Analysis of Variance (41).

K. The null hypothesis were tested by the investigator's using the data pertaining to each of the selected statements to identify significant differences between responses of the four groups. The level of significance required for the rejection of the null hypothesis was set at the five percent level (21). The variables of: teacher management of students, professional preparation, evaluation in the methods class, electronic teaching aids, techniques of teaching, and laboratory methods are the type of data that represent frequencies in discrete categories which can be analyzed by Analysis of Variance. This function was reported by Popham (41). College education faculty, college biology faculty, high school principals and high school biology teachers served as the independent variables for this study. The responses from the questionnaire provided the dependent variables.

L. When the obtained $\underline{F}$ value was sufficiently large to be statistically significant, the null hypothesis was considered untenable and the researcher concluded that significant differences between the means of two or more of his subgroups existed. When the null hypothesis was shown to be untenable, the researcher was able to determine with accuracy precisely which means were different by Duncan's Multiple Range Test (16).

For each statement in the questionnaire, college education faculty, college biology teachers, high school biology teachers and principals responded to a rank-order scale. Each scale ran from "strongly agree," through "agree," to "undecided," then to "disagree," through "strongly

disagree." For computational purposes a five point scale was used and graduated downward from "strongly agree" to "strongly disagree." Respondents were instructed to circle the letter corresponding to the statement that most nearly represents their opinion.

CHAPTER IV

THE RESULTS

Data presented in this chapter were obtained from 50 randomly selected education faculty and 50 randomly selected biology faculty from the six Oklahoma state colleges. The data presented also includes 50 randomly selected high school principals and 50 randomly selected high school biology teachers. Data from each of the four populations were gathered by the investigator in the form of answers to a questionnaire (Appendix B).

After data were secured through the previously outlined procedures and techniques, data were tabulated and analyzed by an appropriate statistical technique (Single-Classification Analysis of Variance) in order to determine the nature and extent of findings.

The results of information received from each of the four populations are presented in paired tables.

The first table of each pair contains responses to the 36 items in the attitude instrument. A numerical report of responses to the statements is made and a mean rank is calculated and reported. The results are presented in the odd numbered tables (III - LXXIV).

In the second table of each pair, responses from the four populations are compared, and a Single-Classification Analysis of Variance test for significant differences is calculated on each item in the attitude instrument. The results are presented in the even numbered

tables (III - LXXIV). The F value for each of the analysis of variance tables has been calculated.

The five percent level of significance was selected for the study. The F ratio for 3 and 163 degrees of freedom at the .05 level of significance is 3.12. When statistical treatment confirmed that differences did not exist at the five percent level of significance, the null hypothesis relative to the selected statements was not rejected. Participants in the study were asked to choose from: strongly agree, agree, undecided, disagree, or strongly disagree, in response to 36 attitude statements in the instrument. The responses which Oklahoma's educators gave to each of the 36 items are reported in this section.

Professional Preparation

One problem in the professional preparation of biology teachers to handle the new science materials lies in the inadequacies of their undergraduate preparation. Few colleges and universities offer teachers the opportunities to work in the new science areas during their undergraduate studies. Since subject-matter courses usually are not offered in the professional teaching sequence, only a superficial look at some of the new materials is being accomplished in many methods courses.

Quite often another of the major difficulties encountered with student teachers is their tendency to imitate a favorite teacher. The teaching pattern which the regular teacher has established through experience may not be suitable for the student teacher. The teacher-to-be must seek a pattern of his own, adjusted to his own personality.

The use of BSCS materials (Tables III and IV). The participants are about evenly divided between "strongly agree" and "agree." More

TABLE III

RESPONSES TO ATTITUDE STATEMENT 1: "ALL BIOLOGY TEACHERS-TO-BE SHOULD HAVE FORMAL TRAINING IN THE USE OF MODERN BIOLOGY PROGRAM MATERIALS SUCH AS BSCS MATERIALS"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	21	20	13	13	67
A	4	12	18	22	13	65
U	3	6	2	4	10	22
D	2	1	3	3	4	11
SD	1		1	1		2
Total		40	44	43	40	167
Mean Rank		4.325	4.2045	4.00	3.8750	

TABLE IV

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 1

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	149.2695	166		
Between Groups	4.9545	3	1.6515	1.8654
Error	144.3150	163	.8853	

than three fourths indicated they felt teachers-to-be should have formal training in the use of modern biology program materials. The mean rank spread of 3.8750 to 4.325 show that the four populations generally agree with the statement. The F value for statement 1 was 1.8654 (Table IV). Since the F value for Table IV was not significant, the null hypothesis may be considered tenable.

The development and use of curriculum guides and resource units (Tables V and VI). There were 140 educators in the sample that perceived the need for this type of instruction as "strongly agree" or "agree." However, the mean rank of high school biology teachers was 3.67 which is somewhat below the other populations on the scale. The F value for statement 2 was 4.9816 (Table VI). Since the F value is sufficiently large to be statistically significant, the null hypothesis is considered untenable. Duncan's Multiple Range Test reveals that significant differences exist between the means of college education departments and high school biology teachers.

Development of short and long term science budgets (Tables VII and VIII). There was a wide variation of opinion from the four groups. Twenty-nine state college faculty were in strong agreement that methods students should be able to develop short and long term science budgets. While there is a fluctuation in responses, a mean rank spread of 3.650 to 4.1363 show that the four populations generally agree with the statement. The F value for statement three was 2.9667 (Table VIII). Since the F value was not significant, the null hypothesis may be considered tenable.

Need to provide sourcebooks for free materials (Tables IX and X). One hundred fifty-five educators in the sample who either "strongly

TABLE V

RESPONSES TO ATTITUDE STATEMENT 2: "SPECIALIZED INSTRUCTION IN THE DEVELOPMENT AND USE OF CURRICULUM GUIDES AND RESOURCE UNITS IS NEEDED"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	16	8	8	3	35
A	4	21	26	31	27	105
U	3	2	7	2	5	16
D	2	1	3	2	4	10
SD	1				1	1
Total		40	44	43	40	167
Mean Rank		4.30	3.8863	4.0465	3.6750	

TABLE VI

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 2

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	99.9042	166		
Between Groups	8.3903	3	2.7967	4.9816
Error	91.5139	163	.5614	

TABLE VII

RESPONSES TO ATTITUDE STATEMENT 3: "BIOLOGY METHODS STUDENTS SHOULD BE ABLE TO DEVELOP SHORT AND LONG TERM SCIENCE BUDGETS"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	13	16	6	4	39
A	4	17	20	25	23	85
U	3	8	6	10	8	32
D	2	2	2	2	5	11
SD	1					
Total		40	44	43	40	167
Mean Rank		4.025	4.1363	3.8139	3.650	

TABLE VIII

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 3

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	113.6527	166		
Between Groups	5.8841	3	1.9613	2.9667
Error	107.7686	163	.6611	

TABLE IX

RESPONSES TO ATTITUDE STATEMENT 4: "METHODS COURSES SHOULD PROVIDE SOURCEBOOKS FOR FREE SCIENCE MATERIALS AND FILMS"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	18	14	16	13	61
A	4	20	26	25	23	94
U	3	1	3	1	3	8
D	2	1	1	1	1	4
SD	1					
Total		40	44	43	40	167
Mean Rank		4.375	4.2045	4.3023	4.200	

TABLE X

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 4

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	72.8743	166		
Between Groups	.8704	3	.2901	.6567
Error	72.0039	163	.4417	

agreed" or "agreed" concerning the perceived need for this service in the methods class. The mean rank spread of the four populations of 4.200 to 4.375 show that they generally agree with the statement. The F value for statement 4 was .6567 (Table X). Since the F value was not significant, the null hypothesis may be considered tenable.

The inclusion of a required biology methods course (Tables XI and XII). One hundred forty-four educators in the sample perceived the need for this requirement as "strongly agree" or "agree." It will be noted that twenty-seven education faculty were in strong agreement while only eight principals were in strong agreement. While there is a fluctuation in responses, a mean rank spread of 4.000 to 4.525 show that the four population generally agree with the statement. The F value for statement 5 was 2.8229 (Table XII). Since the F value for Table XII was below that required for significance at the five percent level, the null hypothesis cannot be rejected.

Meeting students needs by providing a set of teaching experiences (Tables XIII and XIV). College educators and high school educators agreed that the methods course should provide a set of teaching experiences that may be tried later in practice teaching. The mean rank spread of the four populations of 3.850 to 4.350 show that they generally agree with the statement. The F value for statement 6 was 2.740 (Table XIV). Since the F value for Table XIV was not significant, the null hypothesis may be considered tenable.

Management of Students

Many beginning science teachers are worried about classroom control and classroom management. This section includes one attitude

TABLE XI

RESPONSES TO ATTITUDE STATEMENT 5: "THE BIOLOGICAL SCIENCE TEACHING PROGRAM IN OKLAHOMA STATE COLLEGES SHOULD INCLUDE A REQUIRED METHODS COURSE"

		RESPONSE CATEGORIES				
	Rank	State College Faculty Education Department	Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	27	20	8	16	71
A	4	8	15	29	17	69
U	3	4	6	5	6	21
D	2	1	1		1	3
SD	1		2	1		3
Total		40	44	43	40	167
Mean Rank		4.525	4.1363	4.000	4.200	

TABLE XII

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 5

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	123.6647	166		
Between Groups	6.1078	3	2.0359	2.8229
Error	117.5569	163	.7212	

TABLE XIII

RESPONSES TO ATTITUDE STATEMENT 6: "THE METHODS COURSE SHOULD PROVIDE A SET OF TEACHING EXPERIENCES THAT MAY BE TRIED LATER IN PRACTICE TEACHING"

		RESPONSE CATEGORIES				
	Rank	State College Faculty Education Department	Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	17	13	11	9	50
A	4	20	23	26	19	88
U	3	3	6	5	9	23
D	2		1		3	4
SD	1		1	1		2
Total		40	44	43	40	167
Mean Rank		4.3500	4.0454	4.0697	3.850	

TABLE XIV

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 6

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	105.9881	166		
Between Groups	5.0883	3	1.6961	2.740
Error	100.8998	163	.6190	

statement concerning "discipline," but a discussion of classroom management is much broader than a mere description of punishment.

Probably the best approach to classroom management involves planned rather than spontaneous decisions made under pressure. If a teacher is going to use a systematic approach to classroom management or control, how does he decide what to do? How does the beginning teacher identify and cope with problems to be encountered such as ability levels, ghettoed students, individualized instruction, motivation or interaction?

Handling problems of pupil control and discipline (Tables XV and XVI). One hundred thirty-one educators expressed agreement that methods of handling problems of pupil control should be covered in the course. However, there was a significant difference in the degree of intensity of belief. The F value for statement 7 was 4.5297 (Table XVI). Since the F value is sufficiently large to be statistically significant, the null hypothesis is considered untenable. Duncan's Multiple Range Test reveals that significant differences exist between college biology faculty and high school principals.

Methods of motivating pupil interest and response (Tables XVII and XVIII). One hundred fifty-eight educators agreed that methods of motivating pupil interest and response should be investigated. No high school teachers or principals were "undecided," "disagree," or "strongly disagree." The mean rank spread of 4.1136 to 4.500 show that there is strong agreement with the statement. The F value for statement 8 was 2.9359 (Table XVIII). Since the F value for Table XVIII was not significant, the null hypothesis may be considered tenable.

TABLE XV

RESPONSES TO ATTITUDE STATEMENT 7: "METHODS OF HANDLING PROBLEMS OF PUPIL CONTROL AND DISCIPLINE SHOULD BE COVERED"

		RESPONSE CATEGORIES				
	Rank	State College Faculty Education Department	Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	12	6	20	17	55
A	4	17	20	21	18	76
U	3	4	8	2	2	16
D	2	7	9		2	18
SD	1		1		1	2
Total		40	44	43	40	167
Mean Rank		3.8500	3.4722	4.4186	4.200	

TABLE XVI

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 7

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	285.9462	166		
Between Groups	22.0037	3	7.3345	4.5297
Error	263.9425	163	1.6192	

TABLE XVII

RESPONSES TO ATTITUDE STATEMENT 8: "METHODS OF KOTIVATING PUPIL INTEREST AND RESPONSE SHOULD BE INVESTIGATED"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	23	16	12	20	71
A	4	15	21	31	20	87
U	3		4			4
D	2	2	2			4
SD	1		1			1
Total		40	44	43	40	167
Mean Rank		4.4750	4.1136	4.2790	4.500	

TABLE XVIII

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 8

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	81.2216	166		
Between Groups	4.1635	3	1.3878	2.9359
Error	77.0581	163	.4727	

Problems related to ability levels and individualized instruction (Tables XIX and XX). All four populations agreed with the statement that preservice teachers should have some knowledge of problems such as ability levels and individualized instruction (Table XIX). A significant difference in the degree of intensity of belief and not disagreement towards the statement was observed. A total of 159 educators expressed agreement. The F value for statement 9 was 11.8348 (Table XX). Since the F value is sufficiently large to be statistically significant, the null hypothesis is considered untenable. Duncan's Multiple Range Test reveals that significant differences exist between the means of college education and college biology departments. Also, significant differences exist between the means of college education departments and high school biology teachers.

The methods instructor having public school experience (Tables XXI and XXII). Educators agreed more highly with the statement that methods instructors should have public school experience than with any other. An analysis of the data is presented in Table XXI.

One hundred fifty-four educators expressed agreement with the statement. However, the mean rank of college biology teachers is somewhat below the other populations on the scale. The F value for statement 10 was 5.9471 (Table XXII). Since the F value is sufficiently large to be statistically significant, the null hypothesis is considered untenable. Duncan's Multiple Range Test reveals that significant differences exist between the mean of college biology teachers and the means of the other three populations.

TABLE XIX

RESPONSES TO ATTITUDE STATEMENT 9: "PRE-SERVICE TEACHERS SHOULD HAVE SOME KNOWLEDGE OF PROBLEMS TO BE ENCOUNTERED AT THE SECONDARY LEVEL, i.e. ABILITY LEVELS, AND INDIVIDUALIZED INSTRUCTION"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	25	15	14	15	69
A	4	14	27	28	21	90
U	3	1	1	1	4	7
D	2					
SD	1		1			1
Total		40	44	43	40	167
Mean Rank		4.600	4.250	4.3023	4.2750	

TABLE XX

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 9

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	74.1557	166		
Between Groups	13.2609	3	4.4203	11.8348
Error	60.8943	163	.3735	

TABLE XXI

RESPONSES TO ATTITUDE STATEMENT 10: "THE METHODS INSTRUCTOR SHOULD HAVE PUBLIC SCHOOL EXPERIENCE, ESPECIALLY AT THE SECONDARY LEVEL"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	30	24	32	29	115
A	4	9	10	10	10	39
U	3		4	1	1	6
D	2	1	4			5
SD	1		2			2
Total		40	44	43	40	167
Mean Rank		4.700	4.1363	4.7209	4.700	

TABLE XXII

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 10

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	107.2096	166		
Between Groups	10.5765	3	3.5255	5.9471
Error	96.6331	163	.5928	

Methods students being able to design activities related to scientific method and processes of science (Tables XXIII and XXIV). The data presented in Table XXIII reveals that Oklahoma educators generally agree with the statement. Thirty-six of the college educators indicated strong agreement as compared to twelve high school educators. The F value for statement 11 was 6.7368 (Table XXIV). Since the F value is sufficiently large to be statistically significant, the null hypothesis is considered untenable. Duncan's Multiple Range Test reveals that significant differences exist between the means of college education departments and high school principals.

Methods students ability to design and carry out a strategy which will develop student interaction (Tables XXV and XXVI). Table XXV shows a high degree of difference in responses. Twenty-six college educators "strongly agree" with the statement while thirteen high school educators "strongly agree." The mean rank of college education departments was 4.3250 which is somewhat above the other populations on the scale. The F value for statement 12 was 3.5402 (Table XXVI). Since the F value is sufficiently large to be statistically significant, the null hypothesis is considered untenable. Duncan's Multiple Range Test reveals that significant differences exist between the means of college education departments and high school principals. Also significant differences exist between the means of college education departments and college biology departments.

Techniques of Teaching

Renewed emphasis on training in thinking has emerged with most of the new science educational programs such as discovery learning, new

TABLE XXIII

RESPONSES TO ATTITUDE STATEMENT 11: "METHODS STUDENTS SHOULD BE ABLE TO DESIGN ACTIVITIES RELATED TO SCIENTIFIC METHOD AND PROCESSES OF SCIENCE"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	20	16	3	9	48
A	4	19	25	34	25	103
U	3	1	2	6	4	13
D	2		1		2	3
SD	1					
Total		40	44	43	40	167
Mean Rank		4.4750	4.2727	3.9302	4.025	

TABLE XXIV

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 11

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	67.9644	166		
Between Groups	7.4961	3	2.4987	6.7368
Error	60.4680	163	.3709	

TABLE XXV

RESPONSES TO ATTITUDE STATEMENT 12: "PRE-SERVICE TEACHERS SHOULD BE ABLE TO DESIGN AND CARRY OUT A TEACHING STRATEGY WHICH WILL DEVELOP QUALITY STUDENT INTERACTION"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	16	10	5	8	39
A	4	21	25	28	25	99
U	3	3	4	7	5	19
D	2		4	3	2	9
SD	1		1			1
Toatl		40	44	43	40	167
Mean Rank		4.3250	3.8863	3.8139	3.9750	

TABLE XXVI

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 12

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	102.9941	166		
Between Groups	6.3005	3	2.1001	3.5402
Error	96.6936	163	.5932	

biology (BSCS), inquiry training, and the focus on concept learning. Hopefully this emphasis will produce science teachers who have had training in curriculum materials for developing creative thinking.

Emphasis on the inquiry approach and techniques of structuring inquiry (Tables XXVII and XXVIII). Both college educators and high school educators expressed general agreement that the methods course should emphasize the inquiry approach to teaching and also techniques for structuring inquiry. Twenty-eight educators were undecided concerning the need for this type of instruction. The F value for statement 13 was 1.4918 (Table XXVIII). Since the F value was below that required for significance at the five percent level, the null hypothesis cannot be rejected.

Techniques of writing course and behavioral objectives (Tables XXIX and XXX). One hundred nineteen educators in the sample perceived the need for this type of instruction as "strongly agree" or "agree." However, 40 were "undecided" as to the need for this type of instruction. The mean rank of college education departments was 4.2250 which is somewhat above the other populations on the scale. The F value for statement 14 was 6.4559 (Table XXX). Since the F value is sufficiently large to be statistically significant, the null hypothesis is considered untenable. Duncan's Multiple Range Test reveals that significant differences exist between the means of college education departments and high school principals. Also significant differences exist between the means of college education departments and high school biology teachers.

The investigation of motivational techniques (Tables XXXI and XXXII). One hundred fifty-six college and high school educators agree

TABLE XXVII

RESPONSES TO ATTITUDE STATEMENT 13: "THE METHODS COURSE SHOULD EMPHASIZE THE INQUIRY APPROACH TO TEACHING AND TECHNIQUES FOR STRUCTURING INQUIRY"

		RESPONSE CATEGORIES				
	Rank	State College Faculty Education Department	Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	17	11	3	8	39
A	4	15	23	32	23	93
U	3	7	6	8	7	28
D	2	1	2		1	4
SD	1		2		1	3
Total		40	44	43	40	167
Mean Rank		4.20	3.8863	3.8837	3.900	

TABLE XXVIII

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 13

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	109.7845	166		
Between Groups	2.9339	3	.9779	1.4918
Error	106.8506	163	.6555	

TABLE XXIX

RESPONSES TO ATTITUDE STATEMENT 14: "METHODS INSTRUCTION PROVIDE THE TECHNIQUES OF WRITING COURSE AND BEHAVIORAL OBJECTIVES"

		RESPONSE CATEGORIES				
	Rank	State College Faculty Education Department	Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	15	6	2	2	25
A	4	20	37	25	22	94
U	3	4	7	14	15	40
D	2	1	4	2	1	8
SD	1					
Total		40	44	43	40	167
Mean Rank		4.2250	3.7954	3.6279	3.6250	

TABLE XXX

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 14

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	91.2456	166		
Between Groups	9.6899	3	3.2299	6.4559
Error	81.5557	163	.5003	

TABLE XXXI

RESPONSES TO ATTITUDE STATEMENT 15: "VARIOUS MOTIVATION TECHNIQUES SHOULD BE INVESTIGATED"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	15	10	6	14	45
A	4	22	28	36	25	111
U	3	2	3	1	1	6
D	2	1	3			4
SD	1		1			1
Total		40	44	43	40	167
Mean Rank		4.275	3.9772	4.1162	4.3250	

TABLE XXXII

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 15

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	71.3054	166		
Between Groups	3.1594	3	1.0531	2.5193
Error	68.1460	163	.4180	

with the premise concerning the investigation of motivation techniques. The mean rank spread of the four populations from 3.9772 to 4.3250 show that they agree with the statement. The F value for statement 15 was 2.5193 (Table XXXII). Since the F value was not significant, the null hypothesis may be considered tenable.

Techniques of developing discovery questioning skills (Tables XXXIII and XXXIV). All four populations agree with the statement that techniques of developing discovery questioning skills are needed as an alternative to lecture presentations. However, a significant difference in the degree of intensity of belief and not disagreement towards the statement was observed. A total of 151 educators expressed agreement. The F value for statement 16 was 5.2220 (Table XXXIV). Since the F value is sufficiently large to be statistically significant, the null hypothesis is considered untenable. Duncan's Multiple Range Test reveals that significant differences exist between the mean of college education departments and the means of the other three populations.

The development of a style of teaching that focuses on concepts and principles (Tables XXXV and XXXVI). Table XXXV reveals a significant difference in the responses between education faculty and high school principals, although a majority of the respondents indicated agreement with the statement. A total of 154 educators expressed agreement. The F value for statement 17 was 5.0223 (Table XXXVI). The F ratio of 5.0223 is significant at the five percent level; therefore, the null hypothesis is rejected. Duncan's Multiple Range Test reveals that significant differences exist between the means of college education faculty and high school principals.

TABLE XXXIII

RESPONSES TO ATTITUDE STATEMENT 16: "TECHNIQUES OF DEVELOPING DISCOVERY QUESTIONING SKILLS ARE NEEDED AS AN ALTERNATIVE TO LECTURE PRESENTATIONS"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	27	13	9	11	60
A	4	12	25	30	24	91
U	3	1	6	4	4	15
D	2				1	1
SD	1					
Total		40	44	43	40	167
Mean Rank		4.65	4.1590	4.1162	4.1250	

TABLE XXXIV

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 16

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	92.9282	166		
Between Groups	8.1481	3	2.7160	5.2220
Error	84.7801	163	.5201	

TABLE XXXV

RESPONSES TO ATTITUDE STATEMENT 17: "A GOOD METHODS COURSE SHOULD LEAD TOWARD THE DEVELOPMENT OF A STYLE OF TEACHING THAT FOCUSES ON CONCEPTS AND PRINCIPLES, NOT ON ROTE MEMORIZATION OF FACTS"

		RESPONSE CATEGORIES				
	Rank	State College Faculty Education Department	Biology Department	High School Educators Principals	Biology Teachers	Total
SA	5	32	25	13	23	93
A	4	6	15	26	14	61
U	3	2	4	4	2	12
D	2				1	1
SD	1					
Total		40	44	43	40	167
Mean Rank		4.75	4.4772	4.2093	4.4750	

TABLE XXXVI

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 17

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	71.6288	166		
Between Groups	6.0602	3	2.0200	5.0223
Error	65.5686	163	.4022	

The development of a modern concept of science as a process and as a mode of inquiry (Tables XXXVII and XXXVIII). The four populations do not differ enough in their responses for significance at the five percent level. The F value of 2.2721 (Table XXXVIII) is not significant; therefore, the null hypothesis is not rejected. One hundred twenty six educators expressed agreement to the statement while 38 were undecided. Although no significant difference is revealed in Table XXXVIII, more college educators were in strong agreement with the statement than high school educators.

Electronic Teaching Aids

This section is concerned with the preparation needed by future biology teachers in the area of simple electronic teaching aids. Advances in teaching technology such as programmed learning, television, motion pictures, tape recorders, overhead projectors, and film loops have opened up vast possibilities for disseminating and storing information usable in teaching biology. The vastness and importance of the electrical enterprise as a part of industry is evident. What is not evident, though, is the structure needed in our college science education departments for the task of preparing prospective teachers in the area.

Fundamentals of audio-tutorial instruction (Tables XXXIX and XL). College and high school educators are in concurrence relative to this type of instruction. A total of 124 educators expressed agreement to the statement. The F value for statement 19 was 1.9844 (Table XL). Since the F value for was not significant, the null hypothesis may be considered tenable. Although no significant difference is revealed,

TABLE XXXVII

RESPONSES TO ATTITUDE STATEMENT 18: "THERE IS A NEED FOR DEVELOPING A MODERN CONCEPT OF THE NATURE OF BIOLOGICAL SCIENCE AS A PROCESS AND AS A MODE OF INQUIRY"

		RESPONSE CATEGORIES				
	Rank	State College Faculty Education Department	Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	19	12	3	9	43
A	4	12	22	28	21	83
U	3	8	8	12	10	38
D	2	1	1			2
SD	1					
Total		40	44	43	40	167
Mean Rank		4.2250	3.9772	3.7906	3.975	

TABLE XXXVIII

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 18

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	97.9761	166		
Between Groups	3.9325	3	1.3108	2.2721
Error	94.0436	163	.5769	

TABLE XXXIX

RESPONSES TO ATTITUDE STATEMENT 19: "METHODS INSTRUCTION SHOULD INCLUDE THE FUNDAMENTALS OF AUDIO-TUTORIAL INSTRUCTION"

		RESPONSE CATEGORIES				
	Rank	State College Faculty Education Department	Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	9	6	3	10	28
A	4	25	21	31	19	96
U	3	4	12	8	9	33
D	2	2	4	1	2	9
SD	1		1			1
Total		40	44	43	40	167
Mean Rank		4.025	3.6136	3.8372	3.925	

TABLE XL

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 19

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	110.9521	166		
Between Groups	3.9097	3	1.3032	1.9844
Error	107.0424	163	.6567	

33 educators were "undecided."

The use of videotape and microteaching techniques (Tables XLI and XLII). A significant difference exists in responses from the four groups. College education faculty generally concur that the methods instruction should include the use of videotape and microteaching techniques, while college and high school biology teachers show a greater lattitude in responses along the continuum. The F value for statement was 5.1813 (Table XLII). Since the F value is sufficiently large to be statistically significant, the null hypothesis is considered untenable. Duncan's Multiple Range Test reveals that significant differences exist between the means of college education and college biology departments. Also significant differences exist between the means of college education departments and high school biology teachers.

The use of teaching machines (Tables XLIII and XLIV). One hundred thirty-five educators agree with the statement concerning an introduction to various teaching machines for use in biology. Table XLIII reveals that both college educators and high school educators gave identical responses, for all practical purposes, along the continuum. The F value for statement 21 (Table XLIV) of .7563 is not significant at the five percent level; therefore, the null hypothesis is not rejected.

Utilization of audio-visual equipment (Tables XLV and XLVI). One hundred fifty educators in the sample either "strongly agreed" or "agreed" concerning the perceived need for this service in the methods class. The mean rank spread of the four populations of 3.9545 to 4.20 show that they generally agree with the statement. The F value for statement 22 was .9956 (Table XLVI). Since the F value was not

TABLE XLI

RESPONSES TO ATTITUDE STATEMENT 20: "METHODS INSTRUCTION SHOULD INCLUDE THE USE OF VIDEO-TAPE AND MICROTEACHING TECHNIQUES"

		RESPONSE CATEGORIES				
	Rank	State College Faculty Education Department	Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	10	5	5	6	26
A	4	26	21	31	16	94
U	3	4	13	4	13	34
D	2		5	3	5	13
SD	1					
Total		40	44	43	40	167
Mean Rank		4.150	3.5909	3.8837	3.5750	

TABLE XLII

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 20

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	105.0779	166		
Between Groups	9.1478	3	3.0492	5.1813
Error	95.9301	163	.5885	

TABLE XLIII

RESPONSES TO ATTITUDE STATEMENT 21: "METHODS INSTRUCTION SHOULD INCLUDE AN INTRODUCTION TO VARIOUS TEACHING MACHINES FOR USE IN BIOLOGY"

		RESPONSE CATEGORIES				
	Rank	State College Faculty Education Department	Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	8	6	4	8	26
A	4	24	26	35	24	109
U	3	6	8	3	6	23
D	2	2	4	1	2	9
SD	1					
Total		40	44	43	40	167
Mean Rank		3.950	3.7727	3.9767	3.950	

TABLE XLIV

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 21

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	83.6527	166		
Between Groups	1.1486	3	.3828	.7563
Error	82.5041	163	.5061	

TABLE XLV

RESPONSES TO ATTITUDE STATEMENT 22: "THE EXAMINATION AND UTILIZATION OF AUDIO-VISUAL EQUIPMENT IN RELATION TO SCIENCE INSTRUCTION IS NEEDED"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	13	10	7	10	40
A	4	23	27	34	26	110
U	3	3	3	1	4	11
D	2	1	3	1		5
SD	1		1			1
Total		40	44	43	40	167
Mean Rank		4.20	3.9545	4.0930	4.150	

TABLE XLVI

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 22

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	79.4671	166		
Between Groups	1.4300	3	.4766	.9956
Error	78.0371	163	.4787	

significant, the null hypothesis may be considered tenable.

Techniques of operating a motion picture camera (Tables XLVII and XLVIII). A significant difference does not exist in responses from the four groups. Although no difference is revealed, 35 of the educators disagreed with the statement. While there is a fluctuation in responses, a mean rank spread of 3.0681 to 3.6279 shows that the four populations are generally undecided concerning this statement. The F value for statement 23 was 3.8920 (Table XLVIII). Since the F value was below that required for significance at the five percent level, the null hypothesis cannot be rejected.

The use of the film loop projector (Tables XLIX and L). The distribution of responses from the four groups reveals a wide variation of opinion. Fifty-seven educators were undecided concerning the need for this type of training. A total of 34 educators disagreed with the statement. While there is a fluctuation in responses, the F value 2.8363 is not significant at the five percent level. Therefore, the null hypothesis may be considered tenable.

Evaluation

One of the most perplexing problems facing college educators, beginning teachers and administrators is that of evaluation--evaluation of a program and evaluation of the students in it. Educators are faced with the necessity of making a series of decisions based on insufficient, biased, and often subjective information that may affect the entire future of another individual. This responsibility is not to be taken lightly.

In this section, an attempt was made to examine the attitudes and

TABLE XLVII

RESPONSES TO ATTITUDE STATEMENT 23: "METHODS INSTRUCTION SHOULD INCLUDE TECHNIQUES OF OPERATING A MOTION PICTURE CAMERA"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	5	4	3	7	19
A	4	15	13	28	18	74
U	3	9	11	5	8	33
D	2	8	14	7	5	35
SD	1	3	2		1	6
Total		40	44	43	40	167
Mean Rank		3.2750	3.0681	3.6279	3.60	

TABLE XLVIII

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 23

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	183.7006	166		
Between Groups	9.2835	3	3.0945	2.8920
Error	174.4171	163	1.0700	

TABLE XLIX

RESPONSES TO ATTITUDE STATEMENT 24: "METHODS INSTRUCTION SHOULD INCLUDE THE USE OF THE FILM-LOOP PROJECTOR WITH THE STUDENTS MAKING THEIR OWN FILM LOOPS"

		RESPONSE CATEGORIES				
	Rank	State College Faculty Education Department	Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	5	3	1	5	14
A	4	17	10	20	9	56
U	3	11	14	14	18	57
D	2	6	13	8	7	34
SD	1	1	4		1	6
Total		40	44	43	40	167
Mean Rank		3.475	2.8863	3.3255	3.250	

TABLE L

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 24

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	161.3533	166		
Between Groups	8.0045	3	2.6681	2.8362
Error	153.3488	163	.9407	

opinions of Oklahoma educators concerning both individual assessment and program assessment in the college methods class.

The need for evaluation of biology methods programs in Oklahoma state colleges (Tables LI and LII). One hundred twenty-six educators in the sample perceived this need as "strongly agree" or "agree," although 38 persons were "undecided" as to the need. The mean rank spread of the four populations of 3.9534 to 4.20 show that they generally agree with the statement. The F value for statement 25 was 1.0065 (Table LII). Since the F value was not significant, the null hypothesis may be considered tenable.

Assigning grades in a biology methods course (Tables LIII and LIV). All four populations generally agree with the statement that methods of assigning grades in biology methods courses should be continually re-evaluated. The four populations do not differ enough in their responses for significance at the five percent level. The F value of 1.6656 (Table LIV) is not significant; therefore, the null hypothesis is not rejected. Twenty-nine persons were "undecided."

Maintaining minimum objectives to aid in evaluation of methods students (Tables LV and LVI). College and high school educators generally agree in their responses to the statement that minimum objectives should be set to aid in evaluation of students. Only seven educators were in disagreement toward the statement. Twenty-three college educators responded with "strongly agree" as compared to 7 high school educators. The F value for statement 27 (Table LVI) of 1.7822 is not significant at the five percent level; therefore, the null hypothesis is not rejected.

TABLE LI

RESPONSES TO ATTITUDE STATEMENT 25: "WE NEED AN EVALUATION OF THE BIOLOGY METHODS PROGRAMS IN OUR STATE COLLEGES"

		RESPONSE CATEGORIES				
	Rank	State College Faculty Education Department	Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	17	22	11	13	63
A	4	14	14	20	15	63
U	3	9	5	11	12	38
D	2		1	1		2
SD	1		1			1
Total		40	44	43	40	167
Mean Rank		4.20	4.2272	3.9534	4.025	

TABLE LII

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 25

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	124.2695	166		
Between Groups	2.2602	3	.7534	1.0065
Error	122.0093	163	.7485	

TABLE LIII

RESPONSES TO ATTITUDE STATEMENT 26: "THE METHOD OF ASSIGNING GRADES IN A BIOLOGY METHODS COURSE SHOULD BE CONTINUALLY RE-EVALUATED"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	16	14	6	9	45
A	4	16	21	30	20	87
U	3	8	8	5	8	29
D	2		1	1	2	4
SD	1			1	1	2
Total		40	44	43	40	167
Mean Rank		4.20	4.0909	3.9069	3.85	

TABLE LIV

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 26

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	107.9761	166		
Between Groups	3.2117	3	1.0705	1.6656
Error	104.7644	163	.6427	

TABLE LV

RESPONSES TO ATTITUDE STATEMENT 27: "METHODS INSTRUCTORS SHOULD SET MINIMUM OBJECTIVES TO BE REACHED TO AID IN EVALUATION OF STUDENTS"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	11	12	1	6	30
A	4	20	24	33	22	99
U	3	6	8	6	9	29
D	2	1		3	3	7
SD	1	2				2
Total		40	44	43	40	167
Mean Rank		3.925	4.0909	3.7441	3.7750	

TABLE LVI

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 27

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	102.8384	166		
Between Groups	3.2659	3	1.0886	1.7822
Error	99.5725	163	.6108	

Content of the methods course being based on occupational analysis (Tables LVII and LVIII). Seventy-seven educators were undecided concerning the statement that curriculum content of a methods course should be based on occupational analysis. While there is a wide variation of opinion within each group, a mean rank spread of 3.250 to 3.3953 shows little difference between groups. The F value for statement 28 was .3502 (Table LVIII). Since the data show no significance between the responses of the four groups, the null hypothesis cannot be repudiated.

Follow up studies to determine the teaching value of topics in the methods course (Tables LIX and LX). Seventy-nine college educators and 70 high school educators agree with the statement. The F value of 4.5892 (Table LX) is significant at the five percent level and the null hypothesis is rejected. Although a significant difference was determined between the four groups, responses from the groups clustered around the agreement end of the continuum. Duncan's Multiple Range Test reveals that significant differences exist between the means of college education faculty and high school principals.

Testing and grading in biology (Tables LXI and LXII). Ninety-four educators agree with the statement that testing and grading in biology is an area of the teaching process that needs greater attention. Forty-eight educators were undecided as to this need in the methods class. The mean rank spread of 3.3953 to 3.70 is between "undecided" and "agree" on the scale. The F value for statement 30 was .7133 (Table LXII). Since the F value was below that required for significance at the five percent level, the null hypothesis cannot be rejected.

TABLE LVII

RESPONSES TO ATTITUDE STATEMENT 28: "CURRICULUM CONTENT OF A METHODS COURSE SHOULD BE BASED ON OCCUPATIONAL ANALYSIS"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	5	5	1		11
A	4	12	13	18	14	56
U	3	13	33	31	33	77
D	2	10	4	3	4	21
SD	1	1	1			2
Total		40	44	43	40	167
Mean Rank		3.250	3.3636	3.3953	3.250	

TABLE LVIII

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 28

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	112.1797	166		
Between Groups	.7187	3	.2395	.3502
Error	111.4610	163	.6838	

TABLE LIX

RESPONSES TO ATTITUDE STATEMENT 29: "A FOLLOW-UP STUDY OF RECENT GRADUATES TO DETERMINE THE TEACHING VALUE OF TOPICS AND EXPERIENCES IN THE METHODS COURSE IS NEEDED"

		RESPONSE CATEGORIES				
	Rank	State College Faculty Education Department	Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	19	14	6	9	48
A	4	19	27	29	26	101
U	3	2	2	7	3	14
D	2		1	1	2	4
SD	1					
Total		40	44	43	40	167
Mean Rank		4.4250	4.2272	3.9302	4.050	

TABLE LX

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 29

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	73.9521	166		
Between Groups	5.7591	3	1.9197	4.5892
Error	68.1930	163	.4183	

TABLE LXI

RESPONSES TO ATTITUDE STATEMENT 30: "TESTING AND GRADING IN BIOLOGY IS AN AREA OF THE TEACHING PROCESS THAT NEEDS GREATER ATTENTION"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	9	10	4	7	30
A	4	16	16	18	14	64
U	3	13	11	13	11	48
D	2		5	7	8	21
SD	1	2	1	1		4
Total		40	44	43	40	167
Mean Rank		3.70	3.6363	3.3953	3.500	

TABLE LXII

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 30

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	181.2096	166		
Between Groups	2.3486	3	.7828	.7133
Error	178.8610	163	1.0973	

Laboratory Methods

Probably the most radical changes in laboratory procedures have accompanied the BSCS biology program. A major problem is that of providing adequate facilities and equipment for optimum learning conditions. The schools problems become particularly acute when it contemplates a new program, especially in biology where relatively large amounts of equipment and supplies are required. Regardless of the difficulties, it is just as imperative to have the proper equipment and facilities for the new program as it is to have adequately prepared teachers. The suggestions provided in this section are not to be interpreted as the answer to all problems. It is hoped that the ideas presented here will provide some structure and direction for planning.

Emphasis on the utilization of common tools for making materials (Tables LXIII and LXIV). College educators and high school educators do not differ greatly enough in their responses for significance at the five percent level. The F ratio of 1.3396 (Table LXIV) is not significant; therefore, the null hypothesis is not rejected. One hundred thirty-two educators expressed agreement to the statement that the laboratory portion of the course should emphasize the utilization of common tools for making materials.

The construction of housing units, and the feeding and care of common animals (Tables LXV and LXVI). Analysis of Variance (Table LXVI) of responses yielded the F value of .6394 which is not significant at the level of probability set for this study. This is interpreted to mean that differences did not exist among the four response categories as to a perceived need for the study and construction of housing units for animals and the feeding and care of common animals. It should

TABLE LXIII

RESPONSES TO ATTITUDE STATEMENT 31: "THE LABORATORY PORTION OF THE COURSE SHOULD EMPHASIZE THE UTILIZATION OF COMMON TOOLS FOR MAKING MATERIALS"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	12	8	5	13	38
A	4	19	24	31	20	94
U	3	6	6	5	5	22
D	2	3	5	2	3	12
SD	1		1			1
Total		40	44	43	40	167
Mean Rank		4.00	3.750	3.9069	4.100	

TABLE LXIV

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 31

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	116.2755	166		
Between Groups	2.7975	3	.9325	1.3396
Error	113.478	163	.6961	

TABLE LXV

RESPONSES TO ATTITUDE STATEMENT 32: "THE STUDY AND CONSTRUCTION OF HOUSING UNITS FOR ANIMALS AND THE FEEDING AND CARE PROCESSES OF COMMON ANIMALS IS NEEDED"

		RESPONSE CATEGORIES				
	Rank	State College Faculty Education Department	Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	3	8	2	5	18
A	4	13	18	17	17	64
U	3	18	10	18	11	57
D	2	7	7	5	5	25
SD	1		1		2	3
Total		40	44	43	40	167
Mean Rank		3.2750	3.5565	3.3488	3.450	

TABLE LXVI

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 32

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	151.3114	166		
Between Groups	1.7598	3	.5866	.6394
Error	149.5516	163	.9174	

be noted that 57 educators were undecided and that 28 disagreed with the statement.

The utilization of simple scientific apparatus (Tables LXVII and LXVIII). College and high school educators are in concurrence about emphasis being placed on the utilization of simple scientific apparatus for the lab. One hundred forty-five educators expressed general agreement while only 17 were undecided. The F value for statement 33 was .1067 (Table LXVIII). The distribution of responses did not produce a significant difference at the five percent level, therefore, the null hypothesis is not rejected.

Experience in ordering chemicals and supplies (Tables LXIX and LXX). College educators and high school educators expressed general agreement that experience in ordering chemicals and supplies in the lab type situation is needed. Analysis of Variance of responses (Table LXX) yielded the F value of 1.3660 which is not significant at the level of probability set for this study. This is interpreted to mean that differences did not exist among the four response categories as to this perceived need.

Utilization of plastic embedding and animal mounting (Tables LXXI and LXXII). Only 86 educators agree with the statement concerning the examination and utilization of plastic embedding and animal mounting. Fifty-two educators were undecided as to this statement. The F value for statement 35 was 1.6679 (Table LXXII). Since the F value was not significant, the null hypothesis may be considered tenable.

The instructional use of the field trip and possible locations (Tables LXXIII and LXXIV). Both college educators and high school educators expressed agreement that the field trip and possible locations

TABLE LXVII

RESPONSES TO ATTITUDE STATEMENT 33: "EMPHASIS SHOULD BE PLACED ON THE UTILIZATION OF SIMPLE SCIENTIFIC APPARATUS FOR THE LAB"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	7	9	6	10	32
A	4	25	30	33	25	113
U	3	8	2	4	3	17
D	2		3		1	4
SD	1				1	1
Total		40	44	43	40	167
Mean Rank		3.975	4.0227	4.0465	4.050	

TABLE LXVIII

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 33

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	73.9042	166		
Between Groups	.1449	3	.0483	.1067
Error	73.7593	163	.4525	

TABLE LXIX

RESPONSES TO ATTITUDE STATEMENT 34: "EXPERIENCE IN ORDERING CHEMICALS AND SUPPLIES IN THE LAB TYPE SITUATION IS NEEDED"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	3	13	7	11	34
A	4	25	25	31	23	104
U	3	11	1	2	3	17
D	2	1	5	3	3	12
SD	1					
Total		40	44	43	40	167
Mean Rank		3.750	4.0454	3.9767	4.050	

TABLE LXX

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 34

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	98.7066	166		
Between Groups	2.4207	3	.8069	1.3660
Error	96.2859	163	.5907	

TABLE LXXI

RESPONSES TO ATTITUDE STATEMENT 35: "THE EXAMINATION AND UTILIZATION OF PLASTIC EMBEDDING AND ANIMAL MOUNTING SHOULD BE STUDIED"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	3	4	1	8	16
A	4	15	15	22	18	70
U	3	15	15	14	8	52
D	2	7	10	5	6	28
SD	1			1		1
Total		40	44	43	40	167
Mean Rank		3.350	3.2954	3.3953	3.700	

TABLE LXXII

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 35

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	134.9581	166		
Between Groups	4.0199	3	1.3399	1.6679
Error	130.9382	163	.8033	

TABLE LXXIII

RESPONSES TO ATTITUDE STATEMENT 36: "THE INSTRUCTIONAL USE OF THE FIELD TRIP, AND POSSIBLE LOCATIONS THAT ARE APPROPRIATE TO BIOLOGY SHOULD BE COVERED"

		RESPONSE CATEGORIES				
	Rank	State College Education Department	Faculty Biology Department	High School Principals	Educators Biology Teachers	Total
SA	5	9	17	8	15	49
A	4	30	26	33	23	112
U	3	1	1	1	1	4
D	2				1	1
SD	1			1		1
Total		40	44	43	40	167
Mean Rank		4.20	4.3636	4.0930	4.300	

TABLE LXXIV

ANALYSIS OF VARIANCE OF RESPONSES TO ATTITUDE STATEMENT 36

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Total	56.4192	166		
Between Groups	1.8093	3	.6031	1.8205
Error	54.6099	163	.3350	

that are appropriate to biology should be included in the methods class. A total of 161 educators expressed agreement. Only six responses were received in which a response other than agreement was evidenced. The F value for statement 36 was 1.8205 (Table LXXIV) Since the F value was below that required for significance at the five percent level, the null hypothesis cannot be rejected.

Summary. Thirty-six statements related to the biology methods program were tested to determine whether or not significant differences were exhibited between the responses of four populations of Oklahoma educators. Two tables were used to present the findings of each of the statements. An analysis accompanies each set of tables.

A list of the statements manifesting significant differences are as follows.

Professional Preparation. Specialized instruction in the development and use of curriculum guides and resource units is needed.

Management of Students. Methods of handling problems of pupil control and discipline should be covered.

Pre-service teachers should have some knowledge of problems to be encountered at the secondary level, i.e. ability levels, and individualized instruction.

The methods instructor should have public school experience, especially at the secondary level.

Methods students should be able to design activities related to scientific method and processes of science.

Pre-service teachers should be able to design and carry out a teaching strategy which will develop quality student interaction.

Techniques of Teaching. Methods instruction should provide the techniques of writing course and behavioral objectives.

Techniques of developing discovery questioning skills are needed as an alternative to lecture presentations.

A good methods course should lead toward the development of a style of teaching that focuses on concepts and principles, not on rote memorization of facts.

Electronic Teaching Aids. Methods instruction should include the use of videotape and microteaching techniques.

Evaluation. A follow-up study of recent graduates to determine the teaching value of topics and experiences in the methods course is needed.

Laboratory Methods. None.

A list of the statements not manifesting significant differences are as follows.

Professional Preparation. All biology teachers-to-be should have formal training in the use of modern biology program materials such as BSCS materials.

Biology methods students should be able to develop short and long term science budgets.

Methods courses should provide sourcebooks for free science materials and films.

The methods course should provide a set of teaching experiences that may be tried later in practice teaching.

Management of Students. Methods of motivating pupil interest and response should be investigated.

Techniques of Teaching. The methods course should emphasize the

inquiry approach to teaching and techniques for structuring inquiry.

Various motivation techniques should be investigated.

There is a need for developing a modern concept of the nature of biological science as a process and as a mode of inquiry.

Electronic Teaching Aids. Methods instruction should include the fundamentals of audio-tutorial instruction.

Methods instruction should include an introduction to various teaching machines for use in biology.

The examination and utilization of audio-visual equipment in relation to science instruction is needed.

Methods instruction should include techniques of operating a motion picture camera.

Methods instruction should include the use of the film-loop projector with the students making their own film loops.

Evaluation. We need an evaluation of the biology methods programs in our state colleges.

The method of assigning grades in a biology methods course should be continually re-evaluated.

Methods instructors should set minimum objectives to be reached to aid in evaluation of students.

Curriculum content of a methods course should be based on occupational analysis.

Testing and grading in biology is an area of the teaching process that needs greater attention.

Laboratory Methods. The laboratory portion of the course should emphasize the utilization of common tools for making materials.

The study and construction of housing units for animals and the

feeding and care processes of common animals is needed.

Emphasis should be placed on the utilization of simple scientific apparatus for the lab.

Experience in ordering chemicals and supplies in the lab type situation is needed.

The examination and utilization of plastic embedding and animal mounting should be studied.

The instructional use of the field trip, and possible locations that are appropriate to biology should be covered.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purposes of this chapter are to summarize the study, to present the findings of the study, to draw conclusions based on the findings, and to make recommendations for further research pertinent to the biology methods programs.

Summary

The primary purpose of this study was to determine whether or not significant differences existed among the responses of; education faculty, biology faculty, recent graduates of Oklahoma state colleges, and principals of Oklahoma high schools. Also it was anticipated that the study would provide a basis for analyzing the responses within each of the four groups in order to identify the extent of concurrence with selected statements.

This study was designed to test a number of hypotheses with regard to possible occurrence of significant differences between college and high school educators in Oklahoma concerning the biology methods program. Hypotheses so formulated were tested for tenability.

After a thorough review of related literature, the researcher proposed a list of 72 statements concerning selected areas or activities of the biology methods program. The statements were then presented to a jury of thirteen educators to determine the pertinence and

validity of the statements and to obtain judgements as to their clarity and brevity. From the returned pre-tests, thirty-six statements were selected for the attitude instrument.

The test-retest reliability of the instrument was determined by a pilot study composed of twenty graduate science students attending Oklahoma State University Science seminar (spring 1971). The questionnaire was given to the pilot group and after two weeks, the process was repeated. It was established before the pilot study was started that an 85 or higher percentage of "same" responses be required for the instrument to be reliable. All subjects had the required percentage of "same" responses.

The thirty-six statements were sub-divided into six areas of the biology methods program with six statements assigned to each area. Areas selected for investigation were as follows: (1) Professional Preparation, (2) Management of Students, (3) Techniques of Teaching Biology, (4) Electronic Teaching Aids, (5) Evaluation, (6) Laboratory Facilities, Equipment, and Management. Each statement was selected on the basis of recommendations received from jury members.

A total of 200 Oklahoma educators were randomly selected and asked to participate in the study: 50 college biology faculty, 50 education faculty, 50 high school principals, and 50 high school teachers. From this number 167 usable questionnaires or 83.5% were returned. Data from the returns were collated and analyzed. Data pertaining to each of the 36 statements were used to test the null hypothesis to identify those factors which revealed significant differences in responses among the four groups.

The Single-Classification Analysis of Variance was used in the

testing of the null hypothesis. When the null hypothesis was shown to be untenable, the researcher was able to determine which means were different by Duncan's Multiple Range Test. The level of significance required for the rejection of a null hypothesis was set at the five percent level.

Conclusions

Professional Preparation. Five of the six statements concerning professional preparation indicated no significant difference among the responses of the four groups. Data presented in Tables V and VI indicated that the only significant difference was relative to a need for specialized instruction in the development and use of curriculum guides and resource units. It is a general observation from the responses of college educators and high school educators that methods students should be able to develop short and long term science budgets. Also, it would appear that all response categories are positive concerning a need to provide sourcebooks for free science materials and films. While there is a fluctuation in responses, there was general agreement on the need for a required methods course.

Management of Students. Many teachers are worried about classroom control. The new science programs being recommended definitely require the teacher to change his approach if he is to succeed in getting across to the students the objectives for which the course was designed.

There was a significant difference in the responses to five of the six statements. However, significant differences did not exist among responses concerning the need to investigate methods of motivating

pupil interest and response. The greatest significant difference occurred among judgements regarding an assumption that pre-service teachers should have some knowledge of problems related to ability level and individualized instruction.

Although significant differences appeared in five of the six statements, it was recognized that differences were expressed largely in degree of intensity to responses rather than in diametric opposition of the four groups' views concerning management of students.

Techniques of Teaching Biology. Responses to three of the six selected activities relative to hypotheses formulated in this program area were not significant. A slight majority of Oklahoma educators feel that the methods course should emphasize the inquiry approach to teaching. Agreement was strong that various motivation techniques should be investigated. All four populations agree with the statement that techniques of developing discovery questioning skills are needed as an alternative to lecture presentations (Table XXXIII). However, a significant difference in responses was observed. Data presented in Table XXXV indicates a significant difference concerning a course that focuses on concepts and principles and not on rote memorization of facts. The difference appears to be in the degree of intensity of belief and not disagreement towards the statement. Nearly one-fourth of the educators in the sample expressed responses as being "undecided" concerning the need to provide the techniques of writing course and behavioral objectives.

Electronic Teaching Aids. Five of the six selected activities relative to this hypothesis revealed no significant difference in responses. College education faculty generally agree that methods

instruction should include the fundamentals of audio-tutorial instruction whereas the other three populations are somewhat undecided (Table XXXIX). Significant differences exist between college education departments and college biology departments concerning the use of videotape and microteaching techniques. Differences also exist between college education departments and high school biology teachers concerning this statement. Little difference was evident in attitudes expressed by college and high school educators concerning the need to include an introduction to various teaching machines for use in biology.

College educators and high school educators were in agreement as to the need for examination and utilization of audio-visual equipment in relation to science instruction. Responses to attitude statements 23 and 24 concerning the motion picture camera and film-loop projector indicated a greater degree of variance along the continuum than the other four areas in this section. More than half of the educators expressed responses as being "undecided" or "disagree" concerning the need for training in the use of the film-loop projector or the motion picture camera.

Evaluation. Responses to five of the six statements surveyed in this area revealed no significant difference. However, it was found that significant difference did exist between college education faculty and high school principals concerning the desirability of a follow-up study of graduates to determine the value of topics and experiences in the methods course. Significant differences did not exist concerning the assumption that we need an evaluation of the biology methods programs in our state colleges. Responses from all groups were in agreement regarding this assumption. An analysis of Tables LIII and

LIV revealed no significant difference at the five percent level. However, college educators are somewhat higher on the continuum concerning the statement that the method of assigning grades in a biology methods course should continually re-evaluated, than are high school educators. Table LV indicates that college and high school educators generally agree in their responses to the statement that minimum objectives should be set to aid in evaluation of students. Data presented in Table LVII indicate the greatest number of responses at the "undecided" part of the continuum, these data concerning the assumption that curriculum content of a methods course should be based on occupational analysis.

Laboratory Methods. Responses to all six selected activities relative to hypotheses formulated in this program area were not significant. College educators and high school educators expressed general agreement concerning (1) emphasis on the utilization of common tools for making materials, (2) emphasis on the utilization of simple scientific apparatus, (3) need to have experience in ordering chemicals and supplies, (4) use of the field trip and possible locations that are appropriate to biology.

In reacting to the proposal that the construction of housing units, the feeding, and care processes of common animals is needed, slightly over one-half of the responses were either "undecided" or "disagree." In reacting to the proposal that plastic embedding and animal mounting should be studied, slightly over one-half of the educators indicated that they agreed.

TABLE LXXV

DISPOSITION OF NULL HYPOTHESES REGARDING OPINIONS HELD BY FOUR POPULATIONS OF OKLAHOMA EDUCATORS CONCERNING THE UNDERGRADUATE PREPARATION OF BIOLOGY TEACHERS IN A BIOLOGY METHODS COURSE

Factor		Disposition
A.	Professional Preparation	
	1. The use of BSCS materials	Nor rejected
	2. The development and use of curriculum guides and resource units	Rejected
	3. The inclusion of a required biology methods course	Not rejected
	4. Meeting students needs by providing a set of teaching experiences	Not rejected
	5. Need to provide sourcebooks for free materials	Not rejected
	6. Development of short and long term science budgets	Not rejected
B.	Management of STudents	
	1. Handling problems of pupil control and discipline	Rejected
	2. Methods of motivating pupil interest and response	Not rejected
	3. The methods instructor having public school experience	Rejected
	4. Methods students being able to design activities related to scientific method and processes of science	Rejected
	5. Methods students ability to design and carry out a strategy which will develop student interaction	Rejected
	6. Problems related to ability levels and individualized instruction	Rejected

TABLE LXXV (CONTINUED)

Factor	Disposition
C. Techniques of Teaching	
1. Emphasis on the inquiry approach and techniques of structuring inquiry	Not rejected
2. Techniques of writing course and behavioral objectives	Rejected
3. The investigation of motivational techniques	Not rejected
4. The development of a style of teaching that focuses on concepts and principles	Rejected
5. The development of a modern concept of science as a process and as a mode of inquiry	Not rejected
6. Techniques of developing discovery questioning skills	Rejected
D. Electronic Teaching Aids	
1. Fundamentals of audio-tutorial instruction	Not rejected
2. The use of video-tape and microteaching techniques	Rejected
3. The use of teaching machines	Not rejected
4. Utilization of audio-visual equipment	Not rejected
5. The use of the film loop projector	Not rejected
6. Techniques of operating a motion picture camera	Not rejected
E. Evaluation	
1. The need for evaluation of biology methods programs in Oklahoma state colleges	Not rejected
2. Assigning grades in a biology methods course	Not rejected

TABLE LXXV (CONTINUED)

Factor	Disposition
E. Evaluation (Continued)	
3. Maintaining minimum objectives to aid in evaluation of methods students	Not rejected
4. Content of the methods course being based on occupational analysis	Not rejected
5. Follow-up studies to determine the the teaching value of topics in the methods course	Rejected
6. Testing and grading in biology	Not rejected
F. Laboratory Methods	
1. Emphasis on the utilization of common tools for making materials	Not rejected
2. The construction of housing units, and the feeding and care of common animals	Not rejected
3. The utilization of simple scientific apparatus	Not rejected
4. Utilization of plastic embedding and animal mounting	Not rejected
5. Experience in ordering chemicals and supplies	Not rejected
6. The instructional use of the field trip and possible locations	Not rejected

TABLE LXXVI

SUMMARY OF DUNCAN'S MULTIPLE RANGE TEST TO DETERMINE WHERE THE SIGNIFICANT DIFFERENCE LIES

	If the populations are numbered- 1 for education departments, 2 for biology departments, 3 for high school principals, and 4 for high school biology teachers, then differences exist between;					
Statements Manifesting significant Differences	1 & 2.	1 & 3.	1 & 4.	2 & 3.	2 & 4.	3 & 4.
2			xx			
7				xx		
9	xx		xx			
10	xx			xx	xx	
11		xx				
12	xx	xx				
14		xx	xx			
16	xx	xx	xx			
17		xx				
20		xx	xx			
29		xx				

Recommendations

This study was undertaken to determine the nature and extent of agreement among education faculty, biology faculty, recent graduates of Oklahoma state colleges and principals of Oklahoma high schools relative to selected areas of the biology methods program in these colleges. Concomitantly, the study constituted an evaluation of the current science methods programs and provided an insight into some of the more salient problems confronting biology teachers. It is felt that this study will provide information that might be useful to other studies of a more detailed nature.

There is sufficient evidence to imply justification for curriculum revision in pre-service education to develop better prepared teachers of biology, particularly as regards competence in meeting the demands for implementing and supervising student experiences in the newer science programs. Biology teacher education must provide much of the necessary leadership to effect changes in the now existing program of biology. The need for more and closer cooperation among biology teachers, teacher educators and school administrators is strongly recommended.

As a result of this study, the writer makes the following recommendations for further research:

1. Further studies should be conducted in order to include the perceptions of college faculty and high school educators. An assessment of the role of the state college in preparing biology teachers from these legitimate sources would better define the interrelationships of these groups and might assist in planning stratigies for inducing profitable change.

2. Based upon the results of the investigation, state colleges and high schools should develop plans to involve teachers in more of the policy making which is significant and vital to their interest. Perhaps other studies should be made toward the defining and identifying of those areas of vital concern.

3. State colleges might make an increased effort toward communication with public schools. More consultative services, more assistance with experimentation projects, and more relating of the results of current and applicable research should be made available to public schools.

4. Efforts should be made to encourage beginning teachers to obtain additional instruction in the use of modern science programs, materials, methods, etc.

5. More emphasis should be placed on the biology methods course as an introduction to modern science teaching.

6. Education and biology departments should work cooperatively to provide prospective biology teachers with the benefits of both disciplines.

7. Replication of this study on several large campuses could yield important information relative to the biology methods program as well as basis for comparison. However, persons making generalizations from this study should do so with extreme care, as the size, location, and purposes of the institution could affect the opinions and activities of beginning teachers on that campus.

8. There should be further research focused on the needs, activities, and attitudes of recent science education graduates of Oklahoma state colleges as well as Oklahoma educators. The results of this

study revealed some important findings, but only a limited area was considered. This further research should be a continuous process conducted and/or coordinated by the Departments of Biology, Departments of Education or some other responsible agency.

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APPENDIX A

April 19, 1971

Dear Colleague,

As a Research Assistant under the auspices of the Oklahoma State University Research Foundation, we are conducting a survey to determine attitudes and opinions concerning a science methods course for teachers.

In one week I shall be conducting a study with the express purpose of determining the attitudes of selected Oklahoma Education faculty, Biology faculty, high school biology teachers, and high school principals toward selected aspects of the biology methods programs.

Your service as a member of Oklahoma's educational institutions is a vital and responsible service of educational leadership. Your views and opinions concerning educational matters are of great importance on the national and state as well as the local level.

I realize that your time is limited, particularly at this time of year. For this reason, a single opinionnaire has been designed so that it may be completed in approximately fifteen to twenty minutes. May I assure you too, that neither the names of teachers nor their schools will be identified or compared and that all information will be treated as absolutely confidential.

Since this study represents a very small population, I feel that you as one of the selected few will agree that it is imperative that we include your perceptive observations.

Your help in completing and returning the opinionnaire at your early convenience will be most gratefully appreciated.

Please accept my sincere thanks in advance for your assistance.

Respectfully,

J. Phillip Traughber
Research Assistant

Kenneth E. Wiggins
Associate Director,
Research Foundation

April 23, 1971

Dear Colleague,

A few days ago I wrote to you concerning a study I am doing in cooperation with the Oklahoma State University Research Foundation.

The enclosed form is a part of the study being conducted as a partial fulfillment of the requirements for a doctoral degree in Higher Education. These statements pertain to the Biology Methods course with which you are acquainted. It is designed to determine the attitudes of the Education faculty, Biology faculty, high school biology teachers, and high school principals toward changes in the biology methods program. This information, when assembled and evaluated, will represent a general attitude toward our present program with implications for possible changes that should be considered in future program planning.

I am sure that you will want to make a contribution to your profession by furnishing the information requested. Only honest and sincere responses will be of value. Neither the names of teachers nor their schools will be identified in the manuscript; therefore, responses will be confidential.

Please complete the Information Form and return it immediately. A self-addressed, stamped envelope is furnished for your convenience.

Very truly yours,

J. Phillip Traughber
Research Assistant

May 4, 1971

Dear _____:

About April 23, 1971, I sent a letter and a questionnaire form asking for your help in a study concerning attitudes and opinions of Education faculty, Biology faculty, high school biology teachers, and high school principals toward changes in the biology methods programs.

I especially need your help now in completing this study. A questionnaire and self-addressed envelope are enclosed for your convenience. Would you please take a few minutes and complete the form now? It would mean so much to me and I would be sincerely grateful.

Your information will be kept confidential. Coding, by numbers, has been a necessity in order to follow up on those not responding.

Sincerely,

J. Phillip Traughber
Research Assistant
Oklahoma State University
Stillwater, Oklahoma 74074

APPENDIX B

Code _____

Questionnaire

Instructions:

With a pencil or pen, circle the one symbol which best represents your reaction to each statement. The symbols are scaled in this manner:

SA	A	U	D	SD
Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

SA A U D SD 1. All biology teachers-to-be should have formal training in the use of modern biology program materials such as BSCS materials.

SA A U D SD 2. Specialized instruction in the development and use of curriculum guides and resource units is needed.

SA A U D SD 3. Biology methods students should be able to develop short and long term science budgets.

SA A U D SD 4. Methods courses should provide sourcebooks for free science materials and films.

SA A U D SD 5. The biological science teaching program in Oklahoma state colleges should include a required methods course.

SA A U D SD 6. The methods course should provide a set of teaching experiences that may be tried later in practice teaching.

SA A U D SD 7. Methods of handling problems of pupil control and discipline should be covered.

SA A U D SD 8. Methods of motivating pupil interest and response should be investigated.

SA A U D SD 9. Pre-service teachers should have some knowledge of problems to be encountered at the secondary level, i.e. ability levels, and individualized instruction.

SA A U D SD 10. The methods instructor should have public school experience, especially at the secondary level.

SA A U D SD 11. Methods students should be able to design activities related to scientific method and processes of science.

SA A U D SD 12. Pre-service teachers hould be able to design and carry out a teaching strategy which will develop quality student interaction.

SA A U D SD 13. The methods course should emphasize the inquiry approach to teaching and techniques for structuring inquiry.

SA A U D SD 14. Methods instruction should provide the techniques of writing course and behavioral objectives.

SA A U D SD 15. Various motivation techniques should be investigated.

SA A U D SD 16. Techniques of developing discovery questioning skills are needed as an alternative to lecture presentations.

SA A U D SD 17. A good methods course should lead toward the development of a style of teaching that focuses on concepts and principles, not on rote memorization of facts.

SA A U D SD 18. There is a need for developing a modern concept of the nature of biological science as a process and as a mode of inquiry.

SA A U D SD 19. Methods instruction should include the fundamentals of audio-tutorial instruction.

SA A U D SD 20. Methods instruction should include the use of video-tape and microteaching techniques.

SA A U D SD 21. Methods instruction should include an introduction to various teaching machines for use in biology.

SA A U D SD 22. The examination and utilization of audio-visual equipment in relation to science ins-ruction is needed.

SA A U D SD 23. Methods instruction should include techniques of operating a motion picture camera.

SA A U D SD 24. Methods instruction should include the use of the film-loop projector with the students making their own film loops.

SA A U D SD 25. We need an evaluation of the biology methods programs in our state colleges.

SA A U D SD 26. The method of assigning grades in a biology methods course should be continually re-evaluated.

SA A U D SD 27. Methods instructors should set minimum objectives to be reached to aid in evaluation of students.

SA A U D SD 28. Curriculum content of a methods course should be based on occupational analysis.

SA A U D SD 29. A follow-up study of recent graduates to determine the teaching value of topics and experiences in the methods course is needed.

SA A U D SD 30. Testing and grading in biology is an area of the teaching process thats needs greater attention.

SA A U D SD 31. The laboratory portion of the course should emphasize the utilization of common tools for making materials.

SA A U D SD 32. The study and construction of housing units for animals and the feeding and care processes of common animals is needed.

SA A U D SD 33. Emphasis should be placed on the utilization of simple scientific apparatus for the lab.

SA A U D SD 34. Experience in ordering chemicals and supplies in the lab type situation is needed.

SA A U D SD 35. The examination and utilization of plastic embedding and animal mounting should be studied.

SA A U D SD 36. The instructional use of the field trip, and possible locations that are appropriate to biology should be covered.

VITA

J. Phillip Traughber

Candidate for the Degree of

Doctor of Education

Thesis: AN INVESTIGATION OF ATTITUDES AND OPINIONS REGARDING THE UNDERGRADUATE PREPARATION OF BIOLOGY TEACHERS

Major Field: Higher Education

Biographical:

Personal Data: Born in McAlester, Oklahoma, August 1, 1937, the son of L. Oran and Jimmie E. Traughber.

Education: Graduated from Savanna High School, Savanna, Oklahoma, in 1955; received the Junior College Associate degree from Murray State College, Tishomingo, Oklahoma in May, 1957; received the Bachelor of Science degree in Education from East Central State College, Ada, Oklahoma, in May, 1963, with a major in Biology; received the Master of Teaching degree in 1967 from Northeastern State College, Tahlequah, Oklahoma, with a major in Secondary Education; attended Oklahoma State University from September, 1967, to May, 1968, and from June, 1970, to July, 1971; completed requirements for the Doctor of Education degree in May, 1972.

Professional Experience: Taught biology, chemistry, earth science, algebra, and coached basketball and baseball at Cutler Academy Preparatory School, Craftsbury Common, Vermont, 1963 to 1965; taught BSCS Biology, general science, and coached basketball at Cascia Hall Preparatory School, Tulsa, Oklahoma, 1966 to 1967; appointed Principal of Midway Schools, USD # 433, Denton, Kansas, 1968 to 1970.

Professional Organizations: Oklahoma Academy of Science, Rho Theta Sigma Scholastic Society, National Education Association, Kansas State Teachers Association, and the Oklahoma Education Association.