ATTITUDE TOWARD SCIENCE AND THE AUDIO-TUTORIAL METHOD OF TEACHING GENERAL BOTANY AT OKLAHOMA STATE UNIVERSITY

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CHAPTER I

INTRODUCTION

For many years a difference of opinion has existed regarding the relative effectiveness of different kinds of educational experiences upon the development of attitudes and understanding of young people. McKeachie (30) summarizes many of the methods and media used in bringing educational experiences to the burgeoning college population of a decade ago. Today the enrollment of 7.6 million in higher education (1) has surpassed the predictions of the fifties and early sixties. Demographic, sociological, and economic forces have brought this "flood" of students to our nation's campuses. (1)

The above forces have given the stimuli for students to enter college. However, "It is necessary to create an environment in which the learner is motivated to become involved in the process" (38) of learning if success and satisfaction are to reward his academic endeavors. Fundamentally, learning is an activity done by an individual and not something done to an individual. The impact of the above is expressed and clarified by Miller (32) as follows:

> What we do, if we are successful, is to stir interest in the matter at hand, awaken enthusiasm for it, arouse a curiosity, kindle a feeling, fire up the imagination--and now he who is exposed in this fashion goes on his own to learn it.

To further emphasize the importance of effective teaching, Marshall (28) suggests that the attainment of teaching is so infrequent as to be a

special phenomenon and Nason (34) says, "...unless the trends are reversed our university system is headed for a crash." Wireman (51) and many others (52), (29), and (21) attributes much of the unrest today to lack of relevance and student-teacher interaction.

"This is the Golden Age of Man." (38) We live in a day when so many communication devices and innovations exist that could be effectively adapted to education. However, the students have been so computerized that they have protested, revolted, struck and pillaged. Having so done and seriously neglecting their studies, they have voted to give themselves credit for the work they did not do with the accession of the faculty. (34) With the knowledge explosion which exists today the students are challenged to learn more in a relatively short time than people in the past have had to learn during an entire lifetime. However, far more than acquisition of knowledge is vital to our youth and the future of our world society. Jean Piaget, as quoted by Weaver (48), states:

> The principle goal of education is to create men who are capable of doing new things, not simply repeating what other generations have done--men who are creators, inventors, and discoverers. The second goal of education is to form minds which can be critical, can verify, and do not accept everything they are offered. ...We have to be able to resist individually, to criticize, to distinguish between what is proven and what is not.

According to McKeachie (30) of the University of Michigan, research in teaching is essentially the process of finding the teaching and learning situation that is educationally most effective. Programmed instruction, teaching machines, and educational television were hailed by their originators as instructional devices that would promote the fullest development of the individual because individual differences of

the students were taken into consideration. The 1950's and 1960's brought forth vast amounts of programmed material; but unfortunately, much of the material was marketed without the feedback of any results that validated or enhanced its use. The literature related to the Kinnerian designs and the Crowder models of programmed instruction is abundant and comprehensive. (48)

Background for the Study

Samuel N. Postlethwait of Purdue University, in an effort to make adjustments for the diversity of backgrounds of the students taking his freshman botany course, introduced a series of special lectures on tape to supplement each week's traditional lectures during the fall of 1961. These tapes were placed in the Audio-Visual Library and were available to the students on an individual basis so that they could compete more effectively in class through the use of this supplemental material. In the preparation of these taped lectures, Postlethwait envisioned that the students might well bring along their textbooks and open them to the appropriate pages so that the subject matter in the text could be related to the subject matter covered by the taped lecture. Later it seemed logical to have the students bring their laboratory manuals so that the subject matter on the tape could be related to the laboratory manual. Since it was a botany course, it seemed feasible to provide the students with live plants and other laboratory materials so that an integration of the textbook, taped lecture, and laboratory manual could be achieved. This procedure progressed to the point where the tape was no longer a lecture, but rather a discussion about botany in a one-to-one relationship (one teacher-one student).

Postlethwait's original work was initiated in the fall of 1961 and by the end of that semester, he had assembled a weekly learning unit that would allow the students to do the week's work without having to attend the formal lecture or laboratory sessions associated with the course. In surveying the students using his supplementary materials, Postlethwait found that his more academically superior students were also making use of this new instructional method thereby circumventing the traditional lecture-laboratory sessions.

This positive reaction by the students to Postlethwait's efforts led him to set up an experimental section of thirty-six students during the spring of 1962. These students received all of their instruction through this individualized, multi-media approach to learning. This new approach was called the audio-tutorial instructional technique. (38)

The experimental group was required to meet with the instructor once each week for an examination and general discussion session in which the discussion content was dictated by the students. The students participating in the experimental group were required to take the same examinations as those students who were enrolled in the traditional lecture-laboratory courses. At the end of the semester, the results showed that the experimental group did as well as the traditionally taught students, but neither group surpassed the other in the final grade distribution. This was the beginning of audio-tutorial instruction as originally conceived by Postlethwait.

It was Postlethwait's intention, in revising the instructional approach of the course, to eliminate all work not necessary in initiating and sustaining the learning process and to adapt the presentation of the course to the nature of the course objectives through the use of

the most modern audio-visual learning aids. Learning events included a great range of experiences such as reading from reference sources; doing experiments; collecting data; analyzing data; observing time-lapse movies; looking at plant specimens; and viewing charts, diagrams, and photographs.

Presently, audio-tutorial instruction is being utilized in over 200 colleges and universities in the United States and Canada. (49) Several of these institutions apply this technique of instruction in all of the academic areas of the college. Audio-tutorial instruction has had its greatest application in science instruction, with the biological fields the most represented.

The audio-tutorial method of instruction was implemented in General Botany 1114 at Oklahoma State University in the summer of 1966 by Dr. Arthur G. Carroll, Associate Professor of Botany. The initial implementation of the program was sponsored by a Federal grant to purchase equipment and supplies. (46)

Statement of the Problem

Subject to the limitations set forth later, this study attempts to determine if there is a measurable change which occurs in the attitudes of students toward science brought about by the method of instruction currently utilized at Oklahoma State University in teaching General Botany 1114.

More importantly is the attempt to determine the influence that such attitudinal changes may have on the achievement of students experiencing the integrated audio-tutorial method. Guiding toward the determination of such are: considerations of classification, major

(science vs. non-science), sex of students, previous audio-tutorial experience, and pre- and post-opinions as set forth in the hypotheses that follow immediately.

Hypotheses

Specific hypotheses stated in the null form are:

1. There is no significant difference in achievement, as measured by the total accumulated grade points during the course, between those liking and those disliking, as measured by the Frye Opinion Questionnaire Number 1269, the audio-tutorial method of instruction. When previous knowledge of science as measured by ACT science scores is controlled.

2. There is no significant difference in the attitudes of males and females favorable--unfavorable, as measured by the Frye Opinion Questionnaire Number 1269, toward the audio-tutorial method of instruction.

3. There is no significant difference in the attitudes toward the audio-tutorial method of instruction of upper and lower classmen, as measured by the Frye Opinion Questionnaire Number 1269.

4. There is no significant difference between the attitudes of students toward science in general at the beginning of the program (as measured by the science portion of the Frye Opinion Questionnaire Number 969) and their attitudes at the end of the program (as measured by the science portion of the Frye Opinion Questionnaire Number 1269).

5. There is no significant difference in the attitudes (as measured by the audio-tutorial portion of the Frye Opinion Questionnaire Number 969) of those students having previous experience and those

having no previous experience with the audio-tutorial method of instruction.

6. There is no significant difference in the attitudes toward the audio-tutorial method of instruction (as measured by the audio-tutorial portion of the Frye Opinion Questionnaire Number 1269) between science majors and non-science majors.

7. There is no significant difference in students' attitudes (as measured by the audio-tutorial portion of the Frye Opinion Questionnaire Number 1269) toward the independent study session (ISS), the general assembly session (GAS), and the integrated quiz session (IQS).

For the analyses of these hypotheses the investigator selected the probability of 0.05 (37) as the predetermined level of statistical significance.

Significance of the Study

Frequently, in serving a large student body as in freshman general botany at OSU it is important to evaluate the effectiveness of a program. It has been a policy of Dr. Carroll to make a survey at the end of each semester in General Botany 1114 but prior to this semester no serious effort to have a comprehensive study of students attitudes and achievements and the correlation of these factors had been made.

The investigator has been favorably impressed and interested in the audio-tutorial botany course at OSU since his first encounter with it in 1966, first as a graduate student and later as a graduate assistant. During the ensuing interim, until the initiation of this study, the investigator has been privileged to talk with many students who have had the audio-tutorial botany course. The result of such friendly

conversations revealed attitudes of botany students that varied tremendously toward the course and its methodology.

This study should help to give some indications as to why such diversity exists. With a better understanding of the students' attitudes it should be possible to develop greater student-centeredness in the program. Thus the ultimate significance is the definite possibilities of producing greater student satisfaction and better preparation to live a full satisfying life in his environment as he meets independently the challenges of life with its multi-faceted experiences. If A-T is only a method of increasing enrollments for mass education without increasing faculty (47) to meet student needs then a better way should be sought to meet the needs of students.

Limitations of the Study

The population used in this study limits the application of the results of this study. Thus the results are limited to the population of students at Oklahoma State University taking General Botany 1114, a beginning botany course for students who are either majors or non-majors in science and have had no previous formal introduction to botany. Though the questionnaires were given to all students present, only those completing the semester and having attended college only at Oklahoma State University are included in the analyses.

The study by its nature is limited inasmuch as it is not factual but attitudinal having no absolute measurements. The lack of standardized testing instruments and the necessity of developing an instrument for this study have limited the results. The administration of the questionnaires by several different persons, none of them being the

investigator, may have further limited the results.

By the very nature of the independent work necessary for the course there are various abilities of the student that are assumed, accordingly, no attempt is made in this study to correlate intelligence quotient, physical handicaps, or many other ability characteristics with attitudes even though such might be very significant.

Undoubtedly, the attitudes and abilities of "laboratory instructors" in the independent study center and the administering of quiz sessions could influence attitudinal development, but this limitation has not been correlated in any way.

Finally, the most significant limitation of this study is the absence of a control group.

Clarification of Terms

Certain frequently used terms in this dissertation require specific definition. These terms are:

1. "Achievement" refers to the student's acquisition of botanical knowledge as demonstrated by his performance in oral quizzes, written quizzes, and hour examinations and used in this study as only the accumulated score.

2. "Attitude" the meaning of the term attitude was accepted in this investigation as the degree of positive or negative feeling associated with life sciences, the audio-tutorial method and its component parts.

3. "Audio-tutorial" refers to the method of teaching which involves the use of programmed material recorded on magnetic tapes, discussion groups, oral quizzes, lecture sessions, demonstrations, and student experiments all coordinated into the methodology.

4. "Conventional" or "traditional" method (the utilization of these terms in this study assumes large enrollments) refers to the regular lecture-discussion-laboratory methodology.

5. "General Botany" is the beginning freshman level course involving a study of plant structures and functions, the plant kingdom (taxonomy), mineral nutrition, genetics, and ecology.

6. "Independent study" indicates that the student is not as fully dependent on lectures and the direct supervision of laboratory instructors but has the chief responsibility for his own achievement (in reality it is quasi independent).

7. "Laboratory instructor" refers to the person on duty, at all times, in the learning center of adjacent area to answer questions and assist students as needs arise.

8. "Learning center" is the area (rooms 110 and 111 in Life Science East) where the independent study occurs.

9. "Student-faculty ratio" is the average number of students taught by the teaching faculty members.

Basic Assumptions

This study assumes that the Likert-type scale can effectively measure the attitudes of students taking the opinion questionnaires used in the study. Further, it is assumed that the opinion statements will be answered sincerely and directly rather than selecting the choice that "should be" answered.

It is assumed that the population (fall semester 1969-70 sections I and II) is representative of all the general botany students at Oklahoma State University who have had the audio-tutorial botany.

Finally, it is assumed that all students received equal motivation to develop a favorable attitude toward the audio-tutorial in botany.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The appearance of B. F. Skinner's article on automated instruction in the October, 1958, issue of Science gave national attention to the potentials of programmed instruction and served to awaken the educational community to a new era which later became known as the "Programming Boom." (44) Instructors in the scientific fields were among the first to become interested and involved in investigating and utilizing new, programmed instructional concepts in a multi-media approach to learning. (38)

During the period from 1962 to 1964 a striking change in the direction of programmed instruction occurred. The very definition of a program was altered. Lumsdaine authored an article in 1964 that redefined a program as any set of reproducible instructional events which takes the responsibility for changing the student's behavior. (26) This new and current definition of programmed instruction does not require individual instruction, nor small steps, nor active response, nor knowledge of results. The emphasis is on the effects produced by this reproducible sequence of instructional events. The effectiveness of the program is measured by the degree of change that occurs in the behavior of the learner. "Individual differences" advocated by Bloom are served more adequately by the new program. (5)

Under this new concept of a program, a tape recorded lesson or a teaching film is considered a program if it is directed toward implementing a behavioral change in the learner.

Audio-tutorial instruction is treated by B. Lamar Johnson in his recent book in the chapter, "Systems Approach to Instruction: Audio-Tutorial Teaching," but he includes the reservation that with equal appropriateness, audio-tutorial instruction could be included in the chapter under programmed instruction. Basically, the principles and practices of programmed instruction are the same as the systems approach to instruction and can be used synonymously. (22)

Rationale for Audio-Tutorial Instruction

Programmed instruction, used as a method of transmitting basic information to the student, combines both science concepts and scientific models at the same time.

Jerome Bruner was an early advocate of providing a framework in which the student is to accomplish learning. He called this framework "structuring." Structuring, according to Bruner, is understanding in a way that permits many other things to be related meaningfully. To learn structure, in short, is to learn how things are related. (9)

Robert Mager, a noted programmer and professional engineer, describes the application of programmed instruction as:

> ...instructional engineering; it begins with a specific input, and applies a process to achieve a finished product. Programmed instruction is achieved by specifying the desired characteristics of the finished product (that is, the terminal behavior required from the student), by specifying the minimal characteristics of the raw material (prerequisites), and by fabricating a step-by-step process that will mold the raw material into the finished product. (27)

Any program of study, to be effective, must allow for individual differences in the students. By breaking down each unit of study into small parts, the learner can adjust the size of the unit to his own ability to assimilate the information to be learned. This approach allows those who can absorb large quantities of information rapidly to do so, while other students may proceed at a more individualized pace. The audio-tutorial approach allows the learner to proceed at his own rate and to break the subject matter into units commensurate with his ability.

The audio-tutorial instructional method is a multi-media approach to learning. It allows for the presentation of course material in a great variety of ways, allowing the student to exploit the medium which communicates most directly and effectively for him. Some students learn better from printed material (40) while other students learn best through live auditory communication. (12) This statement is supported in depth by the compiled research of McKeachie who states, "...more and more evidence shows that different teaching methods work well for different types of students." (30)

Tutorial help available to the learner through programmed instruction is one of the instructional strengths of the audio-tutorial method. Individual instruction is the most expensive type of instruction but the audio-tutorial instructor is available to operate in this capacity due to the decentralization of the role of the teacher from the traditional system. Research data indicate that if every student had access to competent tutorial assistance, most of them would be able to learn a particular subject to a high degree.

Surveys of Audio-Tutorial Instruction

The audio-tutorial method of instruction is the most widely discussed, but the least reported on technique of teaching in use today. B. Lamar Johnson, in the most recent and comprehensive survey available covering instructional innovations, reports, "...despite attempts at evaluation in a few colleges, virtually no data are available regarding the success of audio-tutorial teaching." (22)

The literature relating to the institutions utilizing this method of instruction places its use more in the lower division college courses with particular emphasis at the two-year college level. (23) Some colleges utilize the audio-tutorial method only in a single course, while at least one institution applies this method of instruction in all of the courses of the college.

Sam Postlethwait of Purdue University is the originator of this instructional technique as was described in Chapter I of this study. Postlethwait's course is a one semester freshman botany course with an enrollment of approximately 600 students per semester. This four credit-hour course is required for agriculture, pharmacy, and forestry students and may be taken as an elective by art students.

Postlethwait divides the course into three basic learning sessions. The first session is an independent study session (ISS) that is conducted on an unscheduled basis at the student's convenience in the audio-tutorial learning center. This session constitutes the bulk of the student's learning experiences and is conducted through "individualized" instruction. The average time spent per student in independent study is 2.8 hours per week. (38) The general assembly session (GAS)

which meets one hour per week, covers the activities that can be accomplished best in a large group situation. These activities include the administration of major exams, showing of long films, presentation of guest lecturers, or any appropriate activity requested by the students in a group setting. The third form of course structure used by Postlethwait is the integrated quiz session (IQS). This session has varied uses but is generally used for individual testing, both oral and written, and small discussion sessions. The duration of this session is forty-five minutes. (38)

The staff required to operate the Purdue facility is one senior instructor of professorial rank, one instructor, ten part-time teaching assistants and a part-time secretary. A summary of the distribution of staff time at Purdue is included in Table I. (38)

TABLE I

DISTRIBUTION OF STAFF TIME AT PURDUE

Session	(1) Senior Instructor	(1) Instructor	(10) Teaching Assistants	Total
Independent Study	2 hrs.	8 hrs.	70(7/TA) hrs.	80 hrs.
General Assembly	2 hrs.			2 hrs.
Integrated Quiz	4 hrs.	4 hrs.	30(3/TA) hrs.	38 hrs.
Total	8 hrs.	12 hrs.	100 hrs.	120 hrs.

The senior instructor has the major responsibilities for determining course content and procedures, testing, and general course organization. The contact load of this instructor involves eight hours per week in the three different sessions. The senior instructor also prepares all of the audio tapes for the independent study session and instructional materials used in the general assembly session.

The full-time instructor supervises the preparation of all other course materials in addition to working approximately twelve hours contact time per week in the independent study sessions. Additional duties of this instructor are the scheduling of work assignements for the teaching assistants. The teaching assistants serve ten hours contact time per week in the independent study sessions and ten hours preparation time per week.

While it is difficult to accurately compare the overall cost of audio-tutorial instruction to that of traditional instruction, it is possible to rationalize cost differences between the two methods due to their organization and procedures. Audio-tutorial students progress independently and rarely are two or more students at a given point in their study at a given time. Consequently, one or two expensive demonstrations or pieces of equipment will suffice adequately for individualized instruction. Under the traditional method all students are proceeding simultaneously, therefore requiring more of the same equipment, demonstrations, materials, and etc.

Independent study allows for flexible student attendance, and consequently more efficient use of the instructional facilities during the school day. As a result, more students can be accommodated in a smaller instructional area. This space savings results in a financial

gain through better utilization of facilities.

In support of the economics of audio-tutorial instruction, Postlethwait offers the following data in Table II, page 18, to indicate some items upon which financial savings accrue when the audio-tutorial method is compared with the traditional lecture-laboratory method of instruction. (38)

Seven years of experimentation and development have led Postlethwait to make the following conclusions with regard to the audio-tutorial approach to instruction: (38)

1. Emphasis is placed on student learning rather than on teaching.
2. Students can adapt the study pace to their ability to assimilate the information. Exposure to difficult subjects are repeated as often as necessary for any particular student.
3. Better students are not a "captive audience" and can use their time most effectively. Their interests are not dulled by unnecessary repetition of information already learned, but they are free to choose those activities which are more challenging and instructive.
4. The student can select a listening time adapted to his diurnal efficiency peak.
5. Tapes demand the attention of the students. Students are not distracted by each other.
6. Students have more individual attention, if they desire it.
7. Scheduling problems are simplified. The four hours of scheduled time from which the students are relieved under the new system can now be distributed throughout the week as necessary to adjust to the student's activities.
8. More students can be accommodated in less laboratory space and with less staff.
9. Make-up labs and review sessions can be accommodated with a minimum of effort.
10. The student feels more keenly his responsibility for his own learning.
11. Each student is essentially "tutored" by a senior staff member.

TABLE II

COMPARISON OF TRADITIONAL AND AUDIO-TUTORIAL INSTRUCTIONAL REQUIREMENTS

	Traditional			Audio-Tutorial		
Number of Students		600			600	
Study sessions	Lab.	Lect.	Rec.	ISS	GAS	IQS
Student time required:	3 hrs.	2 hrs.	1 hr.	2.8 hrs. (avg.)	1 hr.	1/2 hr.
Staff time required:*	2/30/20	1/300/4	1/30/20	1/32/80	1/300/2	1/8/75
Senior instructor	3 hrs.	4 hrs.	1 hr.	3 hrs.	2 hrs.	3 hrs.
Instructor	6 hrs.		6 hrs.	7 hrs.		5 hrs.
Teaching Assts.	111 hrs.		13 hrs.	69 hrs.		31 hrs.
Total	120 hrs.	4 hrs.	20 hrs.	80 hrs.	2 hrs.	38 hrs.
Space required:	2 labs	Hall (300) 4 hrs./wk.	Room (30) 30 hrs./wk.	1 lab	Hall (300) 2 hrs./wk.	Room (16) 38 hrs./wk.
Materials and equipment required:						
Microscopes, microscope slides and similar equipment requiring individual study	72			32		
Spectrophotometer, hot plates and similar equipment	18			1		
Experimental and demonstration materials	18			1		
Tape recorders				32		
Movie projectors				16		

*Based on the ratio indicated (no. of staff/no. of students/no. of sections).

12. Potentially, the system can be used to standardize instruction where desirable, e.g., between the University and the University Centers, or (between junior colleges and the senior institutions of a state, investigators addendum).

13. Opportunities for research on learning processes is enhanced.

Florissant Valley and Meramec Community colleges of the Junior College District of St. Louis were among the first colleges to apply the audio-tutorial instructional method as developed by Postlethwait at Purdue. (38)

Studies from four years of testing in the biology programs indicate qualitative and quantitative differences in learning that favor audio-tutorial instruction. Researchers at Meramec Community College have studied more than 1,200 students taking biology through either the traditional method or the audio-tutorial instructional method with the following results, Table III. The audio-tutorial students had the higher percentage of grades in the A, B, and C ranges than did the traditional group. The largest difference was at the B level. The traditional group had 38.7 percent in the D and F range as compared to the audio-tutorial percentage of 26.0. (22)

Similar testing and grading standards were used for both groups. While inferences made from course grades alone are hard to validate, the number of students involved does add validity for the continued testing of the audio-tutorial instructional method.

A highly innovative audio-tutorial instructed biology course at the State University College, Rockport, New York, was described in detail in the February, 1969, issue of the American Biology Teacher. While the mechanics of the program are basically similar to that used by Postlethwait at Purdue, the operation is unique in that instructional

television is used to convey much of the visual material to the students on an individual basis. The authors reported the use of single-concept TV tapes that are programmed in short, instructional segments. As many as five of these taped modules are used per week. Also in use is a dial-retrieval video-playback system on which previous TV taped segments can be reviewed by the students any time during the course. The Rockport operation is equipped with twenty-five carrels and handles approximately 525 students per semester. (45)

TABLE III

COMPARISON OF FINAL GRADES FOR TRADITIONAL AND AUDIO-TUTORIAL INSTRUCTED STUDENTS AT MERAMEC COMMUNITY COLLEGE

Scheduled Lecture-Laboratory Method (607 Students)	Audio-Tutorial Method (653 Students)
A- 5.8%	A- 8.4%
B-16.0	B-24.2
C-39.5	C-41.3
D-23.2	D-16.4
F-15.5	F- 9.6

In criticism of this article, no student performance data were included, nor was any mention included in the article of any studies being conducted to evaluate the effectiveness of the program. This is

a fault of many new programs as previously reported by B. Lamar Johnson and other authorities on instructional innovations.

The most publicized use of audio-tutorial instruction is at Oakland Community College, Detroit, Michigan, where all of the courses of the college are taught through this instructional method. Oakland opened in September, 1965, with 4,000 students on two campuses using Postlethwait's basic technique of audio-tutorial instruction. Oakland makes use of the general assembly session for large group presentations and the small assembly sessions for individual and tutorial meetings. Initial studies reveal that in those sessions where student attendance is voluntary, student achievement is low and the dropout is high. Conversely, when attendance is required and scheduled, particularly at individual study sessions, student achievement increases and the dropout rate decreases. These data have prompted more required and scheduled attendance sessions for the students with improved results. (22)

Course materials used at Oakland were developed through a cooperative arrangement between the college and Litton Instructional Materials. Faculty orientation sessions in audio-tutorial instruction were also conducted by this company. Recent figures from the Oakland operation show a higher-than-average per-student cost (as compared with other Michigan Junior Colleges), but this was to be expected in light of the innovative and developmental steps taken by this new college. (22)

The success or failure of the Oakland operation cannot be gauged in this three year period, but its impact on the instructional procedures of higher education, particularly at the two-year college level, has been significant.

The health education fields are among the most active in seeking

instructional effectiveness. Henry Ford Community College, St. Petersburg Junior College and Northern Virginia Community College are several colleges presently utilizing audio-tutorial instruction in their health education programs. These colleges have received financial support for their programs from the U. S. Department of Health, Education, and Welfare; the U. S. Public Health Service; National Institute of Health; or combinations thereof. (22)

The big "users" of audio-tutorial are the colleges and universities with large undergraduate enrollments, particularly at the freshman level. Several large universities have, in operation, audio-tutorial facilities that will accommodate several thousand students per semester. Probably the largest installation in operation is at Ohio State University at Columbus, Ohio. The new audio-tutorial laboratory, at Ohio State, that was opened in the fall of 1969 is among the most elaborate now in operation. This laboratory houses 194 student L-shaped carrels, with each carrel having interior dimensions of five by seven feet. Each student station is a "mini-lab" containing individual sinks, water, electrical power, and other laboratory essentials necessary for conducting the full-spectrum of biological learning activities on an individualized instructional basis. This new instructional laboratory is a result of previous successes with audio-tutorial instruction at Ohio State and will accommodate over 3,700 students per quarter. (33)

In regards to attitudes of students toward institutions, which can be generalized to classes within institutions, and the influence of those attitudes on achievement Ellish states: (16)

> Speculation has been that there is a positive correlation between such an attitude and a student's performance--that a poor or negative

> attitude may adversely affect a student's academic achievement.

To test whether such speculations were indeed valid Ellish developed two attitude scales utilizing the Thurstone "equal-appearing intervals." The particular attitudes tested were those toward the institutions the students attended. A major conclusion drawn from his study is:

> There is a definite correlation between the attitude a student has toward the educational institution he attends and his academic performance at that institution. If the matching process adequately eliminated other factors which might significantly affect performance, it can then be said the relationship becomes one of 'cause and effect.' Further, it would appear that the more extreme the attitude, the greater its potential effect on achievement. (16)

George (18) investigated conservation attitudes of groups of people at different stages of academic and physical maturity: Group I - high school students, Group II - college students, and Group III - adults. The instrument adopted for his study was built on the Likert-type scale. Characteristics considered included sex, age, place of residence, and extracurricular activities such as: boy scouts, girl scouts, 4-H club, nature photography, and others. Conclusions drawn by George were that attitude toward conservation is influenced by various characteristics and background experience. Generalizations about attitudes and progress toward goals (achievement) can be drawn from his findings.

Inasmuch as this study is an investigation of the particular audio-tutorial program in botany at OSU and the investigator is particularly interested in the junior college movement, general literature review on attitudes has been minimized. Neidt and Dalva (35) state:

> Many recent studies have pointed to the importance of non-intellective factors in learning. The growing concern over understanding these factors is

> associated with the realization that traditional intellective measures have reflected limited efficiency in predicting academic achievement.... Several studies have dealt with the relationship of attitudes toward school or toward a specific subject matter and achievement, and have usually found significant, although small, relationships. It would appear as though attitudes is an important variable in learning, but that no instruments have been developed which adequately measure it in relation to a specific learning experience. If such an instrument or a new approach to the assessment of attitude were developed, the affective dimension might be found to be of particular value in accounting for the error variance now present in the prediction of academic achievement.

The study of the relationship between attitudes and achievement by Neidt and Dalva led them to conclude:

> ...In two of the three situations studied, that attitudes are significantly related to final course grades rather early in the period of instruction, if final course grade variance due to ability is controlled. However, even though the obtained correlations were statistically significant they were of such a small magnitude as to be of little practical value. Even with this limitation, there are interesting possibilities of influencing student achievement through modification of attitude toward a class.

A Glance Toward the Future

In a commentary on a new book by Oettinger and Marks, (17) released in June, 1969, Featherstone quotes the authors as saying that there presently exists two innovative applications of educational technology with bright futures:

> One is a college biology course that makes imaginative use of tapes and schedules--and the energies of the excellent teacher. The other is some fascinating work with computers in math teaching, building geometric models of algebraic equations, projecting possibilities and alternatives in an open-ended way that actively engages the mind of the learner.

An integration of the methods of computer-assisted instruction and audio-tutorial instruction has been suggested recently by several specialists in this area. One authority, John Novak of Cornell University, predicts that within the next five years we are likely to observe a number of hybrid systems utilizing programmed study carrels, equipped with one or more computer stations for several aspects of instruction. (38) The computer used in conjunction with the audio-tutorial model of instruction could serve both instructional and non-instructional functions.

CHAPTER III

METHOD AND DESIGN

Introduction

This study is an attempt to determine the effect that the integrated audio-tutorial method of teaching general botany at Oklahoma State University has upon the attitudes of those students taking the course. Secondly, the manner in which the grades are influenced by these attitudes as a concomitant experience. This chapter will present the procedures for collection and treatment of data.

Setting of the Study

The students participating in this study were enrolled in General Botany 1114 Section I and Section II at Oklahoma State University during the fall semester 1969-1970. Four hours of college credit were earned for the successful completion of the course. This course is designed to meet the needs of pre-professional students, such as medical, dental, or veterinary. Also it fulfills the general education requirements for the baccalaureate for those electing it and general zoology instead of biological sciences.

The course of study is divided into a sequence of units, generally each unit is for one week's work, as follows: (14)

Introduction to Plant Science
Matter and Mechanics of Plant Cells

Plants and Water
The Transformation of Energy
Mineral Nutrition of Plants
Introduction to Plant Structure
Structure of Tracheophytes
Ecology
Plant Growth and Development
Reproduction
The Plant Kingdom

For each unit of study a set of objectives is made available to the students. These objectives serve as a guideline for preparing evaluations of the student's achievement. Appendix A is an example of such objectives.

The organization of the course is essentially the same as that developed by Professor Samuel N. Postlethwait at Purdue University and described in chapter two of this study. First, the general assembly session (GAS) at Oklahoma State University is designed to integrate and orient the subject matter. (14) Included in this session is the lecture, general directions and announcements, movies, and guest lecturers. The GAS meets in two sections, namely, Section I Monday and Wednesday for fifty minute periods each day. Fifty minutes for the GAS period are scheduled on Tuesday and Thursday for Section II. Dr. Carroll is in charge of the GAS and it is in this session that the hour examinations are given.

Secondly, the independent study session (ISS) is arranged by the student to most adequately fulfill his personal study needs and he may alter his schedule as often as necessary. The independent learning center is open about twelve hours daily Monday through Friday. Teaching assistants are available at all times to assist the students with questions and problems that arise. These sessions include tape recorded instructions and directions. It is in the independent

learning center that the students perform experiments, observe demonstrations, and study specimens, charts, slides, and single concept 8 mm single loop films.

Forty individual carrels are utilized to accommodate as many as six hundred students per semester. Six demonstration boothes are used for setting up the demonstrations for each unit of study. Each student is expected to devote about four hours weekly to the ISS. (14)

Finally, the integrated quiz session (IQS) is scheduled weekly for each student where small groups of students meet for thirty minutes. Oral and/or written quizzes that are worth ten (10) points are usually given each week. This period gives considerable time to interaction between the students and their instructor. (14)

All of these are important in the total achievement of the general botany student. To measure this achievement the weekly quizzes can accumulate one hundred thirty (130) points. The hour examinations are objective type questions most frequently being multiple choice with an accumulative value of three hundred ninety (390) points. (14) The semester grades representing the achievement of the students and utilized in this study for analytical purposes were obtained by the composite of the hour examinations and the weekly quizzes.

Implementation of the Study

As indicated above many of these students are pre-professional, as a result a considerable number are science majors. At the beginning of the semester there were 229 students in section I and 215 students in section II. The attrition was relatively small having only four I's and fifteen W's when the final grades were compiled. The population

was further reduced by the use of ACT science scores as a variable in the data analyses. Inasmuch as the pre-questionnaire was administered before the end of the drop and add period for the semester and some students were absent when the questionnaire was administered there was a further reduction in the population. The attendance, thus the response, was considerably less near the end of the semester when the post-questionnaire was given. However, to give greater validity to the study six pre-questionnaires and one hundred nine post-questionnaires containing a cover letter (Appendix D) and a self-addressed stamped envelope were mailed to students who had completed the alternate forms. Finally, there were only two hundred sixty-five complete sets of questionnaires that could be used, as summarized in Table No. IV.

TABLE IV

SUMMARY OF POPULATION IN THIS STUDY

Initial Population	
Section I 229: Section II 215 Total: 444	
Students Removed From Initial Population By	
Incompletes	04
Withdrawals	15
No ACT scores (transfer students)	60
Questionnaires mailed but no response	50
Native OSU students not responding (other than above)	50
Student Population in this study: Males - 194	Females - 71

Two questionnaires were prepared to gather the data for this study. Each questionnaire had a cover sheet explaining the questionnaire and assuring the student that his grade would not be altered by his reaction to the statements. The pre-questionnaire was in two parts, the first asked for autobiographical information that would be used for variables in analyzing the data on the attitude portion of the questionnaires.

The statements of the questionnaires were developed by the investigator utilizing suggestions of senior instructors in the audio-tutorial botany learning center and Dr. Carroll. Having compiled a considerable list of statements for possible usage it was submitted to Dr. Carroll for his approval and modification. After careful scrutiny, statements that would indicate the attitudes of students toward science and audio-tutorial instruction were selected to be used in the study.

The Frye Opinion Questionnaire Number 969 was the pre-questionnaire thus developed which contained six statements that were analyzed in hypothesis IV and ten statements utilized in hypothesis V, see Appendix B.

The post-questionnaire, The Frye Opinion Questionnaire Number 1269, was composed of forty-four opinion statements for analyses and two statements asking the students to make comments about the course, see Appendix C.

Edwards (15) states "The usefulness of psychological tests in education, industry, and research has been amply demonstrated. It has been a similar desire for a quick and convenient measure of attitudes that could be used with large groups that has led to the development of attitude scales. Attitude scales also provide us with one means of

obtaining an assessment of the degree of affect that individuals may associate with some psychological object."

The instruments, indicated above were constructed utilizing a Likert-type scale, which Edwards describes in Techniques of Attitude Scale Construction. (15) The Likert method has been commonly called the method of summated ratings because the attitude of the respondent is measured by a composite of response scores rather than individual statement scores. Two classes of statements were made: favorable and unfavorable. In obtaining responses to the statements the students were instructed to circle the letters SA (strongly agree), A (agree), U (undecided), D (disagree), or SD (strongly disagree) to indicate the amount of agreement or disagreement with each statement. On the pre-questionnaire an additional category of response was made available to the student, namely, NB (no basis for an attitude). (11) NB was treated in the analyses of the data as U since the purpose of the statements was to measure degree of attitude rather than reason for attitude. (8)

The categories of response were weighted so that the response made by individuals with the most favorable attitudes received the highest possible weight. (15, 39) Thus, the "strongly agree" category received four points for the favorable statements and the "strongly disagree" received a zero score. The unfavorable statements were given a zero score for "strongly agree" and a score of four was given for "strongly disagree." A response of "undecided" always received two for its weight while "agree" or "disagree" received one or three depending on whether the statement was favorable or unfavorable. A total score was

obtained for each subject by summing his scores for the individual statements.

To establish validity of the scales a panel of thirteen experts, all members of the Oklahoma State University faculty or staff, were given copies of both instruments. These experts indicated the extent of agreement or disagreement for the statements, made written criticisms, and/or gave a personal interview discussing the statements and the course in botany, see Appendix E.

The reliability coefficient for the scale used in the study was established by administering the post-questionnaire Form 1269 to nineteen undergraduate students enrolled in Biological Sciences 1214-1 at Oklahoma State University during the summer semester of 1970. A re-test was given two weeks later. The respondents were instructed to indicate how they felt about each statement by circling strongly agree, agree, undecided, disagree, or strongly disagree. The reliability coefficient thus obtained by the test re-test method is 0.88 for the overall questionnaire which is significant at the 0.001 probability. The science portion of the questionnaire has a reliability of 0.66 which is significant at 0.01 probability. The audio-tutorial portion of the questionnaire has a reliability coefficient of 0.90 which is significant at a probability of 0.001.

Parametric (19, 37) statistical techniques that were used in this study include the independent t test for hypotheses two, three, five, and six. The correlated t test was used for hypotheses four. In the first hypothesis the analysis of covariance was utilized. Finally, in hypothesis seven the Duncan Multiple Range technique was applied. A summary of the hypotheses is given in Table V.

TABLE V

SUMMARY OF HYPOTHESES USED TO ANALYZE ATTITUDES

Hypothesis Number	Population Size
Hypothesis I	
Achievement correlated with attitude controlled by ACT science scores	265
Hypothesis II	
Males vs. females in their attitudes toward audio-tutorial	71 pairs
Hypothesis III	
Upper classmen vs. lower classmen in their attitude toward audio-tutorial	17 pairs
Hypothesis IV	
Attitudes toward science at start vs. end of course	265
Hypothesis V	
Attitudes of students toward audio-tutorial with previous audio-tutorial experience vs. no previous audio-tutorial experience	53 pairs
Hypothesis VI	
Attitudes of science majors vs. non-science majors toward the audio-tutorial	58 pairs
Hypothesis VII	
Attitudes of students toward IQS vs. ISS and GAS; GAS vs. ISS	265

Summary

This chapter has presented a brief description of the population used in this study. It has included the design of the study and the methods by which the study was implemented. The course, of which the subjects in this study comprise a significant part, has been briefly described. The instrumentation used in the study has been reviewed. Testing the hypotheses of this study utilizes the design presented in this chapter.

CHAPTER IV

PRESENTATION AND ANALYSIS OF THE DATA

Introduction

The purpose of this study was to: 1) determine the relationship between the audio-tutorial method of instruction and the attitudes of students toward science, 2) determine the correlation between the attitudes toward audio-tutorial and achievement, and 3) isolate components of the audio-tutorial program and the degree of favorable attitude toward these. Results of analyses of the objective data utilized in this investigation are presented in this chapter. Subjective data in the form of essay responses to the last two statements (questions) of the post-questionnaire are not analyzed. Conclusions and recommendations based on the results are presented in Chapter V.

In the treatment of the responses obtained, the investigator is always concerned with whether differences are significant. Parametric techniques of hypothesis testing were used in analyzing the raw data because they give the most powerful statistical tests for the data. (19) To test the hypothesis that the groups were comparable the F ratio (37) was employed to check for homogeneity of variances. It was found that all variances were homogeneous at a 0.05 level of probability.

Findings of the Study

One aim of this study was to determine if a change in attitudes toward science developed during the semester while studying general botany utilizing the audio-tutorial approach of instruction. A second objective was to relate the attitudes to the achievement. Subgroups were categorized for investigation and in groups containing less than the total population random samples were selected to accommodate equal size groups. (8)

Test of the Hypotheses of the Study

The hypotheses are listed with related findings of each hypothesis immediately following its listing.

Hypothesis 1. There is no significant difference in achievement between those liking and those disliking the audio-tutorial method of instruction, when previous science knowledge as measured by ACT Science Scores is controlled.

The null hypothesis was rejected at the 0.001 level of statistical significance. In the comparison of those liking and those disliking the audio-tutorial method the population was divided at the median of the summated scores. When considering the adjusted mean achievement scores of the two groups it was found that: 1) those liking the audio-tutorial method had an adjusted mean score of 385.0339, and 2) those disliking the method had an adjusted mean of 352.7310. A study of the data in Table VI shows the results of the analysis of variance statistic testing the relationship between attitudes and achievement. The Pearson product-moment correlation of 0.29970 between the ACT Science

Scores and achievement indicates that a significant positive relationship exists between them.

TABLE VI

ACHIEVEMENT AS INFLUENCED BY ATTITUDE TOWARD THE AUDIO-TUTORIAL METHOD OF INSTRUCTION

Source	DF	Sum-Squares Unadjusted	Sum-Squares (Due to covariable)	Sum-Squares Adjusted	DF	Mean-Square	F Ratio	P
Total	264	1150528.	178918.7500	971609.2500	263			
Treatment (Between)	1	75328	6287.5625	69040.4375	1	69040.4375	20.041	<0.001
Error (Within)	263	1075200.	172631.1875	902568.8125	262	3444.9189		

Hypothesis 2. There is no significant difference in the attitudes (favorable-unfavorable) of males and females toward the audio-tutorial method of instruction.

The independent t statistic of 2.20001 was significant at the 0.05 level of significance. The H_o was rejected because the females do like the audio-tutorial method significantly better than the males. The data for rejecting this hypothesis are given in Table VII.

TABLE VII

THE ATTITUDES OF FEMALES COMPARED WITH THE ATTITUDES OF MALES TOWARD THE AUDIO-TUTORIAL METHOD OF INSTRUCTION

Group	Mean	Standard Deviation	Standard Error of the Mean	Sample Size	T-Statistic	Probability
Female	94.4789	20.1352	2.38960	71	2.20001	<0.05
Male	87.2535	18.9841	2.25299	71		

Hypothesis 3. There is no significant difference in the attitudes of upper and lower classmen toward the audio-tutorial method of instruction.

The independent t statistic of 2.00741 at 32 degrees of freedom was not significant at the 0.05 level of significance which had been established earlier as the level for rejecting the H_o. Inasmuch as there was no significant difference the null hypothesis was accepted. The non-significant difference of attitudes, indicated by the slightly higher mean of the lower classmen, showed a more favorable, but not significant, attitude among freshmen. Table VIII lists the data for this test.

Hypothesis 4. There is no significant difference between the attitudes of students toward science in general at the beginning and at the end of the program.

The H_o was rejected. The t statistic of 10.85777 was significant beyond the 0.001 level of significance. The less favorable attitude existed at the end of the semester. Data for this correlated t test are given in Table IX.

TABLE VIII

T-TEST OF SIGNIFICANT DIFFERENCE IN ATTITUDES TOWARD AUDIO-TUTORIAL INSTRUCTION BETWEEN UPPER AND LOWER CLASSMEN

Group	Mean	Standard Deviation	Standard Error of the Mean	Sample Size	T-Statistic	Probability
Lower Classmen	95.7059	22.4019	5.43327	17	2.00741	$0.05 < p < 0.10$
Upper Classmen	80.9412	20.4405	4.95754	17		

TABLE IX

T-TEST OF SIGNIFICANT DIFFERENCE IN ATTITUDES TOWARD SCIENCE IN GENERAL AT THE BEGINNING AND END OF THE SEMESTER

Group	Mean	Standard Deviation	Standard Error of the Mean	Sample Size	T-Statistic	Probability
Beginning of Program	17.3245	3.33492	0.204863	265	10.85777	<0.001
End of Program	15.4792	3.24046	0.199060	265		

Hypothesis 5. There is no significant difference in the attitudes toward A-T instruction of those students having had previous experience and those with no previous experience in the A-T methodology.

The independent t test statistic of 1.65038 is not significant at the 0.05 level of significance, therefore, the null hypothesis is

accepted. Those having had experience were slightly, but not significantly, more favorable in their attitudes as shown by the means in Table X.

TABLE X

T-TEST OF SIGNIFICANT DIFFERENCE IN ATTITUDES TOWARD AUDIO-TUTORIAL INSTRUCTION OF THOSE HAVING HAD A-T EXPERIENCE AND THOSE WITHOUT SUCH EXPERIENCE

Group	Mean	Standard Deviation	Standard Error of the Mean	Sample Size	T-Statistic	Probability
Previous A-T Experience	25.2453	3.67374	0.504627	53	1.65038	<0.05
No A-T Experience	24.0943	3.50420	0.481339	53		

Hypothesis 6. There is no significant difference in the attitudes toward the audio-tutorial method of instruction between the science and non-science majors.

This hypothesis was accepted at the 0.05 level of significance. A study of the data in Table XI shows a close relationship of attitudes of science majors and non-science majors toward the audio-tutorial method.

Hypothesis 7. There is no significant difference in students' attitudes toward the IQS, ISS, and GAS. The Duncan multiple-range statistic revealed significant differences at the 0.05 level of

significance, accordingly, the null hypothesis was rejected. Table XII summarizes the data of this test. A significantly more favorable attitude existed toward the IQS than toward either ISS or GAS. The attitudes toward ISS were significantly more favorable than toward the GAS. GAS received the least degree of favorable response as compared to the sessions having greater individual responsibility and interaction with the instructors.

TABLE XI

T-TEST OF SIGNIFICANT DIFFERENCES IN ATTITUDES OF SCIENCE MAJORS COMPARED WITH NON-SCIENCE MAJORS WITH REGARDS TO THE AUDIO-TUTORIAL METHODOLOGY

Group	Mean	Standard Deviation	Standard Error of the Mean	Sample Size	T-Statistic	Probability
Non-Science Major	86.4655	20.0370	2.63099	58	0.80487	<0.05
Science Major	89.6724	22.7876	2.99216	58		

TABLE XII

DUNCAN MULTIPLE RANGE TEST OF SIGNIFICANT DIFFERENCE IN ATTITUDES TOWARD THE IQS, ISS, AND GAS COMPONENTS OF THE AUDIO-TUTORIAL COURSE

Group	Within Sum Squares	Standard Error of Means	Critical Ranges	Difference in Means	Probability
IQS	252.25	0.044	R_2 0.102	1.47	<0.05
ISS	183.40			0.64	<0.05
GAS	54.91		R_3 0.108	0.83	<0.05

Retest of Hypotheses II, III, V, and VI

In the analyses described above the t test statistics were obtained using equal size groups. (8, 31) To incorporate the total data available, thus giving greater creditability to the findings, in this study additional t tests were run using the entire population for hypotheses II, III, V, and VI. (37) The results were as follows: Hypothesis II. Comparing males (194) with females (71) in their attitudes toward the audio-tutorial method of instruction found a significant difference at the 0.05 level of significance. Females had the most favorable attitude. Hypothesis III. Comparing upper (17) and lower (in this case including all freshmen and sophomores of whom there were 248) classmen with regards to their attitudes toward the audio-tutorial method there was no significant difference. Hypothesis V. The t test here revealed no significant difference between those having previous experience (53)

and those without previous experience (212). Finally, Hypothesis VI was accepted at the 0.05 level of significance because the science majors (58) and the non-science majors (207) were not significantly different in their attitudes toward the audio-tutorial method.

Tests for homogeneity of variances were made to determine if the groups were comparable. The results were: hypothesis 2 had a F ratio of 1.0248, hypothesis 3 had a F ratio of 1.0259, hypothesis 5 had a F ratio of 1.1608, and in hypothesis 6 the F ratio was 1.3614. Therefore, no significant difference was found in any of the F ratios for homogeneity of variances at the 0.05 level of significance.

It appears that the tests are equally valid whether using small sized equal groups or the entire population with unequal sized groups.

Summary

Chapter IV has presented a detailed analysis of the data pertaining to this study. The findings were applied to determine the creditability of the stated hypotheses in the study.

An analysis of covariance was used to determine the influence attitudes had upon achievement when achievement was correlated with the ACT Science Scores. The t-tests were used to determine the attitudinal change during the semester and the attitudes of the diverse categories of students as listed in the particular hypotheses. Finally, the Duncan Multiple Range was utilized to check the relationship of IQS, ISS, and GAS as perceived by student attitudes.

The predetermined level of significance was the criterion for accepting or rejecting the null hypotheses. The hypotheses regarding achievement; males and females; at the beginning and end of the semester;

and IQS, ISS, and GAS (numbers 1, 2, 4, and 7, respectively) were rejected. Hypotheses with reference to upper and lower classmen; previous or without previous audio-tutorial experience; and science majors and non-science majors, numbers 3, 5, and 6, respectively, were accepted as being tenable.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to determine the instructional capabilities of the audio-tutorial instruction method as revealed by the attitudes of the students in a general botany course. The concomitant influence such attitudes had upon the achievement of the general botany students. The feasibility of this study was envisioned by the investigator and confirmed by his committee and the professor of general botany.

A summary of the hypotheses indicates a very strong positive relationship between attitudes and achievement. Achievement was accepted by the investigator as that indicated by the professor and instructors through the accumulated points of hour examinations and weekly quizzes for each student. There were no significant differences between the attitudes of: 1) upper and lower classmen, 2) science and non-science majors, and 3) those having previous audio-tutorial experience and those without such experience. Significant differences were strongly indicated in the attitudes: 1) toward the various components of the audio-tutorial program, namely, IQS, ISS, and GAS, 2) between male and female students, and 3) at the beginning and end of the semester.

Conclusions

Certain inferences and conclusions, subject to the limitations of this study, can be drawn. Certainly, a permeating thread throughout these conclusions is that a pilot study preceding this study would have contributed enormously to the researchers ability, greater refinement of the instruments, and better administration and coordination of the questionnaires.

1. The correlation of achievement of those liking and those disliking the audio-tutorial method is very significant. It is not known if the sex of the individual had any implication but it is at least inferential because girls do like the audio-tutorial method better and they achieve significantly better than the boys. (3)

   Males who are generally more confident and relaxed than females in performing scientific experiments felt less challenged by the audio-tutorial method, thus were less favorable in their attitudes. Conversely, that females felt more secure with greater programming of the details to guide them through the course of study. Possibly, the fact that all IQS instructors were males could have adversely influenced male quiz scores as compared to female quiz scores.

2. The significant differences in attitudes that developed during the semester under consideration were in the negative direction as revealed by hypothesis number

four and its test which is summarized in Table VIII. It is not known if maturation and extraneous factors were involved in this psychological process. It would appear that influences within the program had a great impact upon lessening the enthusiasm of students to delve further into scientific endeavor. Supporting this conclusion is the fact that only eighteen baccalaureates were conferred in Botany and Plant Pathology at Oklahoma State University from May, 1960, to May, 1970, inclusive. During the same period thirty-six masters and twenty-six doctors received their degrees at Oklahoma State University in Botany and Plant Pathology. (13)

3. The "do not fold, bend, spindle, or mutilate" reaction of students appears to be smoldering beneath the surface in general botany. This conclusion is drawn from the fact that the most favorable attitudes are expressed toward the small group sessions where greater rapport is established between instructor and the individual student. The large general assembly session is relatively highly unfavorable in the response of many students and shown to be significantly so in hypothesis seven.
4. Inasmuch as this study is an exploratory study and there was no control group with which to compare results it can reasonably be concluded that only a limited degree of generalization can be made.

5. In attempts to evaluate this program or the projection of new A-T programs it would appear that no problems should be anticipated when considering science vs. non-science majors, classification of students, or whether or not the students have had previous audio-tutorial experience.

These conclusions were drawn strictly from the objectively scored opinion statements. However, a random sample of a few brief quotes from students does appear to lend creditability to the conclusions and the recommendations that are given in the next section of this chapter.

This study and its significance are accentuated by a few quotations from students completing the Form 1269 questionnaire. There were two essay questions at the end of the questionnaire. Students were asked to give a brief critique of the course using the two questions as guidelines for their comments.

The first question is given with some quotes immediately following. "What do you regard as the strong features in the course as it is presently organized?"

1. I feel that the strong features of this course were the oral quizzes every week and the audio-tutorial tapes.

2. The oral quiz session is one of the strong points....The pressure is lessened because you are not obligated to answer every question as on a written quiz, yet you have opportunity to show your knowledge.

3. The quiz sessions which motivate the student to learn, week by week, rather than "cramming" all the night before. The tapes which adjust to the individuals' own speed of learning.

4. Freedom of speed of learning.

5. I like the material covered.

6. The communication between quiz session, instructors and students. The opportunity to be exposed to the subject matter for as long as it takes to learn it. The grouping of subject matter for the different tapes i.e., one subject (usually) per tape. Listening to tapes at the student's own convenience.

7. I feel that the lab manual and the quiz sections are the outstanding features of the course. The lecture session and the book had no value for me.

8. The tapes were good, they were even interesting to me at times, and my lab instructor was excellent. A student who wanted to could easily "live" your course.

9. The tape is used so the teacher can sluff off work. Any teacher who thinks that the lecture is out dated is not oriented for college student. The comments were not made out of anger. I am a B+ student. I have done well in the course by reading the text book. I gave up going to the tapes and my grade improved on the quiz score. As to the lecture they aren't relevant to the learning of Botany.

10. The graduate students do a real <u>good</u> job by answering the many questions the students have.

11. The taped lectures are good, as are the demonstrations, but more emphasis needs to be placed on tying together all the facets of Botany which we learn, giving us a better understanding and conception of the whole picture.

The second question asked for recommendations, thusly, "If you were to improve the entire course, what changes would you make?" The responses to this question may or may not be by the same students quoted above, the numbers do not relate to particular students.

1. The oral session should be longer and the lecture session should be eliminated or made interesting enough that more than 1/3 show up.

2. Not make the lecture so repetitious, rather-- (a) have lecture present generalized topic outline, to give student some basis for organization. (b) more questions and answers to clarify difficult or obscure ideas presented on tape.

3. I would teach in the old (conventional) manner. It stimulates the mind more and can be made more interesting than the wiredo on the tapes.

4. Don't have the lecture sessions and extend the quiz section to be one hour long; the first half-hour could be the quiz and the second half-hour could be discussion and explanation.

5. The changes I would make in this course are as follows: do away entirely with the professor's lectures, some how make the experiments more interesting by having to write up lab reports on the experiments.

6. Make lecture into a discussion session with Dr. Carroll over the unit being studied.

7. Some changes to be made might include lecture-class for only one hour a week. Two discussion sessions a week might be more beneficial. One at the first of the week for explanation and the second one for a short written test.

8. I should hope in the future that the lectures be more closely related to the lab. It seemed as if there were no common feature between the two sections of the course (lab and lecture). I realize that Dr. Carroll was in the process of changing the whole format. Hopefully, it will not be as incongruous the coming semesters.

9. The lecture could be revised to teach Botany, not some teacher's theory of life. However, they contain food for thought and do sometimes stimulate a student to think of the surroundings. Dr. Carroll should teach Botany and hold seminars on his views to pollution and food problem. They are enlightening but I don't like to spend my money for Botany and get these lectures.

10. Either: (a) drop the lecture session, (b) change instructors, (c) actually prepare an interesting lecture that is relevant to what we are studying.

11. Convert the conventional lecture sessions into lecture sessions featuring a different speaker each time. The speaker's topics might range from pollution to growth just as they do now, but each speaker would speak on his field; his subject would be scheduled at a time so as to coincide with the tape's subject.

Recommendations

The findings and conclusions of this study suggest several areas of research and innovation.

1. This study should be replicated over a longer period of time.
2. Certain characteristics in students should be identified, and having so done, random samples should be drawn to set up a new study that would include an experimental group and a control group.
3. Studies should be initiated to determine the long-term attitude effects of audio-tutorial instruction.
4. Studies should be initiated to explore instructor attitudes as they relate to audio-tutorial instruction and student attitudinal development.
5. Studies that would investigate the impact of maturation on the attitudes of students toward audio-tutorial science should be initiated.
6. The economic aspects of audio-tutorial instruction should be investigated relative to cost per pupil related to attitudinal change and per achievement gain.
7. Implications of the audio-tutorial method in conjunction with independent study programs in other disciplines should be explored.

8. The development of "Micro Courses" so that students could move more freely in the study of botany to fulfill more adequately the individual needs and interests they have should be explored.
9. Development of a standardized instrument for further attitudinal studies in the area of audio-tutorial instruction in botany and other life sciences.
10. A follow-up study of this same population to determine if a lapse in time (36) after the audio-tutorial experience or if the administration of this study had any influence on the student attitudes.
11. The implication of attitudes and achievements of girls being significantly better than boys suggest this recommendation. An investigation comparing the amount of time spent in the ISS by the opposite sexes and further that consideration be given to attendance in the GAS and IQS.
12. The comments of students, comments of some faculty members, (12), the small number of baccalaureates conferred in botany in recent years, and program revisions by Postlethwait at Purdue all point to the feasibility of developing a program that would more directly involve the entire Botany and Plant Pathology professional staff in the Audio-Tutorial General Botany Class.
13. Students in audio-tutorial botany should be investigated in regards to their attainment of higher cognitive powers, the understanding of scientists and the scientific processes, and the transfer of learning as corollaries to achievement:

achievement too frequently is categorized simply as the end product of subjective and objective knowledge tests.

14. Finally, if additional research is initiated as a consequence of this study the investigator will consider this study to have been successful and worthwhile to some degree.

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APPENDIX A

SAMPLES OF OBJECTIVES GIVEN TO STUDENTS FOR EACH UNIT OF WORK

Behavorial Objectives
for
Matter and Mechanics of Cells

Name_____

Theory Sec._____ Quiz Sec._____

The student should be able to:

1. Identify and name the ocular and objective lens system of the microscope and know the magnification of an object that can be achieved.

2. Distinguish between the coarse adjustment and fine adjustment of a microscope and explain under what conditions which one is used.

3. Identify and name the various components of a typical plant cell.

4. Describe the function of the following components of a typical plant cell.

   (A) mitochondrion
   (B) membranes
   (C) ribosome
   (D) dictyosome
   (E) endoplasmic reticulum
   (F) nucleolus
   (G) chromatin
   (H) chloroplast
   (I) amyloplast
   (J) nucleus
   (K) vacuole
   (L) plasmodesmata

5. Describe the mechanism of the following phenomena which occur within and outside a living plant cell.

   (A) diffusion
   (B) osmosis
   (C) plasmolysis
   (D) imbibition

6. Identify a colloid and micelle and be able to describe how they function in water adsorption, as in germination of seeds and swelling of wood.

7. Describe how a differentially permeable membrane functions in a living plant cell.

8. Describe the effect on a plant if a heavy concentration of salt or fertilizer is applied to the soil around the plant.

Objectives

Botany 1114

Transformation of Energy
(Photosynthesis)

The major objective for this week's work is to investigate the nature of the most important process on earth, the conversion of light energy from the sun into chemical energy of food. The light energy trapped by the chlorophyll molecule is transported by an electron transport system until this energy is ultimately incorporated into chemical bonds of a sugar molecule.

This unit is designed to acquaint the student with various plant pigments, their separation and identification, and the energy wave lengths involved in photosynthesis. The student will also conduct experiments and observe demonstrations showing the necessity of carbon dioxide, light, and chlorophyll for photosynthesis.

Specific objectives.

1. Discuss "transformation of energy;" how is light energy converted into chemical energy.
2. What wave lengths of light are primarily involved in the photosynthetic process? Why is chlorophyll green?
3. Be able to discuss fluorescence, cyclic electron transfer and non-cyclic electron transfer.
4. Discuss the role of chlorophyll, CO_2, ATP, ADP, NADP, $NADPH_2$, RDP, and water in the photosynthetic process.
5. Be able to discuss the function of pigments, in what part of the cell each pigment is found, how to extract pigments from the leaves, and how they may be separated and identified.
6. Discuss the question "Is light needed for photosynthesis?" What is the effect of light intensity on the rate of photosynthesis?
7. Discuss the events which occur during the CO_2 fixation phase of photosynthesis.
8. Observe and discuss the demonstration material which shows CO_2 and Chlorophyll are necessary for photosynthesis.

APPENDIX B

THE FRYE OPINION QUESTIONNAIRE NUMBER 969

Your Name _____
Code Number _____
Lecture Section No. ____ or hour ____

Opinion Questionnaire
Education 6000 Research
By: Benjamin M. Frye 9/69
For Special Study

Attitude Toward Science and
The Audio-Tutorial Method of Teaching Science

We are concerned with your opinions regarding Audio-Tutorial Botany. If this questionnaire is to be of any value, your responses must be honest. This is not a test and you will not be graded. There are two parts in this questionnaire. First a section asking for facts concerning your background and experience. Secondly, a section asking for your opinions concerning science and science instruction.

We can assure you that all the information which you give us will be kept strictly confidential. It will not be graded in any way. In fact, this cover sheet, with your name on it, will be given a code number by Mr. Frye then he will remove it from the questionnaire. The information on the questionnaire, if and when available to Dr. Carroll and/or laboratory instructors, will not have your name. It will in no way influence your grade.

All the questions differ and it is not necessary that you be consistent from question to question. Rather, it is desirable that you answer each question according to how you feel about it, unaffected by previous answers you have given.

Please read both the questions and the directions very carefully.

Thank you very much for your contribution.

PART I.

In this section please check the correct blank or enter the correct number or word. The correct answer is your own experience.

1. What is your sex? ____Male ____Female

2. What is your age?
____17 or younger ____22
____18 ____23
____19 ____24
____20 ____25 & over
____21

3. What is your marital status?
____Single ____Separated
____Married ____Widow
____Divorced ____Widower

4. Place of residence, check one
____I live at home and commute.
____I live in a fraternity home.
____I live in a sorority home.
____I live in a dormitory.

5. In High School I had the following science courses.
____Biology I ____BSCS Biology
____Biology II ____Chemistry
____Other (list_____) ____Physics

6. I have had the following science courses in college.
____General Zoology
____Bio. Sci. (one semester)
____Bio. Sci. (two semesters)
____Gen. Chem. (one semester)
____Gen. Chem. (two semesters)
____Organic Chemistry
____Physics (one semester)
____Physics (two semesters)
____Other (name_____)

7. What is your academic classification?
____Freshman ____Senior
____Sophomore ____Graduate
____Junior ____Special
____Other (list_____)

8. My major field of study is or probably will be:
____Zoology ____History
____Botany ____English
____Business ____Home Ec.
____Premedical or Preveterinarian
____Other (list_____)

9. What is your religious preference?
____Baptist (Southern)
____Church of Christ
____Methodist
____Presbyterian (except Cumberland Presbyterian)
____Jewish
____No preference
____Any of these: Church of God, Nazarene, Holiness, Cumberland Presbyterian
____Other Protestant (list_____)
____Catholic
____It is none of these: It is_____)

10. Disregarding the problem of possible conflicts with other class schedules I would prefer working in the learning center during the: (check one)
____Morning
____Afternoon
____Evening

11. I consider myself to be (check one)
____An average Learner
____A rapid Learner
____A slow Learner

12. ____Number of semesters attended OSU before this semester.

13. YES NO
___ ___ General Botany is the first course I have had in which the audio-tutorial approach was used.

PART II

In this section I have prepared several statements to which there are no right or wrong answers. The only answer is your own feelings or your own opinion. Do not respond as you think you should but, instead, according to how you feel personally. Some of you will have had no previous experience that would cause you to have an opinion for some statements. In such cases please circle NB which means No Basis for an opinion. For each of the following statements, circle the letter or letters which most closely represent your idea concerning that statement.

SA-Strongly Agree; A-Agree; U-Undecided; D-Disagree; SD-Strongly Disagree; NB-No basis for an answer

SA A U D SD NB The grades should be determined by the amount of work done in the learning center rather than by hour examinations.

SA A U D SD NB Only the best students should expect to use the text.

SA A U D SD NB I could learn the most and earn the best grade if I were completely on my own to study the necessary topics when and as I chose then reporting to the office for a comprehensive test when I felt competent.

SA A U D SD NB Individual responsibility for learning is keenly felt by the student.

SA A U D SD NB The sense of greater personal independence and equality is enjoyed by the student in audio-tutorial method.

SA A U D SD NB The problem of "individual differences" among students is solved by the audio-tutorial method.

SA A U D SD NB Students should be allowed to record on their own recorders the taped material for home study.

SA A U D SD NB The textbook is necessary for General Botany.

SA A U D SD NB Those that attend lectures regularly should be rewarded by higher grades.

SA A U D SD NB A question file should be in the learning center of adjoining room for students to use in their studies as a means of self-testing.

SA A U D SD NB I would never pursue the study of science independently.

SA A U D SD NB I have always had a dislike for all science.

SA A U D SD NB The study of science bores me.

SA A U D SD NB I have always been curious about living things.

SA A U D SD NB A student should be permitted complete freedom in choosing the courses he shall take.

SA A U D SD NB I have always been afraid I could not succeed in a science class.

APPENDIX C

THE FRYE OPINION QUESTIONNAIRE NUMBER 1269

Your Name _____
Code Number _____
Lecture Section No. _____

Opinion Questionnaire
Education 6000 Research
By: Benjamin M. Frye 12/69
For Special Study

Attitude Toward Science and
The Audio-Tutorial Method of Teaching Science

We are concerned with your opinions regarding Audio-Tutorial Botany. If this questionnaire is to be of any value, your responses must be honest. This is not a test and you will not be graded. This questionnaire contains several statements to which there are no right or wrong answers. The only answer is your own feelings or your own opinion. Do not respond as you think you should but, instead, according to how you feel personally.

We can assure you that all the information which you give us will be kept strictly confidential. It will not be graded in any way. In fact, this cover sheet, with your name on it, will be given a code number by Mr. Frye then he will remove it from the questionnaire. The information on the questionnaire, if and when available to Dr. Carroll and/or laboratory instructors, will not have your name. It will in no way influence your grade.

All the questions differ and it is not necessary that you be consistent from question to question. Rather, it is desirable that you answer each question according to how you feel about it, unaffected by previous answers you have given.

Please read both the questions and the directions very carefully.

Thank you very much for your contribution.

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

For each of the following statements, circle the letter or letters which most closely represent your idea concerning that statement.

SA A U D SD A question file should be in the learning center or adjoining room for students to use in their studies as a means of self-testing.

SA A U D SD I have always been curious about living things.

SA A U D SD The textbook is necessary for General Botany.

SA A U D SD I would never pursue the study of science independently.

SA A U D SD I could learn the most and earn the best grade if I were completely on my own to study the necessary topics when and as I chose then reporting to the office for a comprehensive test when I felt competent.

SA A U D SD A student should be permitted complete freedom in choosing the courses he shall take.

SA A U D SD The grades should be determined by the amount of work done in the learning center rather than by hour examinations.

SA A U D SD Only the best students should expect to use the text.

SA A U D SD Individual responsibility for learning is keenly felt by the student.

SA A U D SD The sense of greater personal independence and equality is enjoyed by the student experiencing the audio-tutorial method of instruction.

SA A U D SD The problem of "individual differences" among students is solved by the audio-tutorial method.

SA A U D SD Students should be allowed to record on their own recorders the taped material for home study.

SA A U D SD I have always had a dislike for all science.

SA A U D SD I have always been afraid I could not succeed in a science class.

SA A U D SD Since taking Audio-Tutorial botany I like science.

SA A U D SD The Audio-Tutorial method produces a better student to teacher relationship.

SA A U D SD This method does not allow adequate development of students' own opinions.

SA A U D SD This class has been extremely stimulating to the intellect.

SA A U D SD Laboratory instructors seem too busy with their own work and socializing to help students in the laboratory.

SA A U D SD Boredom is eliminated by the Audio-Tutorial method of instruction.

SA A U D SD This course in General Botany will bring great benefit to me in later life.

SA A U D SD Laboratory instructors should regularly stop by each carrel (booth) and ask if the student has any question or problem.

SA A U D SD The Audio-Tutorial method provides a better learning situation for students than the conventional lecture-laboratory-discussion method.

SA A U D SD If I had a choice between the Audio-Tutorial method and the conventional lecture-laboratory-discussion method of teaching I would choose the latter.

SA A U D SD Students should be assigned definite hours rather than choosing their own time to work in the learning center.

SA A U D SD Audio-Tutorial instruction is especially good for the fast learner.

SA A U D SD The lecture is necessary for this course.

SA A U D SD Those who attend lectures regularly should be rewarded by increased grades.

SA A U D SD Audio-Tutorial instruction is especially good for the slow learner.

SA A U D SD I would prefer checking out a copy of the script to my carrel (booth) rather than listening to the tape.

SA A U D SD Everyone should be required a minimum number of hours in the learning center.

SA A U D SD Audio-Tutorial instruction is better for the average learner than the conventional lecture-laboratory-discussion method of instruction.

SA A U D SD There should be no lecture section with Audio-Tutorial classes.

SA A U D SD I have suggested or will suggest to several of my friends that they should take General Botany 1114.

SA A U D SD Many college courses should be taught by the Audio-Tutorial method.

SA A U D SD Of all the methods of teaching I feel the Audio-Tutorial method is the best.

SA A U D SD Audio-Tutorial classes should be offered to upper-classmen (Juniors, seniors, and graduates) but not to freshmen and sophomores.

SA A U D SD My general opinion of the educational value of this course is very good.

SA A U D SD Listening to the tapes and doing other work in the learning center was more effective than the conventional lecture-laboratory-discussion method.

SA A U D SD The oral quiz sessions contributed significantly to better learning.

SA A U D SD I would be delighted to take another course presented in the Audio-Tutorial method.

SA A U D SD I would prefer this course were taught in the traditional (conventional) manner.

SA A U D SD Upon completing the General Botany course taught by the Audio-Tutorial I feel my understanding of the subject is much improved.

SA A U D SD This course in General Botany has been of <u>great</u> <u>benefit</u> to me <u>immediately</u>.

With complete awareness that nothing in this questionnaire can in any way influence your grade please comment on the following questions. Use the back of the page for comments.

What do you regard as the strong features in the course as it is presently organized:

If you were to improve the entire course, what changes would you make?

APPENDIX D

COVER LETTER MAILED WITH QUESTIONNAIRES SENT TO STUDENTS WHO FAILED TO RESPOND IN THE LEARNING CENTER

Biological Science
Room 211
Life Science West
January 24, 1970

Dear William,

I am sure there are many experiences you have had in college and Stillwater this past semester which will have considerable meaning to you in the immediate future and throughout life.

Of particular interest to me and I hope of great benefit to you was your audio-tutorial botany class. Perhaps there were some things you thought should be changed and it is because I want to help in any improvements necessary that I write to you.

I am sure you were aware that questionnaires were distributed to students in your class. Due to reasons beyond my knowledge or control I did not receive a completed questionnaire from you. To contribute the greatest benefits to my study and recommended revisions in Botany 1114 it is very important that I have your opinions of the items listed in the questionnaire. Therefore, would you kindly take a few minutes to read each item carefully and answer each one as you <u>feel</u> personally about it <u>not</u> as you feel it should be answered.

Enclosed with the questionnaire is a self addressed stamped envelope in which you can return the questionnaire to me.

Thank you very much for your assistance and cooperation.

Sincerely,

Benjamin M. Frye

APPENDIX E

SUMMARY OF THE RESULTS OF THE PANEL OF EXPERTS ON QUESTIONNAIRE VALIDITY

Determining the validity of the instruments used in this study was difficult for a number of reasons. One, perhaps the most significant, reason was the limitations imposed upon the investigator by the lack of a behavioral science background. Secondly, the diversity of faculty and staff attitudes toward the instructional methodology. Thirdly, the limitations inherent in the course and its innovative structure. With the astounding absence of data and the limited research in the field of audio-tutorial instruction the investigator was very conscious of the exploratory nature of his investigation. Finally, the last difficulty to be mentioned is: the necessity of correlating the study as fully as possible with the directives and desires of the professor in charge of the class.

A summary of the results of the experts' responses to the statements follows, however, the investigator accepts responsibility for this study including the validity of the statements. Two of the panel responded only by written and oral comments. One other respondent failed to give responses on the pre-questionnaire.

SUMMARY OF VALIDATION OF QUESTIONNAIRES

	Faculty and Staff Opposing the Audio-Tutorial Method			Faculty and Staff Favoring the Audio-Tutorial Method		
	Post-Questionnaire					
Responses	Agree	Undecided	Disagree	Agree	Undecided	Disagree
1.	2	0	1	6	1	1
2.	3	0	0	5	3	0
3.	2	1	0	3	2	3
4.	0	1	2	0	3	5
5.	1	0	2	3	4	1
6.	0	0	3	2	3	3
7.	1	0	2	1	2	5
8.	0	1	2	1	0	7
9.	1	0	2	5	1	2
10.	1	1	1	7	1	0
11.	1	0	2	5	1	2
12.	2	0	1	7	0	1
13.	0	0	3	0	3	5
14.	0	0	3	0	3	5
15.	1	2	0	3	5	0
16.	1	0	2	3	5	0
17.	1	0	2	1	3	4
18.	1	0	2	5	3	0
19.	1	0	2	1	4	3
20.	1	0	2	3	3	2
21.	2	0	1	5	3	0
22.	1	1	1	4	2	2
23.	1	0	2	6	2	0
24.	2	0	1	1	2	5
25.	1	0	2	0	1	7
26.	1	0	2	5	2	1
27.	1	0	2	1	2	5
28.	0	0	3	2	1	5
29.	2	0	1	5	3	0
30.	1	0	2	2	3	3
31.	1	0	2	1	1	6
32.	1	0	2	5	3	0
33.	0	0	3	1	3	4
34.	2	0	1	4	4	0
35.	1	0	2	5	3	0
36.	0	0	3	4	4	0
37.	0	0	3	0	5	3
38.	1	1	1	5	3	0
39.	1	1	1	5	3	0
40.	3	0	0	5	3	0
41.	1	0	2	5	3	0
42.	1	1	1	1	2	5
43.	1	1	1	4	4	0
44.	1	1	1	4	4	0

SUMMARY OF VALIDATION OF QUESTIONNAIRES

	Faculty and Staff Opposing the Audio-Tutorial Method			Faculty and Staff Favoring the Audio-Tutorial Method		
Pre-Questionnaire						
Responses	Agree	Undecided	Disagree	Agree	Undecided	Disagree
1.	0	1	2	2	0	5
2.	0	1	2	2	0	5
3.	2	0	1	3	3	1
4.	2	0	1	4	1	2
5.	1	1	1	6	1	0
6.	1	0	2	5	0	2
7.	2	0	1	7	0	0
8.	2	0	1	5	1	1
9.	0	0	3	2	0	5
10.	2	0	1	6	0	1
11.	0	1	2	0	2	5
12.	0	0	3	0	3	4
13.	0	0	3	0	3	4
14.	3	0	0	5	2	0
15.	0	0	3	3	3	1
16.	0	0	3	0	3	4

VITA

Benjamin Moss Frye

Candidate for the Degree of

Doctor of Education

Thesis: ATTITUDE TOWARD SCIENCE AND THE AUDIO-TUTORIAL METHOD OF TEACHING GENERAL BOTANY AT OKLAHOMA STATE UNIVERSITY

Major Field: Higher Education

Biographical:

Personal Data: Born in Spencer County, Kentucky, December 1, 1925, the son of Jesse M. and Celia M. Frye.

Education: Graduated from Spencer County Elementary Schools in May, 1939; received a two-year diploma from Peniel Bible Institute in 1944; received a three-year diploma from Peniel Bible Institute in 1947 with a major in Religious Education; attended Lee's Junior College in 1958; received the Baccalaureate of Arts degree from Morehead State College, Morehead, Kentucky, in 1964, with majors in History and English; received the Master of Science degree at Oklahoma State University in May, 1968, as a National Science Foundation Academic Year Institute participant with a major in Natural Science; completed requirements for the Doctor of Education degree at Oklahoma State University in May, 1971.

Professional Experience: Teacher in primary grades, Riverside Christian Training School, 1958-59; teacher in one room school, Wolfe County Schools, 1959-60; teacher in primary grades, Riverside Christian Training School, 1961-63; teacher in intermediate grades, Riverside Christian Training School, 1963-64; teacher in high school, Riverside Christian Training School, 1964-67; graduate teaching assistant in the Audio-Tutorial Botany Learning Center, Oklahoma State University, 1968-69; Instructor, part-time, in Biological Sciences, Oklahoma State University, 1969-70.