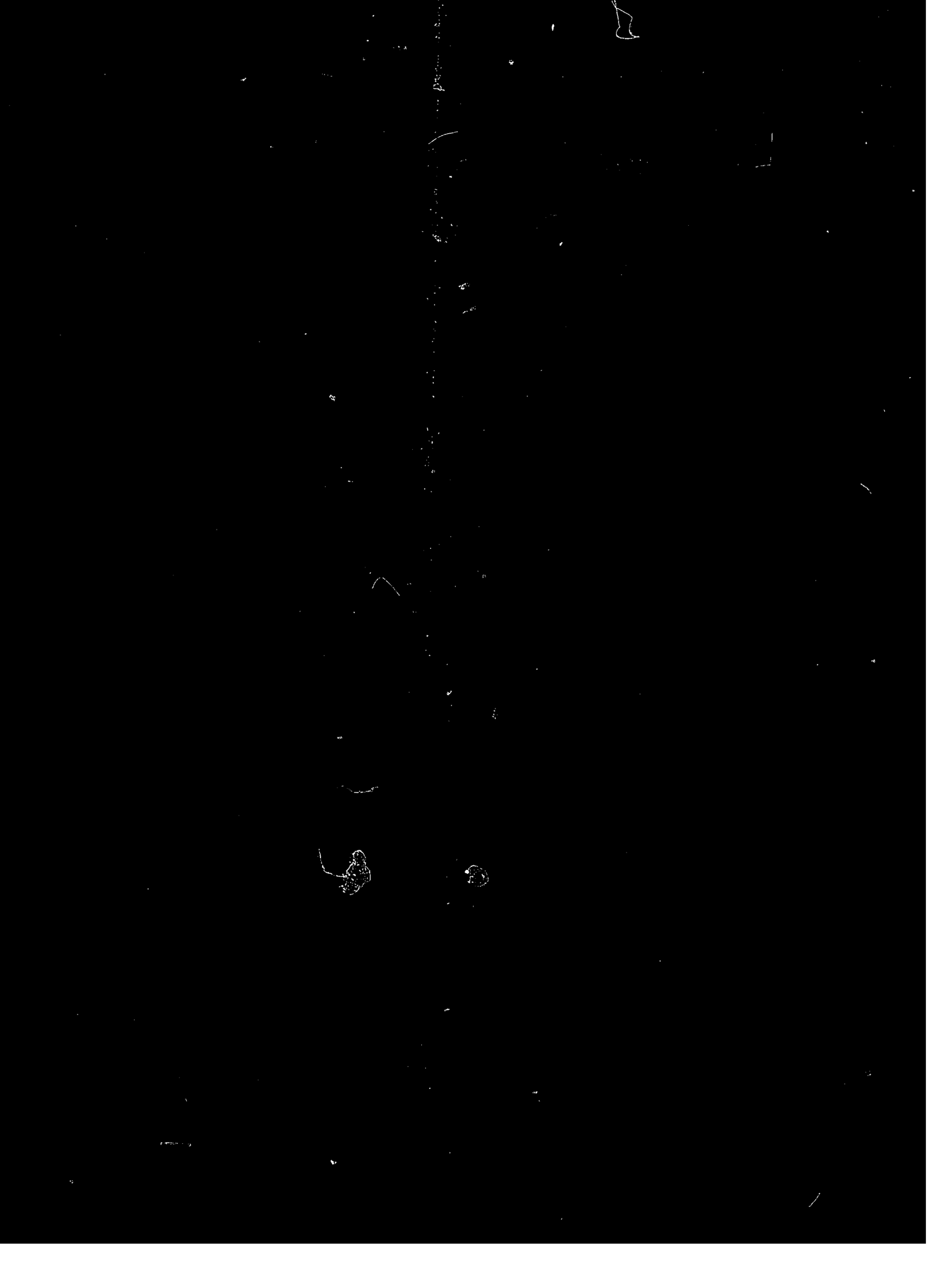

THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

A STUDY OF THE COMPARATIVE EFFECTIVENESS OF THREE METHODS OF TEACHING THE OPERATION OF SELECTED AUDIO VISUAL EQUIPMENT

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APPROVED BY

DISSERTATION COMMITTEE

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CHAPTER I

THE PROBLEM

Introduction

Today, as never before, there are many changes taking place in our schools across the nation. These changes are being made in an attempt to keep pace with pressing requirements of national defense, growing mobility of society, and increasing automation of the economy.

The magnitude of these changes was indicated by Stufflebeam who said, "The severe pressures for change and the many resources to reduce them have resulted in a climate that has already stimulated the production of new educational programs. Modern technology has been harnessed to education through the use of computers, television, teaching machines, and mechanized reading laboratories."[1]

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[1]Daniel L. Stufflebeam, "Educational Changes in Ohio Public Schools," Catalog of the Ohio State University (1966), p. 2.

The importance of these new media in the educational endeavor has been emphasized by Finn[2] who states that "the first function of technological media is to supplement classroom teaching through enhancing the teacher's effectiveness. Educational media are both tools for teaching and avenues for learning; their function is to serve these two processes by increasing clarity in communication, diversity in method, and forcefulness in appeal. Except for the teacher, these new media will determine, more than anything else, the quality of today's educational effort."

Educators face the problem of adapting instruction to individual needs and to local situations. The use of communications media increases the possibility of providing solutions to such instructional problems. These new media challenge the teacher to be creative and to exercise more fully those professional functions for which he has been prepared. It follows, then, that the successful teacher must be aware of the impact technology is having on education and must also have competency in the selection, utilization, and application of new media to teaching. The achievement of such competency is the joint responsibility of the individual teacher and those responsible for his

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[2]James D. Finn and J. V. Edling, The New Machine in Education (Sacramento: Sacramento State College, April, 1960), pp. 54-55.

professional preparation. Ideally, each pre-service teacher would have his own instructor on a one-to-one basis, adequate laboratory space, and a full array of teaching equipment. With the present program of mass education, it is immediately obvious that this one-to-one, student-instructor relationship is not at all feasible.

Today's classroom teacher should have a working knowledge of the basic operation of audio visual equipment. If he is a competent operator who has thoroughly mastered the handling of audio visual devices, he should be able to discover and develop specific applications of media for his own teaching-learning situation.[3]

Many teacher training institutions have initiated programs setting forth the uses and possibilities of audio visual materials and providing guidance in selecting and obtaining related equipment and operating it effectively and to good purpose. These more complete courses are usually elective, not part of the teacher preparation program.

The College of Education of the University of Oklahoma requires all pre-service teachers to be proficient in the operation of selected audio visual equipment. There has been a continuing effort on the part of the audio

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[3]James W. Brown, Richard B. Lewis, and Fred F. Harcleroad, Instructional Materials and Methods (New York: McGraw-Hill Book Company, 1964), p. 539.

visual staff to improve the instructional process and reduce the amount of time required for each student to obtain proficiency in the operation of the equipment.

The first major effort to automate the audio visual laboratory was made in the spring of 1965 with the development of seven self-instructional, sound 35mm filmstrips. Each filmstrip sequence was a complete step-by-step linear program on the operation of a single item of equipment. Results of this laboratory experience seemed to indicate that students could acquire an acceptable level of competence in the operation of selected audio visual equipment when trained with self-instructional materials.

A review of recent research into the use of self-instructional programs for teaching the operation of audio visual equipment indicates three methods which have been or are currently in use: a programed text method, a filmstrip or 2" x 2" slide presentation with accompanying tape recording or disc-recorded commentary, and a transfer of training method. This third method will be referred to in this study as "Each-One-Teach-One."

Each of these methods of instruction has been evaluated and shown to be as good as, and in some cases superior to, the lecture-demonstration method; but no single study has been reported which compares the effectiveness of these three methods. Research was needed to determine which of these three methods of self-instruction

will provide the student with the highest level of competency in the shortest period of time and with the least amount of direct supervision.

Statement of the Problem

The problem was to determine the relative effectiveness of three methods of developing proficiency skills in the operation of selected audio visual equipment.

More specifically, the problem was to compare the level of proficiency of students taught by the three methods: a programed text method, a filmstrip-record method, and a method referred to as "Each-One-Teach-One." The students in all three groups were given the same orientation-lecture demonstration and laboratory practices on equipment operation with the only variable being the instructional method.

The data required in the solution of the problem consisted of a score for each student involved in the study on a practical laboratory checkout, a score on the Mechanical Reasoning Section of the Differential Aptitude Test,[4] a score on a written laboratory pre-test and post-test, the amount of time required to complete the practical laboratory performance checkout test, and the total amount

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[4]George K. Bennett, Harold G. Seashore, and Alexander G. Wesman, Manual for the Differential Aptitude Tests (3rd ed.,; New York: The Psychological Corporation, 1959).

of practice time required to obtain the level of proficiency reflected by the practical laboratory test.

In order to facilitate the analysis of the data the following null hypothesis was formulated:

H_0 There is no difference in performance between those students trained with the programed text method, the filmstrip-record method, or the "Each-One-Teach-One" method.

Limitations of the Study

1. This study was limited to University of Oklahoma students enrolled in the following courses during the spring semester of the school year 1965-66:

Education 140 -- Curriculum and Instruction in Elementary Education

Education 141 -- Curriculum and Instruction in Secondary Education.

2. This study was limited to the validity and reliability of instruments designed and used for comparative analysis.

3. This study was limited to students who had no previous training or experience in the operation of audio visual equipment.

4. This study was limited primarily to the development of manipulative skills.

Definition of Terms

The following technical terms in the field of educational technology, as defined by the Commission on Definition and Terminology of the National Education Association,[5] were used in this study.

Auto Instructional Device -- Systems and machines for individual instruction which present verbal and pictorial programs in various electronic and mechanical ways so that the individual responds and is informed of errors and progress.

Cue -- A stimulus added to the terminal stimulus to make the correct response more likely while the student is learning. It may be pictorial or verbal.

Converter -- An electronic device used in altering the voltage applied to any device.

Crop -- To trim or cut off parts of the picture to eliminate superfluous portions and thus improve composition.

Definition -- In photography, the sharpness or focus of an image.

Dry mount -- A picture mounted by use of a thermal-seal process.

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[5]The Commission on Definition and Terminology, "The Changing Role of the Audio Visual Process in Education: A Definition and a Glossary of Related Terms," Audio Visual Communication Review, II (Jan.-Feb., 1963), pp. 129-131.

Graininess -- In photography, a defect characterized by poor uniformity of color distribution, more or less in the pattern of small dots or grains amplified by enlargement.

Instructional Aid -- Devices which assist an instructor in the teaching-learning process by simply presenting supporting material, usually intermittently.

Instructional Media -- Devices which present a complete body of information and are largely self-supporting rather than supplementary in the teaching-learning process.

Layout -- A visualized plan for a display, poster, bulletin board, publication, or chalkboard presentation; usually done to scale with sufficient detail to indicate how the final product will appear.

Lighting Contrast -- The ratio between the maximum and minimum intensities of incident light on the subject, or radiated or reflected light from the subject.

Multi-Media Approach -- Methodology based on the principle that a variety of audio visual media and experiences correlated with other instructional materials overlap and reinforce the value of each other. Some of the material may be used to motivate interest, other material to communicate basic facts, still other material to clear up misconceptions and deepen understanding.

Pacing -- In programed instruction, the rate at which the student proceeds through a given number of items. The usual procedure is self pacing: the student reads and responds at his own rate.

Print -- To make positives from a negative either by contact or by projection.

Program -- A sequence of carefully constructed items leading the student to mastery of the subject with minimal errors. The distinguishing characteristic of programed materials is the testing procedure to which they are subjected.

Programed Instruction -- The utilization of programed materials to achieve educational objectives.

Programed Text -- A book in which a program is printed in one or two typical formats -- page to page or down the page. A programed text almost always presents a linear program.

Programing, Linear -- Set sequence of items presents information in small units and requires a response from the student at each step. The steps are so designed that errors will be minimal for even the slower students in the target population. Every student takes each step in the program, his progress differing from that of others only in the rate at which he proceeds through the sequence. Constructed responses are demanded of the student most of the time.

Rear Screen Projection -- For this procedure the projector, located behind a translucent screen, is placed in front of the viewers. It may be housed in a self-contained unit or in a projection room.

Response -- A term used to designate a wide variety of behavior. It may involve the production of anything from a single phoneme or letter, word, or phrase, to the solution of a problem requiring an hour or more. It may involve selection among alternatives, in which case the response often includes the non-verbal manipulation of buttons, keys, etc.

Script -- A set of written specifications for the production of a motion picture, television program, or other rendition of a presentation; includes narration and presentation layout.

Sequence -- A series of scenes, items, or experiences directly related by subject or by underlying thought.

Research Design

This study was designed to compare the effectiveness of three methods of teaching the operation of audio visual equipment to pre-service elementary and secondary teachers.

The subjects for this study were selected from two sections of Education 140 and three sections of Education 141 during the spring semester, 1965-66, at the

University of Oklahoma. The students were divided according to the "free time" indicated on their class schedule sheets. This method of selection permitted assignment to a method of instruction without regard to any student's mechanical ability. There were three groups of equal size.

The six items of equipment used in this study were selected from the list of minimum competency requirements for pre-service teachers.[6] They included the Bell and Howell combination filmstrip and 2" x 2" slide projector, the Bell and Howell Specialist 16mm sound motion picture projector, the Pentron tape recorder, the Audiomaster combination record player and public address system, the Besler Vulite II opaque projector, and the American Optical Delineascope 10" x 10" overhead projector.

Each student was expected to acquire a reasonable level of competence in operating the above types of equipment in the laboratory before he completed the course. This included setting up the equipment; performing minor maintenance such as changing lamps, fuses, and repairing spring belts; operating the equipment; and securing the equipment for proper storage.

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[6]Harold Caldwell, "Teacher Competency in the Use of Educational Media," Kansas Audio Visual Coordinator, V (January, 1967).

During the first class meeting each student received two printed forms: a class schedule sheet and a personal data sheet. The class schedule sheet asked for information on free periods when the student could work in the laboratory while the personal data sheet asked for general background information and previous audio visual training and/or experience.

Each student was assigned to one of the eighteen hour laboratory sections. They met four to five hours a week for three to four weeks.

A graduate assistant scheduled the carrels, maintained the equipment, and provided general supervision. Students who encountered difficulty were referred to the appropriate lesson in the filmstrip or programed text, thus enabling them to answer their own questions or correct their own mistakes.

Identical subject matter content was presented to each group, the only variable being the method of presentation. The subject matter was divided into two distinct parts:

1. An orientation-lecture-demonstration on general principles that could be applied to many makes and models of equipment;

2. Instruction and practice in the step-by-step operation of the equipment.

The three groups were designated as Groups A, B, and C and were instructed as follows:

Group A: Programed Text Method -- This method utilized a linear programed text patterned after those developed by Johnson[7] at the University of Colorado.

Group B: Filmstrip-Record Method -- This method also used a linear program and consisted of a 35mm color filmstrip and disc-recorded commentary for use on the DuKane Auto-Instructional Device. The programs were similar to some developed by Guy Johannes, Jr., in a preliminary study in self-instructional programing at the University of Oklahoma.

Group C: "Each-One-Teach-One" Method -- This transfer of training method was patterned after the system developed at Washington State University. Ten students were taught to operate a different item of audio visual equipment and, through an organized system of rotation, each student in turn taught another student. This process continued until the entire group had received instruction on each item of equipment in the laboratory.

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[7]Donald W. Johnson, "A Study of the Comparative Effectiveness of Programed Self-Instruction Versus the Demonstration-laboratory Method in Teaching the Operation of Six Types of Audio-Visual Equipment" (Unpublished Doctor's dissertation, University of Colorado, 1964).

Collection of the Data

In order to analyze each student's ability to develop the manipulative skills required for the operation of audio visual equipment, several evaluative instruments were used as a part of the study.

1. Performance Checkout Score -- At the end of the eighteen hours of laboratory instruction, each student was given an individual performance checkout on the operation of each item of equipment included in the laboratory. The students were tested on the following equipment: the motion picture projector, the filmstrip slide projector, the opaque projector, the overhead projector, the tape recorder, and the record player. A checkout sheet was used to rate each student's performance in setting up, operating, servicing, and securing the equipment (see Appendix C). The student received no specific operating instructions during the checkout -- only general directions for order of performance. The score on the performance checkout was used to determine whether the student could achieve an acceptable level of competency in developing the manipulative skills.

2. Mechanical Reasoning Test -- The Mechanical Reasoning Section of the Differential Aptitude Test[8] was

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[8]Bennett, Seashore, and Weisman, loc. cit.

administered to all students enrolled in Education 140 and 141. The test was designed primarily for use at the secondary level to spot students with differing mechanical ability. The test served as an independent variable to try to determine whether mechanical reasoning was an influential factor in the student's ability to develop manipulative skills.

3. Written Test -- The written test was administered as a pre- and post-test. It consisted of seventy-five multiple choice questions on the operation of the six items of audio visual equipment used in this study. The test was developed for use in the regular audio visual instruction program to evaluate a student's understanding of equipment operation.

4. Practice Time -- Each student was required to keep a record of practice time. Time cards were distributed at the beginning of the period; students were instructed to enter the name of the equipment, the date, starting time, finishing time, and the total number of hours worked on the equipment. In the design of the study, the amount of practice time was considered to be an important factor in determining the student's ability to achieve a certain level of proficiency. It was assumed that the greater the practice time the higher the level of proficiency, regardless of the method by which the student may have been taught.

5. Checkout Time -- A stop watch was used to time each student's performance, and the time was recorded on the checkout sheet. In order to make equipment operation the only time variable, each student projected the same slides, recorded the same material, and projected the same film. The checkout time was considered to be an influential factor in determining the student's proficiency in equipment operation. A student who took additional time in performing the skills could conceivably make a higher score on the checkout.

Experimental Design

The design used was basically a completely randomized design. The assignment of students to the three methods was determined by the "free time" on their schedule, but otherwise each group represented a random sample of students in Education 140 and 141. Although there was no reason to believe that the three groups differed in any way, data were collected on a number of variables and were evaluated in the study to make sure the groups were comparable.

Under the null hypothesis it is assumed that there are no differences among the sample means, but there are indications that some methods are better than others. If the null hypothesis be accepted, then one could claim with justification that no real difference in population means exists.

The data obtained from this study will be treated statistically in the following ways: computation of the mean, standard deviation, variance, and range as a comparative analysis of the performance checkout score, Mechanical Reasoning test, pre- and post-test scores, checkout time, and practice time. Analysis of variance will be used to test for significant differences among the sample means. The null hypothesis would be accepted at the .01 level of probability if the F-ratio is less than 4.79 with 2 and 141 degrees of freedom.

Organization of the Study

The report of the study is organized into five chapters. Chapter I, a description of the study, includes the background, need, significance, statement of the problem, limitations of the study, definition of terms, collection of the data, and experimental design.

A review of the selected research studies is presented in Chapter II. Procedures for development of the self-instructional programs and the statistical design are presented in Chapter III. Chapter IV contains the treatment and analysis of the data. The summary of the study, including conclusions based on the findings, with recommendations offered in the light of the conclusions, is presented in Chapter V.

CHAPTER II

REVIEW OF SELECTED RESEARCH STUDIES

A number of preliminary exploratory studies have been made utilizing various types of new media and self-instructional devices. The studies selected for review in this chapter are considered to be of particular significance in the overall development of self-instruction teaching programs, especially those related to the teaching of perceptual motor skills as required in the operation of audio visual equipment.

Syracuse University Study

One of the more important studies was reported by Walter J. Mars[9] of the Inter-University Cooperative Program in Teacher Education at Syracuse University. The study involved the establishment of a self-instructional laboratory to train education students in the operation of standard audio visual equipment. In the laboratory operated by the audio visual center, students were given

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[9]Walter J. Mars, "Student Teachers Teach Themselves," Educational Screen and Audio Visual Guide (October, 1963), pp. 566-567.

the opportunity to acquire competency in operating tape recorders, 2" x 2" slide projectors, filmstrip projectors, 16mm sound motion picture projectors, opaque projectors, and overhead projectors on their own time and at their own speed.

There were four individual student stations, each equipped with a tape recorder, a slide projector, a filmstrip projector, a 16mm motion picture projector, and a complete program for each device. One of the unique features of this program was the principle of continuing reinforcement. This required the student to use one or more pieces of equipment in order to learn the operation of another device.

The student began with the tape recorder and learned its operation by flip chart drawings and dittoed instruction sheets. The second item studied was the combination 2" x 2" slide and filmstrip projector, for which instructions were provided on tape. This required the student to develop skills in operating the tape recorder and also to learn to project 2" x 2" slides. Instruction then proceeded to the 16mm motion picture projector, the operation of which utilized all previously studied materials and devices including tapes, slides, and filmstrips, as well as motion pictures. Thus, every student received functional practice in the use of each device, and operational knowledge of equipment was also reinforced.

Upon completion of the self-instructional phase of the program, all students were given a competency examination by a qualified graduate assistant. The results of the competency examination were forwarded to the School of Education office, to be placed in the student's permanent file.

During the first three semesters the self-instruction laboratory produced the following results:

	Number of Students	Percent Achieving Competency
1st Semester	60	95
2nd Semester	150	73
3rd Semester	205	92

Future plans called for further revision of the content and procedures and for the development of completely automated sequences for all machines.

Pennsylvania State Study

Another experiment in the use of self-instructional materials and techniques was conducted at Pennsylvania State University and reported by Reeves and Torkelson.[10] Four procedural patterns were compared for preparing preservice teachers to use audio visual materials and methods in subsequent teaching positions: (1) a separate course

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[10] T.M. Reeves, and G.M. Torkelson, "Self-Instruction in Audio Visual Education: A Title VII Progress Report," Audio Visual Communication Review, 8, (July-August, 1960), pp. 202-206.

in the use of the equipment, (2) a course in which the audio visual course content was integrated with subject methods, (3) an arrangement involving student teaching, and (4) a self-instruction pattern.

The content of the self-study course was presented with the aid of pre-recorded tapes, filmstrips, slides, overhead transparencies, photographs, charts, graphs, diagrams, posters, bulletin boards, readings, dittoed sheets, models, dioramas, specimens and artifacts, motion pictures, kinescopes, and specially prepared study guides. Students learned to operate the equipment through a step-by-step procedure, utilizing the equipment to obtain course content.

The evaluative instruments used in the experiment included an information test, a pictorial test, an attitude scale, a written test measuring knowledge of equipment, and an equipment operation test.

Preliminary results of the self-study pattern indicated the following:

1. Out of 475 students, the self-study group operated equipment with less error and with greater confidence than did the students who learned how to use equipment in a laboratory course conventionally taught.
2. Time records showed that the self-study group spent less time than

other groups in achieving the same ends.

3. Given specially prepared materials, equipment, and proper facilities, pre-service teachers could learn equipment operation without benefit of an instructor.

Arizona State University Study

The use of 8mm film to train students in the operation of audio visual equipment was reported by Gerlach and Flanagan[11] of the Department of Education, Arizona State University. The films were made by graduate students as a project in the summer workshop in 8mm film production.

The class-produced 8mm films were stored in a plastic film cartridge as a continuous loop for use in a small rear screen projector. All films were silent, with printed captions. A mimeographed instruction sheet, film guide, and laboratory manual were also used. The projector and the individual piece of equipment the student was learning to operate were placed in a single carrel or booth.

The results of this project showed that there were a number of advantages in the use of these particular self-instructional films. The student could observe audio

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[11]Vernon S. Gerlach and Athol C. Flanagan, "A Unique Partnership Via 8mm," Educational Screen and Audio Visual Guide (October, 1964), pp. 588-590.

visual skills performed correctly by an expert and could view the same performance many times until a particular technique was firmly implanted in his mind. Demonstrations which were missed could be made up by selecting the appropriate film cartridge. The films were self-pacing; the student could start and stop the projector when desired. With this feature, certain skills could be practiced before a new skill was presented. The confusion which was typical when presentation of one skill followed another without interspersed practice time was thus eliminated.

Results of this study indicated that considerable instruction time was saved when self-instructional films were used. By contrast, the traditional lecture-demonstration method is costly in time and money since the instructor must present a demonstration more than once and outside resource experts must continually supplement laboratory instruction.

Preliminary subjective evaluation of the effect of using these films indicated that they were definitely superior to the traditional teacher-demonstration mode of teaching.

Reactions of the undergraduate students who used the cartridge films were almost universally favorable.

University of Connecticut Study

The development of an automated equipment laboratory at the University of Connecticut Audio Visual Center was reported by David H. Curl.[12]

The laboratory was composed of twelve student stations which were equipped as electronic carrels. It was open daily, enabling each student to spend as much time as he wished at any station, returning at his own convenience for further practice. A laboratory assistant was on duty to record attendance and to give help when needed. Each laboratory station provided 8mm motion pictures and 2" x 2" slide sequences, both of which demonstrated the process to be performed. The learner could watch the movie first or begin directly with the slides, referring to the movie for review of sequences where motion or time was important. Each slide emphasized one small step, or a sequence of closely related steps, and called for a specific response which the learner made before proceeding. Provision was made for reversing and repeating slide sequences as often as desired. Final instruction directed the student through procedures which readied the equipment for the next student to begin.

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[12]David H. Curl, "Automated Equipment Operation Training," Audio Visual Instruction (September, 1965), pp. 564-565.

Programed sequences were used to teach the operation of the motion picture projector, slide and filmstrip projector, opaque projector, overhead projector, tape recorder, and record player.

Students were not tested for performance on equipment operation, though course examinations included questions regarding familiarity with laboratory procedures. One of the objectives was to help students overcome their reluctance to handle machinery. Provision was made for additional practice in the use of equipment during previewing sessions, as a part of demonstration units prepared for methods courses in subject matter specialities, and in the practice teaching program for undergraduates.

The study showed that self-instructional materials permitted the teachers to attend to individual needs of students while media served simultaneously as private tutors, allowing each learner to proceed at his own pace. The study also verified the fact that students could indeed teach themselves more of the fundamental skills than most educators realized.

University of Colorado Study

Johnson[13] developed linear programs in illustrated manual form to teach the operation of six types of audio visual equipment for a course in pre-service elementary

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[13]Johnson, loc. cit.

teacher training. He compared the performance of students taught by this method with the performance of students taught by the conventional demonstration-practice laboratory method.

To evaluate the effectiveness of programed self-instruction, the experiment was designed to involve seventy-two pre-service students in elementary education. The experimental population was divided into two levels according to the scores on the mechanical reasoning test. The two levels were, in turn, divided into an experimental and control group by random selection.

Both groups were taught how to operate the motion picture projector, the filmstrip-slide projector, and the opaque projector -- one group by programed self instruction, and the other in the conventional demonstration-practice laboratory. The groups were then interchanged. The experimental group became the control group, and vice versa. The groups were then taught to operate the overhead projector, the tape recorder and the record player. Each student thus received instruction on three types of equipment in the conventional laboratory and instruction on three types in the programed self-instructional laboratory.

Every student was given a timed checkout on his ability to operate each of the six pieces of equipment. These data were subjected to statistical treatment in

order to test the significance of the observed differeces.

The results of the study indicated that it is possible to design a programed self-instructional sequence that will teach the operation of audio visual equipment without the aid of an instructor.

The experimental self-instructional group performed as well or significantly better than students taught by the conventional method.

From this study, there appeared to be a positive relationship between the amount of time the students spent in practice and the level of their mechanical performance.

Students, in general, preferred programed self-instruction to the conventional demonstration-practice method.

Pennsylvania State Study

Murray[14] made an evaluation of two methods of teaching the operation of the V-M tape recorder and the Victor 16mm motion picture projector.

In the "condensed-visualized" method students were given threading diagrams and were shown a motion picture film on the care and operation of the Victor 16mm projector.

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[14]James Robert Murray, "The Comparative Effectiveness of Condensed Visualized Methods Versus Tape-Demonstrated Methods in Teaching the Operation of the V-M Tape Recorder and Victor Projector" (Unpublished Doctor's dissertation, Pennsylvania State University, 1960).

To teach the operation of the tape recorder, threading diagrams and a specially prepared filmstrip were used. The study time and practice time were controlled on both machines.

For the "taped demonstration" method, the explanation was heard on quarter-inch magnetic tape while the instructor demonstrated the operation of the equipment. The study time and practice time for this method were also controlled.

The two methods were subdivided into two groups, one in which there was laboratory supervision, the other with no supervision.

Performance tests on the projector were significant at the .01 level of confidence for supervision compared to no supervision. On the tape recorder, the "condensed-visualized" method was significantly better than the "taped-demonstration" method at the .025 level of confidence.

Teacher supervision was found to be more effective than lack of supervision for both the motion picture projector and the tape recorder.

State University of South Dakota Study

An extensive study was done by Colwell[15] to determine significant differences in achievement between students who were taught selected audio visual machine

operation by the conventional lecture-demonstration method and those taught through self-instructional techniques.

The self-instructional programs developed for the experimental group included charts, photographs, 2" x 2" color slides, and magnetic tapes.

Sixty-five students were assigned by random selection to two sections of twenty-two students each and one section of twenty-one students. Two of the sections used the self-instructional materials, one with assistance of the instructor when desired and the other without assistance of any kind. The second section was taught by conventional means and served as the control.

Results of this study indicated that students can successfully master selected audio visual machine operation through self-instructional techniques on an independent basis. It was also found that students taught with self-instructional materials can be expected to perform at comparable levels when taught with or without assistance of an instructor.

In none of the comparisons did the conventionally-taught group achieve a significantly higher mean either on the written test or on the performance test.

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[15]Dell McDonald Colwell, "The Effectiveness of Self-Instructional Techniques in Teaching Selected Phases of an Introductory Course in Audio Visual Education" (Unpublished Doctor's dissertation, State University of South Dakota, 1963).

The amount of time required by students to master the operation of audio visual equipment can be reduced to a large degree by the use of self-instructional materials.

Many of the studies thus far reported indicate that programs are a slightly superior method of instruction in terms of achievement of the pupils on a post-test. It has also been found that students using programed materials learn just as well as those taught by other methods and appear to do so in considerably less time.

Hughes Study

A study made by Hughes in 1961, as reported by Fry[16], compared the effect of conventional lecture and discussion methods with the use of programed materials, using the first fifteen hours of a customer-engineer training course prepared for the 7070 computer. Results of this study showed that student learning was greater and that training time was reduced in the programed course. Also, the students developed a favorable attitude toward programing. The amount of time saved was substantial; it took eleven hours to learn the material by program and fifteen hours by the conventional method.

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[16]Edward B. Fry, Teaching Machines and Programmed Instruction (New York: McGraw Hill Book Company, 1963), pp. 100-101.

The achievement level was also significantly higher; those who studied by program achieved a mean test score of 95.1, while those studying by conventional method had a mean score of 86.2, which was significant at the .01 level.

The evidence reported in the study by Hughes appears to demonstrate that programed materials may substantially increase both the learning speed and the level of skill in situations requiring the development of manipulative skills. This appears to have important implications for the present study.

CHAPTER III

PROCEDURES

The purpose of this study was to determine the comparative effectiveness of three methods of teaching students the operation of six types of audio visual equipment: a programed text method, a filmstrip-record method, and a method referred to as "Each-One-Teach-One." The experimental population for this study was composed of 148 elementary and secondary pre-service teachers who were enrolled in Education 140 and 141 at the University of Oklahoma. The students were divided into three groups, according to the "free time" indicated on the class schedule sheet.

The students in all three groups were given a one hour orientation-lecture-demonstration on the basic fundamentals of equipment operation. The remaining laboratory periods were devoted to instruction and practice. The only variable was the instructional method.

The programed self-instructional materials were prepared for use in two forms: a color filmstrip with accompanying disc recording and an illustrated programed

text. The color pictures in the filmstrip and the recorded commentary were identical with the still pictures and the written captions in the programed text.

The audio visual laboratory was open to students from 8:00 a.m. to 12:00 noon and from 1:00 p.m. to 5:00 p.m., Monday through Friday, and from 8:00 a.m. to 12:00 noon on Saturday.

The laboratory was physically arranged so that all three instructional methods could use the same facilities. (See Appendix D.) There were ten individual study carrels, each designed with appropriate shelf space for the individual piece of audio visual equipment and a shelf to hold the programed text or self-instructional device (see photograph in Appendix E). Each carrel contained a duplex 110 volt electrical outlet which furnished power for the equipment and the self-instructional device.

The audio visual equipment selected for the study, widely used in schools and educational institutions throughout the United States[17], consisted of the (1) 16mm motion picture projector, (2) 35mm combination filmstrip-slide projector, (3) tape recorder, (4) record player and public address system, (5) overhead projector, and (6) opaque projector.

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[17]Brown, Lewis, Harcleroad, op. cit., p. 523.

The laboratory period for all three methods was limited to eighteen hours, which included one hour for the pre-test, one hour for the orientation-demonstration, fifteen hours of practice time, and one hour for the checkout. The post-test and mechanical reasoning test were given during the regularly scheduled 140 and 141 classes.

In order to minimize the problem of shifting materials and equipment for the three methods of instruction, the sections utilizing the programed texts were scheduled for the morning and those using the filmstrips were scheduled in the afternoon. In no case were the students scheduled for one method permitted to use materials prepared for the other teaching method. Those students assigned to the "Each-One-Teach-One" method were not permitted to use any of the self-instructional materials.

A graduate assistant was on duty in the laboratory to schedule carrels, check the roll, and to keep the equipment repaired and operating. Those students who encountered difficulty in operating the equipment were not given assistance since the materials were designed to be entirely self-instructional.

At the end of the instructional periods, six measurements of data were collected on each student: a performance checkout score, a score on the Mechanical

Reasoning Test, a pre-test score, a post-test score, the amount of practice time, and the checkout time.

Background for Development of the Self-Instructional Programs

A number of experimental feasibility studies in the use of self-pacing, self-instructional programs for the training of students in the operation of audio visual equipment have been undertaken at the College of Education, University of Oklahoma.

A special seminar project was developed by Fred A. Teague and Guy Johannes, Jr., under the direction of Dr. W. R. Fulton. A series of 2" x 2" slides and tape recorded commentary was prepared on the operation of six types of audio visual equipment. A number of students were selected to make a preliminary evaluation of the materials and instructional method. The preliminary results of this project indicated that students could learn the operation of equipment and attain an acceptable level of performance without benefit of an instructor.

A more extensive investigation to determine the effectiveness of self-instructional programs for teaching the operation of audio visual equipment was done by Guy Johannes under the direction of Dr. Fulton. This study was an outgrowth of the previous study, and the self-instructional slide-tape programs were expanded into a filmstrip-record combination for use on the Dukane Auto-Instructional Device.

The performance of students taught by this method was compared with the performance of students taught by the conventional lecture-demonstration method. The preliminary results of the study seemed to indicate that students could successfully master the operation of selected audio visual equipment through the use of self-instructional programed materials.

Development of the Programs

The filmstrip and record combinations which were developed for use in the spring audio visual laboratory classes were used for the fall classes also. This provided additional testing of the effectiveness of these self-instructional programs and gave insight into the feasibility of their continued use as an instructional device. During this time, each sound filmstrip was critically analyzed for content, continuity, camera angles, composition, and step-by-step detail. The areas in which students had difficulty locating parts or understanding the operation of the equipment were also noted. The individual checkout at the end of each laboratory session provided an additional source of knowledge regarding problem areas. This information proved to be invaluable for revision and development of the new self-instructional programs. The original scripts were then rewritten to include the necessary changes indicated by the previous

laboratory classes, which involved approximately 600 students.

The scripts followed a set pattern for each piece of equipment: (1) setting up the equipment for operation, (2) general maintenance such as changing projection lamps, fuses, and cleaning the optical system, (3) operation of the equipment, and (4) securing the equipment for storage. Each program was thus divided into sections by the use of appropriate sub-titles in the filmstrip and large captions in the programed text. The sections were then further divided into individual steps, with each step in the program occupying a single page in the book or a single frame in the filmstrip. The length of the program depended on the complexity of operation of the equipment. It varied from twenty-eight pages for a record player to eighty-seven pages for a motion picture projector.

Preparation of the Filmstrip-Record Combination

For a well planned self-instructional program with all titles, camera angles, and sequences firmly developed into a tight shooting script, it was found most economical to use a 35mm single frame, single lens reflex camera employing a film such as Kodacolor-X negative. After development, the negative film became the original color printing master for preparing the positive filmstrips for projection. This gave excellent color quality,

image sharpness, and low contrast since it was essentially a first generation original.

There were a number of problems associated with this production method. It was difficult to make any changes in the master to correct for exposure, add scenes which might have been inadvertently skipped, or provide for additional steps which might need to be inserted later. The film could be spliced, but the splices in the master were hard to get through a continuous contact printer and resulted in poor contact at the splices, making for soft focus frames with the added risk of the splices coming apart in the printer. Dust and dirt also had a tendency to accumulate at the splicing edge regardless of whether it was a butt splice with clear mylar tape or an overlapped splice using film cement.

Another method which is frequently used is the preparation of double-frame positive color slides, arranging them in the proper sequence and shooting a single frame 35mm negative master from the slide sequence. Even though the quality of the end product was not quite so good as that of the first method, since the master would be second generation, it did provide 2" x 2" slides for maximum program testing, review, and revising prior to the preparation of the color printing master. This was the method used for preparation of the filmstrip self-instructional programs.

The camera selected for photographing the 2" x 2" slides for the filmstrip was a 35mm single lens reflex with a set of extension rings for closeup photography. The camera was positioned to photograph the scene just as the student would view it when operating the equipment. An operator's hands were included in those scenes where hand positioning or placement was considered to be of importance. Red arrows were used to point out the location of small switches or knobs.

The color film was processed and returned in 2" x 2" cardboard slide mounts. The slides were placed in sequence in plastic trays and projected on a large screen for checking color quality, exposure, and finally, continuity with the narration script.

The narration was recorded on quarter-inch magnetic tape, then edited, and again checked with the slides for continuity. A transfer was made from the quarter-inch tape to a 10-inch long playing microgroove, 33⅓ rpm audiodisc. During the transfer a 30/50 cycle tone was recorded between narration takes, which corresponded to one frame per signal.

The 2" x 2" slides were edited and placed into a compartmentalized rotary slide tray in proper sequence with titles, subtitles, and credits. The completed slide trays, with instructions, were shipped to a commercial laboratory for preparation of the color printing master.

To prepare the master, the 2" x 2" slides were photographed in sequence utilizing a 35mm single frame filmstrip camera. Each frame of the master was numbered consecutively in the lower right hand corner of the picture. These numbers appeared as white letters on the color background and were used to assist the student in maintaining synchronization between the disc recording and the filmstrip. To do this, at the beginning of each frame the narrator announced the frame number before proceeding with the narration for that particular frame.

After processing, the color printing master was used as an intermediate negative for printing the final filmstrips. The completed 35mm color filmstrips and disc recordings were used on the DuKane Auto-Instructional Device (see Appendix E). This machine is a 35mm filmstrip rear screen projector and disc playback with an electronic 30/50 cycle control system which is designed to keep the filmstrip and record in synchronization. A switch located on the front of the projector positions the advance mechanism for automatic or semi-automatic operation. With the switch in the automatic position or to the "right," the record runs continuously, and the 30/50 cycle tone located between narration sequences automatically advances the filmstrip. In the automatic position the student could go through the entire filmstrip to become familiar with the equipment before attempting to use it for instruction.

With the switch in the semi-automatic or "left" position the record stops at the 30/50 cycle tone, and as soon as the remote control button is pressed the filmstrip advances to the next frame, and the record again starts. In this way the student could perform each skill and proceed at his own rate.

Preparation of the Programed Texts

The black and white still photographs for the programed texts were made at the same time as the color slides utilizing the identical lighting setup but a different camera and film. Each 2¼ x 3¼ negative corresponded to an individual frame in the 35mm filmstrip.

After exposure the film was developed, placed in envelopes, numbered, and contact printed on single weight glossy paper. The contact prints were each numbered consecutively to match the number appearing on the negative envelopes.

Standard, unruled 5" x 8" cards were used to prepare a preliminary layout book on each separate machine. For uniformity the following information was dittoed on each card: page number, negative number, scene number, description of the picture, and the commentary. The 2¼" x 3¼" contact prints were cemented to the upper left corner of each card, and the narration was typed on the lower right side of each card. Thus each card contained a

photograph, the scene number, negative number, and the typed commentary to match the scene. The cards were all placed in sequence and bound together to form the finished layout book. After completion, the layout books were checked with the scripts for continuity and then checked with the slide sequences for continuity and cropping. While checking the layout books, the 2¼" x 3¼" prints were marked with a china marking pencil for cropping, arrow positions, and other inserts. These layout books served as a guide in the preparation of the final programed texts.

To prepare the programed texts the same type of 5" x 8" unruled cards were used, but the format was considerably different. The cropped area indicated on the 2¼" x 3¼" prints was enlarged to 4" x 5" size. These single weight, glossy enlargements were dry mounted on the left side of the card and the matching narration or commentary was typed on the right side of the card. Two circular holes were punched in the left side for binding with standard locking rings. The red arrows used in photographing the color filmstrips were removed from the scene before shooting the black and white pictures and were replaced on the finished photographs with black artype arrows with white borders. Each page was then sprayed with a protective lacquer coating to protect the surface from fingerprints and to prevent the artype from being removed.

Self-instructional programed texts and filmstrip-record combinations were prepared on each of the six basic items of audio visual equipment in the laboratory.

Experimental Population

Every candidate for a teaching certificate at the University of Oklahoma was required to take one or the other of the two courses from which the experimental population for this study was drawn. One of these courses should have been completed prior to the student's practice teaching experience. As a part of the course, each student had to have proficiency in the operation of audio visual equipment. Students in the study were undergraduates and were classified as sophomores, juniors, or seniors.

Scheduling

At the beginning of the Education 140 and 141 classes, each student was requested to fill out an individual class schedule indicating all classes, laboratories, and work scheduled for the semester (see Appendix F). An audio visual laboratory assignment was made according to the "free time" indicated on each student's schedule sheet.

The self-instructional classes were limited to ten students in a section since this was the total number of individual carrels available. The "Each-One-Teach-One" classes were limited to a total of twenty students, or

two students per carrel, for this teaching-training method. A dittoed laboratory assignment sheet was given to each student indicating his section and the date the laboratory would begin (see Appendix G). The laboratory schedule for the semester is included in the appendix (see Appendix H).

Instructional Procedure

Orientation-Lecture-Demonstration

An orientation-lecture-demonstration was presented to each new group in order to give the students some understanding of the application of audio visual equipment to a classroom situation. This was done between the written pre-test and the first laboratory practice period.

The orientation-lecture-demonstration followed a set pattern so that each student received the same background information.

The presentation was divided into six parts and covered the operation and utilization of the 16mm motion picture projector, 35mm filmstrip-slide projector, overhead projector, opaque projector, combination record player and public address system, and the tape recorder.

In demonstrating the 16mm projector, emphasis was placed on those features which were common to all 16mm sound projectors. A number of overhead projection transparencies were used to explain the relationship of the various parts of the projector including the feed reel,

drive-in sprocket, intermittent movement, optical system, first drive-out sprocket, sound system and takeup mechanism. It was further emphasized that students who had a good basic understanding of the fundamentals of equipment operation could operate any comparable machine regardless of make since they all have basically the same components.

This type of presentation was given for each piece of equipment utilized in the audio visual laboratory.

Programed Text

The students who used the self-instructional programed texts required very little direction. They were assigned to the carrels during the first practice period and for the remainder of the self-instructional laboratory were left "on their own" to move from one machine to another, practicing until they were confident they could operate the equipment in a classroom situation.

Filmstrip-Record

Those students using the filmstrip-record combination required additional time to learn the operation of the DuKane Auto-Instructional Device. This machine was first demonstrated to the group, then each student was assigned to a carrel and checked out on the operation of the machine before the beginning of the practice time. The students were then allowed to move from one carrel to another until they had learned to operate all of the audio visual equipment in the laboratory.

Each-One-Teach-One

Students trained with the "Each-One-Teach-One" method required considerably more time to become familiar with this method of instruction than did those trained by the other two methods. The procedure was patterned after the method used at Washington State University, as described by Dr. Hite in a telephone conversation on October 16, 1965.

For this method, twenty students were assigned to each laboratory. Each group was then divided into two sections with ten students in each section. Only those students assigned to the first section were scheduled for the first practice period. In order to simplify the pattern of rotation, each student in the first section was arbitrarily assigned an identifying number from one to ten, which was retained by the student during the entire laboratory session.

Student number one was assigned to carrel number one, student number two to carrel number two, and so forth. This procedure was continued until all ten carrels had been assigned. The students were then directed to the assigned carrels and instructed to look over the individual item of equipment. A graduate assistant trained each of the ten students in setting up the equipment, performing minor maintenance, and operating and securing the equipment.

The remainder of the first laboratory period was devoted to practice time. In this way, each student

learned to operate one item of equipment. After completing this initial training period, the students in section one were designated as instructors.

At the beginning of the second laboratory period, the students designated as instructors returned to their originally assigned carrels. The ten students in the second group were arbitrarily assigned identifying numbers from eleven to twenty. Each student retained his number during the entire laboratory session. Student number eleven was directed to go to carrel number one, number twelve to carrel number two, and so forth, until all ten carrels had been assigned. Thus, student number one, now the instructor, trained student number eleven, and student number two trained student number twelve, and so forth. In this way each student in the first group trained a student in the second group.

After thirty minutes of instruction and practice an orderly system of rotation was followed. Students in section two (11 through 20) were instructed to remain at their carrels while those in section one (1 through 10) moved to the next carrel. The students in section two now became the instructors, and those in section one became students on a new item of equipment. This system of rotation was continued throughout the entire laboratory schedule (see Appendix H). Thus, each student was taught how to operate each item of equipment and, in turn, taught the operation of the equipment to another student.

Collection of Data

There were six measurements of data collected on each student included in the study. These were (1) a performance checkout score, (2) a score on the Mechanical Reasoning Section of the Differential Aptitude Test, (3) a score on a written pre-test, (4) a score on a post-test, (5) the amount of practice time, and (6) the total amount of time for the checkout.

IBM machine-graded answer sheets were used for the pre-test, post-test, Mechanical Reasoning Test and for the scoring of the performance checkout. This not only increased the accuracy but greatly simplified the process of collecting the data.

Performance Checkout

At the end of the practice period, which was limited to a maximum of fifteen hours, each student signed up for an individual proficiency checkout on the following types of equipment: (1) 16mm motion picture projector, (2) filmstrip-slide projector, (3) overhead projector, (4) opaque projector, (5) tape recorder, and (6) record player and public address system.

A checkout schedule of approximately fifty minutes was prepared and placed on the bulletin board in the audio visual laboratory. A student could sign up for any open period regardless of the time scheduled for the

laboratory and regardless of the method of instruction used.

Prior to the checkout, each student filled out a personal data sheet (see Appendix J), picked up the practice time card from the file, and filled in his name and section number on an IBM machine-graded score sheet. The score sheet was used to rate the student on each item listed on the checkout.

The following procedure was used to score the student on each step of the performance checkout:

(a) A score of "1" indicated the student did not know how to perform the specific task or failed to do so;

(b) A score of "2" was used to indicate that the student was hesitant or took extra time in trying to remember how to perform the task;

(c) A score of "3" indicated the student performed the step with confidence;

(d) A score of "4" was used to indicate the student was exceptionally proficient in performing the task.

The maximum possible score was a total of 384 points.

The two graduate assistants who performed the proficiency checkout were thoroughly briefed on the methods and procedure for scoring the performance checkout sheet. As a result, each student was asked the same questions

and given the same instructions to follow. In this way the rating system for all of the students was approximately the same on each item of equipment. Furthermore, the individual conducting the checkout did not know which method of training the student had received.

Mechanical Reasoning Test

The Mechanical Reasoning Section of the Differential Aptitude Test was administered to all students enrolled in Education 140 and 141. The tests were provided by the University of Oklahoma Testing Service and were scored on the IBM scoring machine located in the Statistics Laboratory of the College of Education.

Pre-Test

A pre-test was administered to all students prior to the lecture-demonstration. It consisted of seventy-five multiple choice questions on the operation of the six different pieces of equipment used in the study. The test was specifically prepared for use in the audio visual laboratory course and was considered the best test available on the operation of audio visual equipment.

Post-Test

A post-test which was identical to the pre-test was administered after the performance checkout.

Practice Time

Each student was required to keep a record of the actual amount of time spent in learning to operate the equipment (see Appendix B). The time cards were kept in an indexed file box in the laboratory. They were picked up by the student at the beginning of each laboratory session; the appropriate entries were made; and the cards were returned to the file box at the end of the practice time. The same time card was used by the student for the entire laboratory schedule.

Checkout Time

The total amount of time required for the checkout was entered on the checkout sheet. Each student projected the same number of slides, the same filmstrip, the same motion picture film; he played the same record, recorded the same information on tape, projected the same transparencies, and showed the same flat pictures. The only time variable was in setting up the equipment, performing minor maintenance, operating the equipment, and securing the equipment.

Statistical Design

The data obtained for this study were treated statistically in the following ways: (1) computations were made of the mean, standard deviation, variance, and the range as a comparative analysis on the performance

checkout, Mechanical Reasoning Test, pre- and post-test scores, practice time and checkout time; (2) analysis of variance was computed to determine the significance among the sample means since the variance among individuals taught by the three methods was homogenous, a single classification analysis of variance (completely randomized design) was justified. In this method the total variance among the 144 students is partitioned in two parts: (1) variance among teaching method means and, (2) variance among individuals taught by the same method. The ratio of the two variances (F test) indicates whether or not the teaching method means are the same.

CHAPTER IV

ANALYSIS OF THE DATA

Presentation of the Analysis

Data were collected on each student taught by each of the three methods. The raw scores on the pre- and post-test, performance checkout, Mechanical Reasoning test, practice time, and checkout time are presented in Appendix L. The scores for each individual student are grouped according to the method by which he was taught.

Before final tabulation of the data each student's records were checked for accuracy and completeness. Those students who had neglected to keep the necessary records or who had indicated previous audio visual experience were eliminated from the study. In this way the number of subjects for each instructional method was equated so that n = 48 for each instructional method.

The three groups of students were randomly assigned to Group "A", "B", or "C". These groups were treated as follows: Group "A" was trained with the self-instructional programed text; Group "B" was trained with the self-instructional filmstrip-record; and Group "C" was trained with the "Each-One-Teach-One" method.

In this study the mean score on the performance checkout was used as the evaluative criteria to compare the levels of proficiency skill attained by each group on each of the three instructional methods. The mean, standard deviation, and range were computed for each group on the Mechanical Reasoning test scores, the pre- and post-test scores, checkout time, and practice time. These data are presented in Tables 1, 3, 5, 7, 9, and 11. The analysis of variance on each of the above variables is presented in Tables 2, 4, 6, 8, 10, and 12.

A restatement of the null hypothesis for the purpose of applying the data is now appropriate. There is no statistical difference in performance between those students trained with the programed text method, the filmstrip-record method, or the "Each One Teach One" method. Data to test this hypothesis are analyzed and presented in Tables 1 and 2.

The formula used to compare the mean, variance, and standard deviation is described in Appendix M.

Performance Checkout

Table 1 gives a comparison of the scores of the three groups on the performance checkout. The mean scores for groups "A" and "B" are higher than that for group "C".

Since there are differences in the sample means, the question is whether these differences are large enough

to represent real differences or whether they are due to sampling error. The analysis of variance was selected to make this determination. It is essentially a statistical process which partitions a total sum of squares into components associated with recognized sources of variation.

TABLE 1

SCORES FOR GROUPS "A", "B", AND "C" ON THE "PERFORMANCE CHECKOUT"

Statistic Computed	A (Book)	B (Filmstrip)	C (EITI)
Mean	75.40	73.38	68.88
Standard deviation	6.24	5.87	5.43
Variance	38.92	34.49	29.47
Range	62-91	63-91	58-85

In this study the analysis of variance was used to compare the variance between the means of the three groups with the variance among the scores within the groups. The statistical treatment for the analysis of variance, one way classification is described in Appendix M.

The ratio between two independent estimates of the same population variance follows the theoretical F-distribution. The F-value is calculated in the analysis of variance by dividing the treatment mean square by the error mean square because, under the null hypothesis, both mean squares estimate the same population variance. A significant F implies that the evidence is sufficiently strong

to indicate that all the treatments do not belong to the same population with a common mean.

The analysis of variance was computed to determine the significance of the differences between the teaching method means. As shown in Table 2, the analysis yielded a value of F = 15.60, which was significant at the .01 level of probability with 2 and 141 degrees of freedom. This indicates that there are real differences in the results obtained from the three methods of teaching; therefore the null hypothesis is rejected. However, the F-test does not indicate which of the three methods differs from another.

TABLE 2

ANALYSIS OF VARIANCE OF "PERFORMANCE CHECKOUT" OBSERVED FOR THREE GROUPS OF STUDENTS TRAINED BY DIFFERENT METHODS OF TEACHING

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio
Between groups	2	1069.75	534.88	15.60**
Within groups	141	4835.98	34.30	
Total	143	5905.73		

**Significant at the .01 level of probability.

In an analysis of variance, if there is a significant difference among several means it is desirable to know what mean or set of means differs significantly from another mean or set of means. A number of methods have

been proposed for this purpose, among them the least significant difference (lsd) which is a generalized t-test. It should be used only if F is significant and only when the number of treatments is small.

The lsd is basically a Student's t-test using a pooled error variance. Since the lsd need be calculated only once and takes advantage of the pooled error variance, its use is seen to be a timesaver as compared with making individual t-tests. For the differences between two means to be significant at any level of probability, the observed differences must not exceed the lsd calculated for that particular level.[18]

The least significant difference (lsd) for the .01 level was calculated by using the following formula:

$$lsd = t_{.01}\sqrt{\frac{2s^2}{n}}$$

Where $t_{.01}$ was 2.617 for 141 degrees of freedom at the .01 level of probability;

s^2 is the error mean square in the analysis of variance;

n is the number of subjects taught by each instructional method.

Applying the statistics from Table 3 to the lsd formula, we find the following:

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[18]Robert G. D. Steel, James H. Torrie, Principles and Procedures of Statistics (New York: McGraw Hill Book Company, 1960), p. 106.

$$lsd_{.01} = 2.617\sqrt{\frac{2(34.30)}{48}}$$

$$= 2.617\ (1.195)$$

$$lsd_{.01} = 3.10$$

$$lsd_{.05} = 1.98\sqrt{\frac{2(34.30)}{48}}$$

$$= 1.98\ (1.195)$$

$$lsd_{.05} = 2.35$$

The observed differences are $\overline{X}_A - \overline{X}_B = 75.40 - 73.38 = 2.02$; $\overline{X}_B - \overline{X}_C = 73.38 - 68.88 = 4.50$; $\overline{X}_A - \overline{X}_C = 75.40 - 68.88 = 6.52$, which indicates that the differences between the mean score of Groups "A" and "B" are not significant at the .05 level of probability whereas the differences between the mean scores of Groups "B" and "C" and Groups "A" and "C" are both significant at the .01 level of probability.

The results of this computation suggests that the test results of students taught with the programed text method and those taught with the filmstrip-record method were not significantly different at the .05 level of probability. Both groups performed significantly better than the group taught with the "Each-One-Teach-One" method at the .01 level of probability.

The preceding statistical analysis demonstrated that the variability between the groups was much greater than the variability within the groups. There is low probability that the between-group variance could have been a result of sampling error.

Mechanical Reasoning Test

The Mechanical Reasoning Section of the Differential Aptitude Test was administered during the regular class period and was not used for grouping but served as an independent variable to determine homogeneity of the groups in relation to mechanical ability. Table 3 gives a comparison of the three groups.

TABLE 3

SCORES FOR GROUPS "A", "B", AND "C" ON THE "MECHANICAL REASONING TEST"

Statistic Computed	A (Book)	B (Filmstrip)	C (EITI)
Mean	31.90	30.57	31.98
Standard deviation	13.40	12.00	11.41
Variance	179.63	144.04	130.10
Range	0-54	0-63	0-54

The mean scores for the three groups are approximately equal, which would seem to indicate that the groups are homogenous with respect to mechanical ability.

In Table 4 the analysis of variance technique gives a comparison of the variance between the means of the three groups with the variance among the scores within the groups. The resulting value of F = .20 was not significant at the .01 level of probability with 2 and 141 degrees of freedom. In order to achieve significance, the F value would have to be equal to or greater than 4.79 at the .01

level of probability. Since the F value was not significant one could conclude that there are no real differences among the three groups with respect to mechanical ability.

TABLE 4

ANALYSIS OF VARIANCE OF "MECHANICAL REASONING TEST" OBSERVED FOR THREE GROUPS OF STUDENTS TRAINED BY THREE DIFFERENT METHODS OF TEACHING

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio
Between groups	2	59.80	29.90	.20[ns]
Within groups	141	21327.44	151.26	
Total	143	21387.24		

[ns]Not significant at the .01 level of probability.

Pre-Test

The written pre-test was given prior to the orientation-lecture-demonstration and the beginning of the laboratory practice periods. The test consisted of seventy-five multiple choice questions on the operation of the six items of audio visual equipment used in the study. A comparison of the statistics on the pre-test is presented in Table 5.

The analysis of variance of the pre-test resulted in a ratio of F = .41, which was not significant at the .01 level of probability. The data are presented in Table 6.

TABLE 5

SCORES OF GROUPS "A", "B", AND "C"
ON THE WRITTEN "PRE-TEST"

Statistic Computed	A (Book)	B (Filmstrip)	C (EITI)
Mean	28.02	28.96	28.12
Standard deviation	6.06	5.61	4.84
Variance	36.70	31.44	23.47
Range	2-38	17-47	16-43

TABLE 6

ANALYSIS OF VARIANCE OF "PRE-TEST" OBSERVED FOR THREE GROUPS OF STUDENTS TRAINED BY THREE DIFFERENT METHODS OF TEACHING

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio
Between groups	2.00	25.35	12.68	$.41^{ns}$
Within groups	141.00	4306.15	30.54	
Total	143.00	4331.50		

^{ns}Not significant at the .01 level of probability.

The resulting non-significant F ratio implies that all the treatments belong to populations with a common population mean.

From this one could conclude that there are no differences among the population means and that the three groups were approximately equal in their basic understanding of audio visual equipment operation.

Post-Test

The written post-test, which was the same as the pre-test, was administered at the end of the laboratory practice period. Table 7 compares the statistics of the three groups.

TABLE 7

SCORES FOR GROUPS "A", "B", AND "C" ON THE WRITTEN "POST-TEST"

Statistic Compared	A (Book)	B (Filmstrip)	C (EITI)
Mean	46.06	44.94	42.73
Standard deviation	6.44	4.90	6.71
Variance	41.49	23.97	45.01
Range	27-58	38-55	23-58

The students in both Group "A" and Group "B" had a higher mean score than those students in Group "C". This would seem to indicate that those students taught with the self-instructional methods achieved a greater understanding of the basic principles of equipment operation than those taught with the "Each-One-Teach-One" method.

Computation of the analysis of variance yielded a value of $F = 3.7$, which was not significant at the .01 level of probability. In order to be significant, the value would have had to equal or be greater than $F = 4.79$

with 2 and 141 degrees of freedom. The data are presented in Table 8.

TABLE 8

ANALYSIS OF VARIANCE OF "POST-TEST" OBSERVED FOR THREE GROUPS OF STUDENTS TRAINED BY THREE DIFFERENT METHODS OF TEACHING

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio
Between groups	2.00	273.09	136.54	3.71^{ns}
Within groups	141.00	5192.22	36.82	
Total	143.00	5465.31		

^{ns}Not significant at the .01 level of probability.

Even though there was not enough difference in the means of the treatment groups to be statistically significant at the .01 level, they were significantly different at the .05 level, which is at least suggestive of real differences.

Practice Time

Each student kept a record of the time that he spent practicing while learning to operate each piece of equipment in the laboratory. As shown in Table 9 the mean practice time for Group "C" was higher than the mean practice time for Groups "A" and "B". This suggests that those students trained with the "Each-One-Teach-One" method practiced more than those students trained with the self-instructional methods.

TABLE 9

"PRACTICE TIME" FOR GROUPS "A", "B", AND "C" (HOURS)

Statistic Computed	A (Book)	B (Filmstrip)	C (EITI)
Mean	7.49	7.90	8.07
Standard deviation	1.75	1.95	2.29
Variance	3.06	3.81	5.26
Range	4-12.7	5-15	2.7-12

The analysis of variance was computed to test the difference among the sample means. The obtained value of F = 1.04 was not significant at the .01 level of probability with 2 and 141 degrees of freedom. The data are presented in Table 10.

TABLE 10

ANALYSIS OF VARIANCE OF "PRACTICE TIME" OBSERVED FOR THREE GROUPS OF STUDENTS TRAINED BY THREE DIFFERENT METHODS OF TEACHING

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio
Between groups	2.00	8.45	4.23	1.04^{ns}
Within groups	141.00	570.36	4.05	
Total	143.00	578.81		

^{ns}Not significant at the .01 level of probability.

The amount of practice time for each of the instructional methods was not significant since the F value was

considerably below the required 4.79 level at the .01 level of probability.

Checkout Time

Every student was given a timed checkout on his ability to operate each item of equipment in the laboratory. This included the total time that it took to set up the equipment, perform minor maintenance, operate the equipment, and secure it. Table 11 shows a comparison of the checkout time for the three groups.

TABLE 11

"CHECKOUT TIME" FOR GROUPS "A", "B", AND "C" (MINUTES)

Statistic Computed	A (Book)	B (Filmstrip)	C (EITI)
Mean	47.71	47.50	47.08
Standard deviation	8.63	7.00	7.71
Variance	74.42	48.94	59.40
Range	25-65	35-60	35-70

Even though there was considerable variation in the range of the checkout time, the mean time for each of the three instructional methods was approximately the same. As presented in Table 12 the analysis of variance was computed to test the differences among the treatment means. The F-test yielded a value of F = .08 which was not significant at the .01 level of probability with 2 and 141 degrees of freedom.

TABLE 12

ANALYSIS OF VARIANCE OF "CHECKOUT TIME" OBSERVED FOR THREE GROUPS OF STUDENTS TRAINED BY THREE METHODS OF TEACHING

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio
Between groups	2.00	9.72	4.86	.08[ns]
Within groups	141.00	8589.59	60.92	
Total	143.00	8599.31		

[ns]Not significant at the .01 level of probability.

This indicates that the differences in the checkout time among the three treatment means are not significant -- that is, all three groups belong to the same population mean.

Interpretation of the Analyzed Data

The primary objective of this study was to compare the effectiveness of three methods of teaching students the operation of selected audio visual equipment as measured by the performance checkout score. The analysis of the data indicated that there were significant differences between the mean performance scores of the individuals using the three methods. The results of this study support the belief that differences in the results gained through the three teaching methods exist.

The analysis of variance of the performance checkout yielded a ratio of F = 15.60, which is significant at the .01 level of probability. This indicates that there are real differences in the results obtained through use of the three methods, but which of the three methods is the best? Computation of the least significant difference suggests that the students taught with the programed text method and those taught with the filmstrip record method were not significantly different at the .05 level of probability. Both groups performed significantly better than the group taught by the "Each-One-Teach-One" method at the .01 level of probability.

The following variables did not seem to influence the results of the performance on the checkout: the score on the pre- and post-tests, the score on the Mechanical Reasoning test, the checkout time, and the practice time. F-tests in the analysis of variance of these scores indicated no significant differences in the three groups. All F-values were below the 4.79 required for significance at the .01 level of probability with 2 and 141 degrees of freedom.

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This study was designed to compare the effectiveness of three methods of teaching the operation of selected audio visual equipment. More specifically, the problem was to compare the level of proficiency of students taught by the three methods: a programed-text method, a filmstrip-record method, and the "Each-One-Teach-One" method.

The data for this study were collected during the spring semester of the school year 1965-66. The subjects for this study were students enrolled in two sections of Education 140 and three sections of Education 141. The students were divided into three groups of equal size. The "free time" indicated on each student's schedule sheet determined the group to which he would be assigned. Each of the laboratory sections was limited to an enrollment of ten students for the self-instructional laboratory and twenty students for the "Each-One-Teach-One" laboratory.

Linear self-instructional programs were developed to teach the operation of the following audio visual equipment: (1) the 16mm motion picture projector, (2) the

filmstrip-slide projector, (3) the opaque projector, (4) the 10" x 10" overhead projector, (5) the combination record player and public address system, and (6) the tape recorder. The self-instructional programs were developed in two identical forms: a 35mm filmstrip-record combination and a programed-text. Two of the groups were trained with the self-instructional programs while the third group was trained by a transfer of training method referred to as "Each-One-Teach-One."

All three groups received the same introductory orientation-lecture-demonstration and were given the same course content, the only variable being the method by which each group was taught the manipulative skills. Each student was limited to a maximum time of eighteen clock hours which included one hour for the pre-test, one hour for the orientation-lecture-demonstration, fifteen hours of practice time, and one hour for the proficiency checkout.

There were six measurements of data collected on each student: a performance checkout score, a pre-test score, a post-test score, a score on the Mechanical Reasoning test, the practice time, and the checkout time.

These data were subjected to the following statistical treatment: computation of the mean, the standard deviation, the variance, and the range. Analysis of variance was computed to determine the differences among the sample means.

Findings

Students learned best from the programed text method although the mean "performance checkout" score for this method was not significantly higher (probability = .05) than the score for the group taught by the filmstrip-record method.

The scores of the students taught with the programed text method and with the filmstrip-record method were significantly better than the scores of students using the "Each-One-Teach-One" method at the .01 level of probability.

Conclusions

Within the scope and limitation of this study and on the basis of an analysis of data, the following conclusions seem warranted.

Those students taught with the self-instructional methods achieved a significantly higher level of proficiency than those students taught by the "Each-One-Teach-One" method as measured by the performance checkout.

None of the independent variables such as the scores on the pre- and post-tests, scores on the Mechanical Reasoning test, the checkout time and the practice time had any influence on the results obtained from the three teaching methods.

The self-instructional methods exhibited three distinct advantages: the students learned to operate the equipment (1) at their own pace, (2) in a shorter period of time, and (3) without the assistance of an instructor.

Recommendations

1. Based on the findings of this study, the programed self-instructional method of teaching the operation of audio visual equipment should be adopted by the College of Education, University of Oklahoma.

2. During the time the laboratory is open there should be a qualified person available to perform minor repairs on the equipment.

3. The laboratory should be open every school day, and all students in the College of Education should be encouraged to avail themselves of the opportunity to learn how to operate the audio visual equipment.

4. Self-instructional programed texts should be developed on items of audio visual equipment other than those used in this study.

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APPENDIX A

PRE- AND POST-TEST

APPENDIX A

PRE- AND POST-TEST

Select the item that is most appropriate. There is only one response to each item. Mark the correct response in the proper space on the answer sheet provided. If you change your answer be certain to erase completely your first choice. Please do not write or make any marks on the examination sheets.

1. The speaker should be placed
   1. on the floor
   2. at ear-level to the audience
   3. on a chair
   4. at the top of the screen

2. The power cord is properly secured by
   1. wrapping it around the leg of the projection stand
   2. wrapping it around the leg of a chair or table halfway between the projection stand and the electrical outlet.
   3. wrapping it around the leg of a chair or table near the electrical outlet and around the leg of the projection stand
   4. wrapping it around the leg of a chair or table near the electrical outlet.

3. The ends of the drive cables should be attached by
   1. screwing or hooking them together
   2. soldering them together
   3. taping them together
   4. buckling them together

4. The internal lens is located
   1. in the projection lens barrel
   2. between the exciter bulb and the sound drum
   3. between the reflector mirror and the projection bulb
   4. between the projection bulb and the film gate

5. To remove the exciter bulb
   1. press down on the bulb and twist to the right
   2. unscrew the bulb to the left
   3. press down on the bulb and twist to the left
   4. lift straight up

6. To clean the internal lens use
   1. a toothpick
   2. a soft handkerchief
   3. lint-free tissue
   4. a soft toothbrush

7. 16mm is a measurement of
   1. the width of the film
   2. the height of the image
   3. the width of the frame
   4. the size of the aperture

8. Which of the following is not found on a motion picture projector?
   1. condenser lens
   2. reflector mirror
   3. fresnel lens
   4. focusing lens

9. The film at the beginning of a reel of film is known as
   1. the tail
   2. the introduction
   3. the leader
   4. the guide

10. The sound motion picture projector using silent film will project
   1. 16 frames per second
   2. 24 frames per second
   3. 32 frames per second
   4. 36 frames per second

11. The condenser lens
   1. focuses the image on the screen
   2. reduces the amount of light projected
   3. concentrates the beam of light
   4. protects the aperture from excessive heat

12. The claw
   1. frames the image
   2. positions the frame
   3. opens and closes the aperture
   4. all of these

13. The feed-in loop's primary function is
    1. to facilitate threading the projector
    2. to provide access to the film
    3. to act as a buffer between the drive-in sprocket wheel and the film gate
    4. none of these

14. Before showing the film check the reel to determine if
    1. the film is coming off the reel in a counterclockwise direction
    2. the image is upside down
    3. the emulsion is on the side towards the rear of the projector
    4. all of these

15. Before showing the film check the threading by
    1. turning on the power switch
    2. turning on the power switch and the lamp switch
    3. feeling the film as it feeds in the projector
    4. rotating the "flywheel"

16. During the film showing the take-up reel should
    1. turn counterclockwise
    2. turn clockwise
    3. turn in a direction opposite to the feed reel
    4. turn freely

17. If a black line bisects the projected image, correct this by
    1. raising or lowering the projector
    2. rotating the framer
    3. disengaging the clutch
    4. none of these

18. To bring out the "naturalness" of the sound
    1. use the volume control
    2. use the tone control
    3. use both of these controls
    4. use neither of these controls

19. Reverse the film by first
    1. fading out the sound
    2. stopping the projector
    3. turning off the lamp
    4. engaging the reverse lever

20. When the film breaks, the first thing to do is to
    1. turn off the lamp switch
    2. turn down the sound
    3. turn off the motor switch
    4. disengage the clutch

21. Check the film periodically during the showing by
    1. turning on the trouble lamp and inspecting the film
    2. gently grasping the film between your fingers
    3. paying close attention to the projected image on the screen
    4. all of these

22. To show a single frame leave the power switch on and
    1. turn off the sound
    2. disengage the clutch
    3. remove the rewind cable
    4. none of these

23. When the caption "THE END" is projected on the screen
    1. fade out the sound
    2. turn off the lamp
    3. let the film run through the projector
    4. all of these

24. In rewinding the film
    1. the feed reel should turn clockwise and the take-up reel should turn counterclockwise
    2. the feed reel should turn counterclockwise and the take-up reel should turn clockwise
    3. the feed reel should turn clockwise and the take-up reel should turn clockwise
    4. the feed reel should turn counterclockwise and the take-up reel should turn counterclockwise

25. If the edges of the light image are fuzzy
    1. the projection bulb is about to burn out
    2. the condenser lens needs to be cleaned
    3. the aperture is dirty
    4. the focusing lens needs to be focused

26. For a filmstrip to be shown properly
    1. the start of the filmstrip should be in the center of the roll
    2. the image should be right-side-up
    3. the roll should be to the rear of the projector
    4. the emulsion side of the film should be towards the screen

27. The aperture on the filmstrip projector is
    1. the metal tongue that curls forward
    2. the rectangular glassed window
    3. the channel that the film feeds through the carrier
    4. the metal piece that is used to push out the last slide

28. One of the following is not found on the filmstrip-slide projector
    1. the shutter
    2. the condenser lens
    3. the reflector mirror
    4. the focusing lens

29. On the filmstrip-slide projector, if the image does not center on the screen correct this by using
    1. the focusing lens
    2. the film advance knob
    3. the framer
    4. the elevator release knob

30. On the 10" x 10" overhead projector the condenser lens may be reached by
    1. going through the rear panel
    2. going through the side panel
    3. going through the top panel
    4. going through the front panel

31. The overhead projector is focused by
    1. adjusting the distance from the transparency to the focusing lens
    2. raising and lowering the image on the screen with the reflector mirror in the focusing lens housing
    3. by releasing the butterfly bolt and turning the focusing lens
    4. none of these

32. In showing a transparency on the 10" x 10" overhead
    1. the top of the transparency should be toward the screen and the image should be reversed
    2. the bottom of the transparency should be towards the screen and the image should be reversed
    3. the top of the transparency should be towards the screen and the image should be right-side-up
    4. none of these

33. The fresnel lens is located
    1. in the focusing lens housing
    2. in back of the projection bulb
    3. under the transparency glass plate
    4. between the focusing lens

34. Markings on a transparency that are made with a grease pencil should be removed with
    1. an alcohol solution
    2. plain soap and water
    3. a paper tissue
    4. a special gum eraser

35. In the 10" x 10" overhead projector there are
    1. four reflector mirrors
    2. three reflector mirrors
    3. two reflector mirrors
    4. one reflector mirror

36. When the light image is canted, straighten it by
    1. moving the projector
    2. turning the vertical knob
    3. turning the focusing knob
    4. turning the lens barrel

37. Change the projection bulb on the opaque by
    1. going through the side panel
    2. going through the rear panel
    3. going through the front panel
    4. going through the top panel

38. Types of materials shown over a 10" x 10" overhead projector are
    1. opaque
    2. transparent
    3. translucent
    4. none of these

39. Which of the following does not have a fan or "cool" position on the switch?
    1. 10" x 10" overhead
    2. opaque
    3. 16mm motion picture projector
    4. 35mm filmstrip-slide projector

40. To show a flat picture in the opaque projector
    1. the top of the picture should be towards the screen with the carrier down
    2. the bottom of the picture should be towards the screen with the carrier down
    3. the top of the picture should be toward the screen with the carrier up
    4. the bottom of the picture should be toward the screen with the carrier up

41. To record music on the Pentron tape recorder plug the microphone into
    1. the microphone jack
    2. the radio jack
    3. the speaker jack
    4. the amplifier jack

42. To record on the Pentron tape recorder
    1. depress the record key
    2. depress the play key
    3. depress the record and play keys simultaneously
    4. depress first the record key and then the play key

43. Dictation is recorded at 3¾ speed
    1. to provide higher fidelity of sound
    2. to economize on tape
    3. to save wear on tape
    4. to pick up more high and low tones

44. At a speed of 7½ IPS a seven inch reel of tape will record on one side of the tape for
    1. one hour
    2. two hours
    3. 15 minutes
    4. 30 minutes

45. To record on a tape recorder directly from a radio with no outside interference
    1. use a cable with alligator clamps and plug into the microphone jack
    2. use a microphone and plug it into the radio jack
    3. use a cable with alligator clamps and plug it into the radio jack
    4. use a microphone placed on a handkerchief a foot in front of the speaker

46. When using the public address system on the record player a squeal develops over the speaker, correct this by
    1. moving the speaker further away from the microphone
    2. turn down the bass control
    3. turn up the treble control
    4. all of these

47. The 35mm filmstrip projector may also use
    1. 16mm film
    2. 2¼ x 2¼ slides
    3. 3¼ x 4 slides
    4. 2 x 2 slides

48. Which of the following is found on the opaque projector?
    1. a platen
    2. the exciter bulb
    3. a heat lens
    4. a shutter

49. Tape recorders today play at the following speeds
    1. 3¾, 7½, 15, 27½
    2. 1 7/8, 3¾, 7½, 15
    3. 3½, 15, 22½, 30
    4. 15/16, 1 7/8, 3¾, 7½

50. When a tape is played and a voice on tape sounds like Donald Duck
    1. adjust the volume
    2. adjust the volume and tone
    3. change the tape recorder to a higher speed setting
    4. change the tape recorder to a lower speed setting

51. A horizontal line across the projected image
    1. the image is out of frame
    2. the image is out of focus
    3. the shutter is not closing
    4. the film gate is dirty

52. Which of the following is <u>not</u> a part of the motion picture projector optical system (the system used to produce the picture)?
    1. projection lens
    2. projection lamp
    3. exciter lamp
    4. internal condenser lens

53. When placing a roll of tape on a recorder the glossy side should be
    1. toward the outside of the reel
    2. toward the inside of the reel
    3. away from you as you thread the recorder
    4. toward the recording head

54. Film is most apt to break when
    1. the film is not properly attached to the take-up reel
    2. the belt is not attached to the take-up reel arm
    3. the film loops are too small
    4. the film gate is dirty

55. The tape recorder erases as it
    1. plays
    2. rewinds
    3. winds forward
    4. records

56. Motion picture film should be rewound
    1. when they are to be immediately returned to the film library
    2. when they are to be used in another class before being returned to the film library
    3. both of the above times
    4. neither of the above times

57. The main reason for cooling the projection lamp is to
    1. lengthen the life of the lamp
    2. prevent damage to the filmgate
    3. prevent damage to the lenses
    4. prevent damage to the photo cell

58. Which statement is true?
    1. A silent film may be shown on a sound projector
    2. A sound film may be shown on a sound projector
    3. both of the above statements are true
    4. neither of the above statements is true

59. Which of the following projectors require more darkening of the classroom?
    1. opaque
    2. overhead
    3. filmstrip
    4. motion picture

60. The most important purpose for the lens cover on the opaque projector is to
    1. keep the lens clean
    2. protect the lens from breakage
    3. shut off the light when a picture is not being shown
    4. keep the lens from being over-heated by the lamp

61. The purpose for test running the projector is
    1. get the image centered on the screen
    2. see that the motor is turning the drive sprockets
    3. see that the lamp is burning
    4. all of the above

62. A fuzzy image indicates that a motion picture projector is
    1. out of frame
    2. out of focus
    3. could be either
    4. could be neither

63. If the motion picture projector runs and sound comes from the speaker but no image appears on the screen the probable trouble is
    1. a burned out fuse
    2. a burned out exciter lamp
    3. a burned out projection bulb
    4. a burned out photo cell

64. To use the record player as a public address system
    1. the treble control should be turned down
    2. the treble control should be turned up
    3. the bass control should be turned up
    4. the treble and bass controls should be balanced to your desire

65. If a film is broken and must be shown to a class immediately you should
    1. tape the film together with scotch tape
    2. leave the film broken and plan to re-thread it when it runs to the broken place
    3. staple the film together with a paper staple
    4. have the class wait while you properly splice the film

66. If the motion picture projector runs and an image appears on the screen but no sound is produced in the speaker, the most probable cause of trouble is
    1. a burned out fuse
    2. a burned out exciter lamp
    3. a burned out projection lamp
    4. could be none of the above

67. On which projector can you write on the projected materials while they are being shown?
    1. opaque
    2. filmstrip
    3. overhead
    4. slide

68. Which of these factors would affect the brightness of the image on the screen?
    1. dirty lenses
    2. the watt rating of the projection lamp
    3. room light control
    4. all of the above

69. The projection platform crank on the opaque projector is turned when showing
    1. a flat print
    2. a series of flat prints
    3. a page in a large book
    4. a transparency

70. The projection platform roller is removed from the opaque projector
    1. when showing a flat print
    2. when showing a series of flat prints
    3. when showing a page in a large book
    4. when showing a pencil drawing

71. Which of these components is <u>not</u> a part of the projector's sound reproduction system?
    1. the photo-electric cell
    2. the fuse
    3. the exciter lamp
    4. the sound drum

72. When a recording is made on the tape recorder
    1. the volume level should be set before the recording is started
    2. the volume level should be set soon after the recording is started
    3. the volume control should always be at about mid-point on the volume indicator
    4. it doesn't matter since the volume can be controlled when the recording is played

73. The same projector may be used to show
    1. sound and silent motion pictures
    2. filmstrip and 2" x 2" slides
    3. neither of the above
    4. both of the above

74. Which projector would you use to project a page of a textbook?
    1. 10" x 10" overhead projector
    2. 2" x 2" slide projector
    3. opaque projector
    4. motion picture projector

APPENDIX B

TIME CARD

AUDIO VISUAL TIME CARD

(CIRCLE ONE)

LAB. TIME____ M T W T F S

EQUIP.	DATE	TIME	HOURS	MIN.

NAME_____

START AT THE BOTTOM AND GO UP

WHEN FILLED USE REVERSE SIDE

APPENDIX C

CHECKOUT SHEET

APPENDIX C

CHECKOUT SHEET

I. OPAQUE
1. Secure cord
2. Clean lens
3. Change projector bulb
4. Fit image to screen
5. Focus and show pictures
6. Show series of pictures
7. Show picture in book
8. Use pointer
9. Secure projector

II. TAPE RECORDER
1. Secure cord
2. Check tape
3. Attach reels
4. Thread
5. Attach mike
6. Adjust volume for dictation
7. Record dictation
8. Return to start
9. Play back
10. Record music
11. Secure projector

III. RECORD PLAYER
1. Secure cord
2. Set up amplifier
3. Check turntable speed
4. Check arm speed
5. Play record
6. Adjust volume
7. Adjust tone
8. Attach mike
9. Broadcast
10. Secure record player

IV. 10"x10" OVERHEAD PROJECTOR
1. Secure cord
2. Clean lens
3. Change projection bulb
4. Level image
5. Adjust image to screen
6. Focus and show pictures
7. Show overlay
8. Write on acetate roll
9. Cool bulb
10. Secure projector

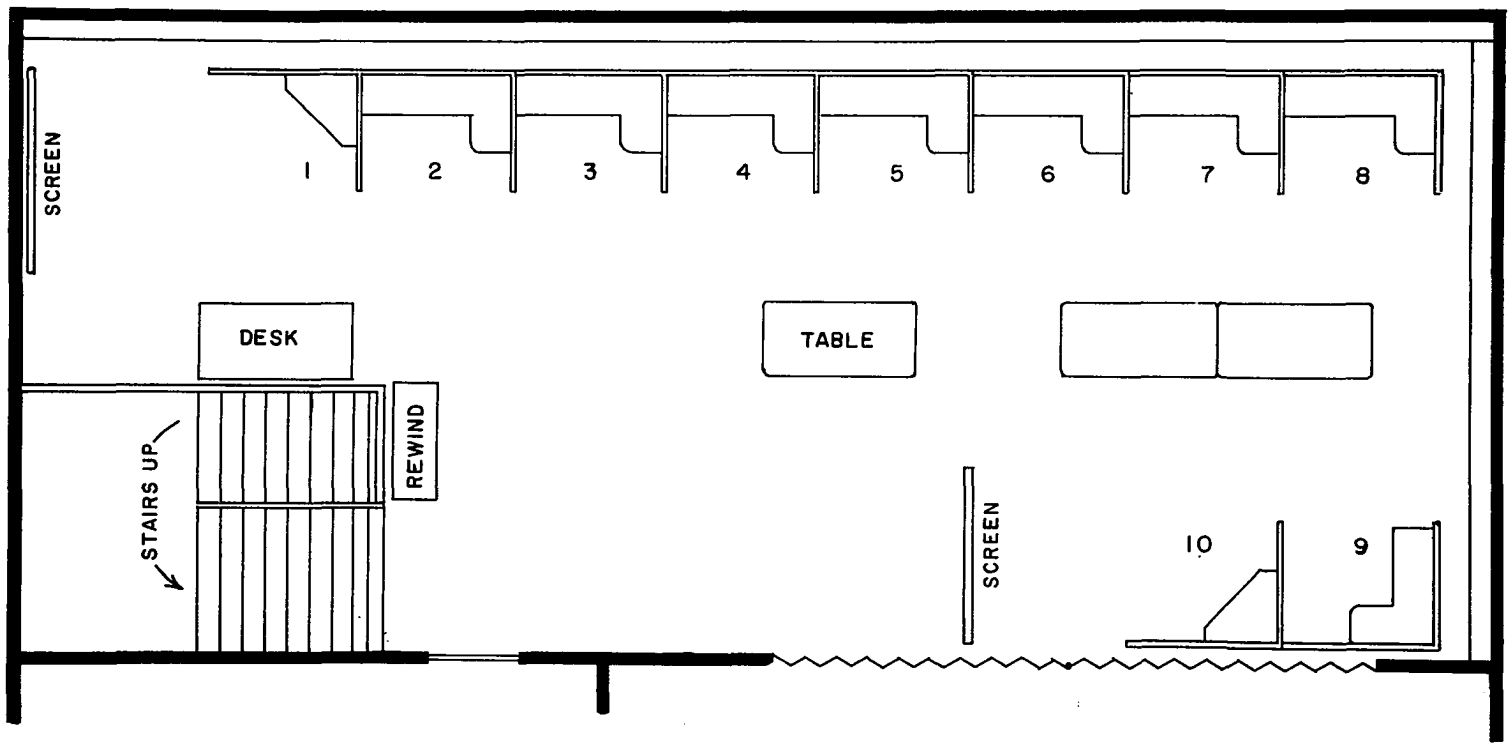
V. 35mm PROJECTOR
1. Secure cord
2. Clean lens
3. Change projector bulbs
4. Fit image to screen
5. Pre-focus
6. Check film strip
7. Thread film
8. Focus
9. Frame
10. Cool projection bulb
11. Rewind film
12. Change to slide carrier
13. Check slide and show
14. Focus
15. Remove last slide
16. Cool projection bulb

17. Change to film-strip carrier
18. Secure projector

VI. 16mm MOTION PICTURE PROJECTOR
1. Attach drive cables
2. Set up speaker
3. Secure cords
4. Turn on amplifier
5. Test run projector
6. Change projector bulb
7. Change exciter bulb
8. Clean focus lens
9. Clean internal lens
10. Clean gate
11. Replace drive cables
12. Change fuze
13. Fit image to screen
14. Pre-focus
15. Check film
16. Thread film
17. Focus
18. Frame
19. Adjust volume
20. Adjust tone
21. Return to start of film
22. Turn off projector
23. Turn down volume
24. Turn on projector
25. Adjust sound, fade in
26. Adjust focus
27. Turn down volume
28. Secure film to takeup reel
29. Re-thread film
30. Adjust sound, fade in
31. Fade out sound
32. Cool projection bulb
33. Rewind film
34. Secure projector

APPENDIX D

LABORATORY ARRANGEMENT



AUDIO VISUAL LABORATORY

APPENDIX E

CARREL ARRANGEMENT

APPENDIX F

STUDENT CLASS SCHEDULE

AUDIO VISUAL LABORATORY

STUDENT CLASS SCHEDULE

PRINT NAME_____ COURSE _____

CLASS INSTRUCTOR_____ SECTION _____

List below the courses in which you are currently enrolled. List all regularly scheduled laboratories as well as all classes in which you are enrolled. You will be scheduled to attend laboratory sessions during times which do not conflict with your other classes. You will be required to spend approximately 18 hours in the laboratory in completion of this requirement.

HOUR DAYS

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
8:00						
9:00						
10:00						
11:00						
12:00						
1:00						
2:00						
3:00						
4:00						

Students who have successfully completed or are currently enrolled in Education 290 are not required to complete audio-visual laboratory work for Education 140 and 141. All other students enrolled in Education 140 and 141 are required to complete this laboratory work. If you have completed, or are currently enrolled in Education 290 please check below.

Education 290. Date completed _____.

APPENDIX G

STUDENT LABORATORY ASSIGNMENT SHEET

APPENDIX G

STUDENT LABORATORY ASSIGNMENT SHEET

NAME _____ COURSE _____

CLASS INSTRUCTOR_____ SECTION _____

You have been assigned to work in the audio visual laboratory as follows:

Time_____Days_____Starting date_____

Estimated date of completion_____Required date_____

Note: Students <u>are required</u> to attend laboratory sessions to which they are assigned.

_____
Graduate Assistant

APPENDIX H

LABORATORY SCHEDULE

APPENDIX H

LABORATORY SCHEDULE

Section	Time & Days	Duration	Assigned	Method
1	8 MWF	Feb.14-Mar.18	10	Book
2	9 MWF	Feb.14-Mar.18	10	Book
3	10 MWF	Feb.14-Mar.18	10	Book
4	11 MWF	Feb.14-Mar.18	10	Book
5	1 MWF	Feb.14-Mar.18	10	Filmstrip
6	2 MWF	Feb.14-Mar.18	10	Filmstrip
7	8 daily	Mar.21-Apr.15	20	Each One Teach One
8	9 daily	Mar.21-Apr.15	10	Book
9	10 daily	Mar.21-Apr.15	10	Book
10	11 daily	Mar.21-Apr.15	10	Book
11	1 daily	Mar.21-Apr.15	10	Filmstrip
12	2 daily	Mar.21-Apr.15	10	Filmstrip
13	8-10 TTh	Apr.19-May 12	10	Filmstrip
14	10-12 TTh	Apr.19-May 12	10	Filmstrip
15	1-3 TTh	Apr.19-May 12	10	Filmstrip
16	8-12 Sat.	Feb. 19-26 March 5-12	20	Each One Teach One
17	8-12 Sat.	April 9-16 April 23-30	20	Each One Teach One

APPENDIX I

LABORATORY SCHEDULE --"EACH-ONE-TEACH-ONE"

AUDIO VISUAL LABORATORY SCHEDULE

EACH-ONE-TEACH-ONE

Date	Time	Student or Instructor	Overhead Projector	Kodak Projector	Kodak Projector	Bell & Howell Projector	Bell & Howell Projector	Record Player	Pentron Tape Recorder	Bell & Howell Filmstrip	Bell & Howell Filmstrip	Opaque
April 9	8:00-10:00	S	1	2	3	4	5	6	7	8	9	10
April 16	10:00-10:30	I	1	2	3	4	5	6	7	8	9	10
		S	11	12	13	14	15	16	17	18	19	20
	10:30-11:00	I	11	12	13	14	15	16	17	18	19	20
		S	10	1	2	3	4	5	6	7	8	9
	11:00-11:30	I	10	1	2	3	4	5	6	7	8	9
		S	20	11	12	13	14	15	16	17	18	19
	11:30-12:00	I	20	11	12	13	14	15	16	17	18	19
		S	9	10	1	2	3	4	5	6	7	8
April 23	08:00-08:30	I	9	10	1	2	3	4	5	6	7	8
		S	19	20	11	12	13	14	15	16	17	18
	08:30-09:00	I	19	20	11	12	13	14	15	16	17	18
		S	8	9	10	1	2	3	4	5	6	7
	09:00-09:30	I	8	9	10	1	2	3	4	5	6	7
		S	18	19	20	11	12	13	14	15	16	17
	09:30-10:00	I	18	19	20	11	12	13	14	15	16	17
		S	7	8	9	10	1	2	3	4	5	6
	10:00-10:30	I	7	8	9	10	1	2	3	4	5	6
		S	17	18	19	20	11	12	13	14	15	16
	10:30-11:00	I	17	18	19	20	11	12	13	14	15	16

APPENDIX J

PERSONAL DATA SHEET

PERSONAL DATA SHEET

DATE _____

NAME _____
Last First Middle

AGE_____ SEX: M___ F___ SINGLE_____ MARRIED_____

CURRENT ENROLLMENT: EDUC. 140_____ EDUC. 141_____

CIRCLE CLASS: 1 2 3 4 5 6 7
Fr. Soph. Jr. Sr. Uncl. Grad. Spec.

CIRCLE COLLEGE: 1 2 3 4 5 6 7 8
A&S Bus. Educ. Eng. F.A. Grad. Law Pharm.
9 10
U.C. Nursing Other Than Above _____

MAJOR _____

DO YOU PLAN TO TEACH UPON GRADUATION? YES_____NO_____

ARE YOU A CANDIDATE FOR A TEACHING CERTIFICATE? YES__NO__

HAVE YOU TAUGHT SCHOOL? YES__ NO __ YEARS EXPERIENCE____

HAVE YOU HAD ANY FORMAL AUDIO VISUAL TRAINING? YES__NO__

IF ANSWER TO ABOVE IS YES, WHERE WERE YOU TRAINED?

COLLEGE_____TECHNICAL SCHOOL_____MILITARY_____

HAVE YOU OPERATED AUDIO VISUAL EQUIPMENT FOR A SCHOOL, CHURCH, OR OTHER ORGANIZATION? YES_____ NO_____

HAVE YOU EVER BEEN A MEMBER OF A PROJECTIONIST OR AUDIO VISUAL CLUB? YES_____ NO_____

APPENDIX K

CERTIFICATE OF PROFICIENCY

APPENDIX K

CERTIFICATE OF PROFICIENCY
IN
AUDIO VISUAL EQUIPMENT

_____ has exhibited an operational proficiency in the following audio visual equipment:

_____ 16mm sound projector
_____ 35mm filmstrip projector
_____ 2" x 2" slide projector
_____ 10" x 10" overhead projector
_____ opaque projector
_____ tape recorder
_____ record player
_____ public address system

Course _____

Section _____

_____
Graduate Assistant

APPENDIX L

TEST SCORES

APPENDIX L

DISTRIBUTION OF TEST SCORES FOR THE GROUP TRAINED WITH THE PROGRAMED TEXT METHOD

Mechanical Reasoning	Pre-Test	Post Test	Checkout	Checkout Time	Practice Time
22	33	51	68	60	6.5
53	34	55	86	35	7.0
34	14	45	76	45	6.0
34	35	50	76	40	8.0
32	35	52	84	50	8.2
34	21	49	62	65	8.3
36	33	47	71	40	8.5
12	27	47	68	40	7.2
41	21	38	73	55	7.0
41	34	56	83	50	8.5
26	23	40	70	55	8.0
8	25	44	83	45	8.3
37	27	47	81	60	7.2
37	37	54	72	50	4.5
39	25	51	70	40	4.0
12	24	43	70	35	12.7
34	33	51	73	35	9.2
12	25	54	72	55	9.0
33	32	45	77	45	8.0
31	24	38	73	55	6.5
7	24	39	72	55	7.0
27	30	50	91	50	7.7
27	32	38	79	50	10.5
28	19	35	72	55	9.7
49	30	47	76	50	8.0
40	31	48	73	35	8.0
41	35	55	84	50	8.5
29	35	54	78	55	10.0
50	31	50	79	45	7.5
30	29	37	82	45	5.5
0	18	38	81	55	7.2
29	25	42	68	50	7.0
52	33	54	78	40	10.5
39	28	47	76	50	10.0

Mechanical Reasoning	Pre-Test	Post Test	Checkout	Checkout Time	Practice Time
34	12	44	71	55	7.2
54	38	58	91	25	5.5
29	30	50	70	50	7.2
30	27	39	68	50	5.5
42	31	42	74	35	6.5
37	37	51	77	55	6.0
27	29	43	79	35	5.2
54	22	44	76	40	7.0
30	28	46	70	50	6.2
17	23	40	65	50	5.2
1	23	27	76	65	10.5
37	20	44	73	40	7.2
27	33	48	80	55	8.2
46	30	43	72	45	4.5

DISTRIBUTION OF TEST SCORES FOR THE GROUP TRAINED WITH THE "EACH ONE TEACH ONE" METHOD

Mechanical Reasoning	Pre-Test	Post Test	Checkout	Checkout Time	Practice Time
24	30	45	71	45	6.3
14	28	42	71	45	10.0
33	31	55	76	40	9.3
43	41	47	85	50	9.0
32	28	40	71	50	6.5
28	34	50	63	60	6.5
32	29	43	68	45	6.0
41	31	46	77	40	12.0
38	32	45	73	40	10.0
48	27	36	64	40	10.0
38	29	45	68	50	11.5
37	28	48	68	50	5.2
27	32	50	60	60	11.5
12	32	37	62	60	11.5
23	28	33	68	50	9.0
31	29	43	81	35	8.0
60	30	53	79	35	9.0
36	23	40	67	45	11.5
25	16	39	73	40	11.5
35	34	36	75	35	7.7
32	17	41	68	40	3.5
29	37	49	64	50	8.7
17	28	46	67	40	7.2
37	24	42	67	45	2.7
42	29	36	67	50	6.5
18	23	33	57	55	4.5
48	23	46	69	50	11.5
27	21	42	69	45	6.2
6	23	33	69	55	4.2
54	29	45	67	45	4.2
37	26	43	71	45	9.0
36	43	47	64	50	9.2
38	27	45	63	55	6.5
37	31	41	67	50	9.5
29	30	33	65	70	10.0
34	22	49	70	55	6.0
29	29	48	73	55	8.2
27	24	54	74	40	8.0
41	32	45	71	35	10.0
28	29	41	66	35	7.2
27	29	23	73	50	6.7
31	32	46	66	45	9.0
32	27	37	67	50	8.2
34	26	44	67	50	8.7

Mechanical Reasoning	Pre-Test	Post Test	Checkout	Checkout Time	Practice Time
42	31	47	72	40	6.7
0	22	42	68	50	7.5
19	22	37	67	55	8.5
47	32	53	58	40	7.2

DISTRIBUTION OF TEST SCORES FOR THE GROUP TRAINED WITH THE FILMSTRIP-RECORD METHOD

Mechanical Reasoning	Pre-Test	Post Test	Checkout	Checkout Time	Practice Time
29	30	50	76	40	8.7
34	28	41	71	50	8.5
51	33	46	73	50	7.5
10	22	42	63	60	9.0
41	28	51	80	40	7.3
24	32	43	75	50	7.5
24	24	49	81	40	7.5
39	20	47	69	40	7.5
48	32	45	73	40	5.7
36	32	39	68	45	11.0
20	29	36	67	45	5.2
37	33	45	73	50	6.0
19	32	44	78	50	8.7
32	25	37	74	55	8.0
32	31	47	88	55	8.0
29	31	41	69	60	8.5
41	38	55	71	45	8.0
17	22	39	68	40	6.7
8	28	38	72	60	10.5
37	28	41	75	50	12.0
10	32	50	72	40	7.5
22	31	37	75	55	6.5
41	25	42	69	55	5.0
27	18	45	73	40	8.0
22	28	42	70	55	8.0
63	22	45	80	35	5.7
25	24	38	65	45	8.0
42	33	48	66	40	5.0
30	29	48	74	50	9.5
27	31	47	76	50	6.0
25	27	40	66	60	7.5
35	30	43	76	35	6.0
29	27	52	80	45	10.7
24	47	47	66	50	5.0
44	38	54	71	45	8.0
37	22	47	71	55	9.0
6	31	40	67	50	7.7
17	25	43	66	45	8.0
23	34	49	74	40	7.0
42	29	52	73	45	8.7
33	26	43	91	50	8.2
29	34	43	73	45	7.5
59	40	53	80	35	11.5
25	24	40	80	45	5.2

Mechanical Reasoning	Pre-Test	Post Test	Checkout	Checkout Time	Practice Time
29	30	47	79	45	7.2
39	32	48	72	50	8.5
20	17	53	70	60	15.0
39	26	45	83	50	7.5

APPENDIX M

FORMULA FOR COMPARISON OF THE MEAN VARIANCE, AND STANDARD DEVIATION

APPENDIX M

FORMULA FOR COMPARISON OF THE MEAN, VARIANCE, AND STANDARD DEVIATION

$$\bar{X} = \frac{\sum X_i}{n}$$

$$s^2 = \frac{\sum X_i^2 - \frac{(\sum X_i)^2}{n}}{n-1}$$

$$s = \sqrt{s^2}$$

Where: $\bar{X}$ = mean

s^2 = variance

s = standard deviation

APPENDIX N

ANALYSIS OF VARIANCE: ONE WAY CLASSIFICATION WITH EQUAL REPLICATION (SYMBOLIC)

APPENDIX N

ANALYSIS OF VARIANCE: ONE WAY CLASSIFICATION WITH EQUAL REPLICATION (SYMBOLIC)[19]

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio
Between groups	t - 1	S_t	M_t	$\frac{M_t}{M_e}$
Within groups	t (n-1)	S_e	M_e	
Total	tn - 1	S		

Where: t = number of groups (teaching methods)

n = number of students in each group

$$S_t = n\sum_{i=1}^{t} (\bar{X}_i - \bar{\bar{X}})^2$$

$$S = \sum_{i=1}^{t} \sum_{j=1}^{n} X_{ij}^2$$

$$S_e = S - S_t$$

$$M_t = St/ (t-1)$$

$$M_e = Se/t (n-1)$$

$$F = \frac{Mt}{Me}$$

[19]Steele, Torrie, loc. cit., p. 103.