AN INVESTIGATION OF THE EFFECT OF A PROGRAMED INSTRUCTIONAL METHOD ON SKILL LEARNING IN AUDIOVISUAL EDUCATION

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ABSTRACT

AN INVESTIGATION OF THE EFFECT OF A PROGRAMED INSTRUCTIONAL METHOD ON SKILL LEARNING IN AUDIOVISUAL EDUCATION

by Roger L. Gordon

Much interest during the recent past has centered in the area of motor skill learning. Much research has been conducted demonstrating that motor skills can be taught and learned successfully by a number of methods. A major problem in the training of motor skills lies in the choice of an efficient teaching method.

Increased use in schools of audiovisual devices, shop and business machines, and automated office devices has created a strong need for new and more effective motor skill training techniques.

A teaching technique commanding much interest and research today is that of programed learning. At the present time, documented research on motor skill training through programed learning has been carried out only by the military and industry on teaching machines with the use of projected media (film, filmstrip, slide) and/or computer based programing systems.

It was proposed that if the programed textbook, with its advantages of economy and availability could be found

effective in teaching motor skills information in the classroom, the results could be of great importance to education.

This study investigated the effect of a programed textbook on student learning and reactions regarding 16mm motion picture projection principles and projector operation skills.

Sixty-eight students participated in the experiment in the winter term, 1963. The students were divided into two matched groups. One group received a carefully prepared lecture with demonstration on projection principles and projector operation followed by an individual unguided projector practice session while the other group worked through a programed textbook on projection principles and projector operation. The book contained a linear program with photographs or drawings in each individual frame. Following the programed lesson, the participants in the programed textbook group engaged in an individual unguided projector practice session. Immediately following the training sessions, the participants completed a projection principles written test and a projector operation skills test. Each participant also filled out a training session reaction questionnaire.

Findings showed that when students used the programed textbook with visuals for the learning of principles (an intellectual activity), they learned more in less time and reacted more favorably to the method employed than did the

lecture with demonstration group. But when the students used the programed textbook with visuals as a step toward learning projector operation (a mechanical skill), they had difficulty transfering skills information from the book to the machine and consequently showed no advantage over the other group in actual learning of projector operation or in use of training session time.

It appeared that a major reason for this outcome arose from the basic problem of attempting to learn details about a skill prior to actual work on the skill itself. Although an attempt was made to anticipate this difficulty in the nature and number of programed items developed for the skills part of the experiment, it was not successful.

A replication experiment was held during the spring term of 1963 to test the reliability of the findings. Findings either showed exact duplications or were closely similar to those obtained in the original experiment one term earlier.

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Other special acknowledgement goes to Mr. John Gordon and Mr. Elwood Miller for their assistance in analyzing the statistical data and Mrs. Ann Brown for the typing.

The author would like to pay special tribute to Miss Johanna Schunemann for her complete and concise editing of the original manuscript. Without Miss Schuneman's interest and that of the previously mentioned persons, this study could not have been completed.

DEDICATION

This study is dedicated to my darling wife Sharon whose overall patience and understanding contributed so greatly to my work. . . .

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CHAPTER I

INTRODUCTION

Statement of the Problem

There has been much interest during the recent past in the area of motor skill learning. Educators, psychologists, industrialists, and the military have conducted extensive research, not only to emphasize the importance of motor skill learning as an occupational aid, but to demonstrate that motor skills can be taught and learned successfully by a number of methods.

Motor skill training and research aided this nation in its economic recovery from the depression of the 1930's. It aided industry with technological developments, and promoted rapid national mobilization of the armed forces during World War II. Currently, advances in technological change and manpower utilization have made motor skill training even more important in many levels of education.[1] Within our schools today, motor skill training has become widespread.

A major problem in the training of motor skills lies in the choice of an efficient teaching method. Accompanying

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[1]U. S. Office of Education, Progress of Public Education in the United States of America, 1961-1962 (Washington, D. C.: U. S. Office of Education, 1962), p. 18.

the problem of selection is the uncertainty of student reactions toward one particular method of teaching to another.

A teaching technique commanding much interest and research today is that of programed learning. There has been much research on complex skill learning with regard to computer controlled and projected media teaching machines in industry and the military. The programed textbook, though having advantages of economy and availability, remains untested in the teaching of motor skills information.

We are primarily concerned in this study with investigating the effect of a programed textbook with visuals on student learning regarding 16mm motion picture projection principles and projector operation.

Our specific interest in this study is to determine the degree of factual and skills information learning with respect to 16mm motion picture projector principles and operation, which are provided in a training session by two alternative methods:

1. Lecture with demonstration. (Instructor lecture with demonstration consisting of films, slides, transparencies, mock-ups, and a 16mm motion picture projector, followed by individual unguided student practice.)
2. Use of a written response programed textbook containing visual illustration of the verbal text, followed by individual unguided student practice.

We also wish to determine student reactions to the teaching methods presented in the training session.

Background of the Problem

Motor Skills

Most studies of skill learning began in the middle 1920's. The influence of technology in a number of fields following World War I took hold in industry and ultimately brought changes in the school curriculum.

During the depression years of the 1930's, skill learning became more important as men were forced to learn new trades and readapt old methodologies.

During World War II, when manpower shortages in industry were apparent, there was extensive training and research into skill learning. World War II brought a further increase in motor skill research and experimentation on the part of the military. Much of the research emphasis during these years has carried over to the present time. However, the post-war boom in technological developments in an untold number of areas has brought increased research and experimentation from the military and industry. Industrialists and educators alike have realized that most occupations require high levels of skill and technical knowledge for beginning and long-term employment.

Some occupations, such as labor, farm work, and single machine operations require fewer workers; other occupations are being dispensed with because of changing

consumer habits, increasing automation, and other technological developments.[2]

Educators are attempting to meet the need for better and more efficient methods of motor skill training by the use of federal, state, and local funds for expanded vocational and distributive educational programs.

Educational Media and Motor Skills

Much research and experimentation beginning during World War II has been carried out by the military and industry in the use of audiovisual instructional devices for the teaching of motor skills.

Motion and still projected pictures and 3-dimensional models and mock-ups have been used extensively to teach a number of motor skills. These skills have included simple operations, such as tying a knot, learning gymnastic skills, and assembling a breech block and more complex skills, such as operation of industrial equipment.

From the end of World War II until the present, research information in the use of audiovisual media for the teaching of motor skills has been growing. A series of military research findings indicate that these media, used to advantage under proper conditions, could, and

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[2] Ibid.

are now contributing to more efficient motor skill learning.[3]

Along with the advantages in the use of these media, a number of disadvantages have been found. Researchers have found the following general problems in the use of films for motor skill training:[4]

1. The lesson is presented in a sequential series of steps at a fixed pace. The learner cannot vary this pace.
2. Smaller learning steps are eliminated because of limitations on the length of the film.
3. The film cannot allow for individual differences in background experience and facility, but must strike an average in these respects.

In the use of three-dimensional models and mock-ups in the teaching of motor skills, one of the advantages found in research studies by the military is that the student can actually perform the physical activity needed for motor skill learning.[5] A major disadvantage of

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[3]American Educational Research Association, "Audio-visual Communication," Encyclopedia of Education Research (New York: The MacMillan Co., 1960), p. 117.

[4]Sol M. Roshal, "Effects of Learner Representation in Film Mediated Motor Skill Learning," Human Engineering Report SDC 269-7-29, Special Devices Center 1952, Part III.

[5]Thomas Vris and J. A. Murnin, "Comparison of Training Media: Transfer of Principles Involved in a Manipulative Skill; Operation of the Aircraft Load Adjuster Slide Rule," Technical Report SDC 269-7-102, Special Devices Center, 1955, Part III.

3-D materials is that they are costly and cannot always be justified against use of the real object itself.[6]

Slides and filmstrips have been used successfully to teach complicated motor skills information.[7] Their greatest drawbacks lie in their lack of motion and their flat two-dimensional quality.[8]

There are many studies investigating the use of educational media including motion picture film, slides, filmstrips, and 3-D objects in various combinations in a cross-media approach for the teaching of motor skills.[9] While many of these combinations have been shown to be highly successful, some studies have shown that problems inherent in the singular use of these media are present when the media are combined.[10]

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[6]G. M. Torkelson, "The Comparative Effectiveness of a Mock-up, Cutaway, and Projected Charts in Teaching Nomenclature and Function of the 4mm Anti-craft Weapon and the Mark 13 Type Torpedo," Technical Report SDC 269-7-102, Special Devices Center, 1954, p. 21.

[7]Charles F. Hoban, Jr. and Edward B. VanOrmer, "Instructional Film Research, 1918-1950," Technical Report No. SDC 269-7-19, Special Devices Center, 1950, p. 180.

[8]Ibid.

[9]American Educational Research Association, Op. Cit, p. 120.

[10]P. E. Vernon, "An experiment on the Value of the Film and Film-Strip in the Instruction of Adults," British Journal of Educational Psychology, Vol. 16 (1956), pp. 149-162.

Printed Media and Motor Skills

There has been much research in motor skill learning through the use of such printed media as textbooks, workbooks, and training manuals. Textbooks were first used for skill training immediately before an during World War I. Early skills described in textbooks centered around physical education activities, such as tumbling and exercising. Passage of the Smith-Hughes Act of 1917, with emphasis on funds for vocational and skill training in schools, influenced the design and organization of many textbooks during this period. During the 1920's, vocational skills were taught for the first time through the use of textbooks.[11]

Motor skills information has also been taught by use of workbooks. The workbooks, usually bound by a paper cover, allow the student to write on the pages for frequent drill and review. The material is presented in small steps, sometimes as a follow-up to a textbook lesson.

The text and workbook have similar advantages in the teaching of motor skills information. They can be used individually by the learner and allow him to proceed at his own rate of speed. The workbook, allows some measure of active participation and reinforcement for the student by requiring him to give a written response to the material presented, followed by reference to an answer page.

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[11]U. S. Office of Education, Education for a Changing World of Work (Washington, D. C.: U. S. Government Printing Office, 1962), p. 5.

Surprisingly very few work books have been used for the teaching of motor skills.[12]

The training manual has been used frequently for skill training by the military and industry. The manual, bound by a paper or cloth cover, contains highly condensed material with frequent illustrations. The manual proved an instant success during World War I when it was necessary to train thousands of men quickly and efficiently. The advantages of the manual for motor skill training are that it is highly mobile, economical, and contains condensed, frequently illustrated material. It can be used often and allows for feedback by frequent testing at the end of chapters or sections. Few training manuals are used in schools today for skill or other types of learning.

Summary

Most studies of skill learning began in the middle 1920's. World War II brought a further increase in motor skill research and experimentation by the military and industry. Because of rapid technological developments in industry and in the military, a heavy emphasis continues today on research in motor skill learning.

Educators are meeting the greater demand for skill training by use of federal, state, and local funds for

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[12]Albert Gray, Lift the Workbook Cover (Wichita: McCormick Mathers Publishing Company, 1951), p. 286.

expanded vocational and distributive education programs.

There was much research and experimentation during World War II by the military and by industry in the use of audiovisual instructional tools for the teaching of motor skills.

Motion and still projected pictures, television, and 3-dimensional objects have been used to teach both simple and complex motor skills. Each of these media, used to advantage under proper condistion, was found to be most effective in teaching some skills. Each instructional tool was found to possess certain unique advantages for particular learning situations.

There are also a number of problems encountered with these media in motor skills training. Two general film problems to be met are an inflexible learning pace and limitations on film length resulting in elimination of short learning steps. A major disadvantage of the 3-dimensional materials is that the cost cannot always be justified against use of the real object itself. Drawbacks in the use of slides and filmstrips center around their lack of motion and their flat-2-dimensional quality.

There has been much research into motor skill learning through the use of such printed media as textbooks, workbooks, and training manuals. Following passage of the Smith-Hughes Act of 1917, many textbooks have been written to teach vocational motor skills.

Researchers have found that the text and workbook can be used individually and that they allow the learner to proceed at his own rate of speed. The workbook has also been found to allow some measure of active participation and reinforcement for the student by requiring him to give a written response to the material presented and reference to an answer page. The training manual has been used frequently for skill training by the military and industry. Advantages of the manual for motor skill training are that it is highly mobile, contains condensed material with frequent illustrations, and allows for feedback with frequent testing sections.

Importance of the Problem

With greater emphasis on skill and other kinds of learning today, the need for new and more effective teaching methods in the classroom is evident.

Recent research findings indicate that many types of effective learning can result from programed instruction. Teaching machines have been used successfully to teach many kinds of motor skills.[13] Research has been conducted by the military and industry on costly computer operated machines and programs.

The programed textbook, a simulated teaching machine possessing the advantages of programed learning, is similar

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[13]Charles I. Foltz, The World of Teaching Machines (Washington, D.C.: Electronic Teaching Laboratories, 1961), p. 65.

to text and workbooks in appearance, is economical, and is more readily available in the classroom than most teaching machine models.[14]

Teaching Machines and Programed Learning

There has been much interest in teaching machines and programed instruction since 1958, as evidenced by the availability of government and private funds for research, by interest within institutions of higher learning, by numerous conferences, by meetings and publications, and by the variety of teaching machines now in use and in production. This interest has been stimulated by the growing shortage of skilled teacher, by inadequate facilities throughout the country, and by the belief of many educators, industrialists, and military personnel that automated instructional devices can aid in increasing learning efficiency.[15]

A teaching machine is a device which can present systematically programed materials while making efficient use of the principles of reinforcement. There are many different types of machines designed to serve a number of teaching-learning purposes.

Teaching machines are designed for the type of program presented on them. Generally, a program consists of

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[14] Ibid.

[15] A. A. Lumsdaine, "Teaching Machines: An Introductory Overview," Teaching Machines and Programed Learning (Washington, D. C.: National Education Association of the United States, 1960), pp. 1-22.

the data to be assimilated and a set of questions and answers. The purpose of a program is to shape a series of responses into a complex act. This is done by reinforcing specific actions or responses that lead most directly to the learning desired.[16]

There are two types of program construction. One is concerned with breaking up a discipline into its smallest pieces to form incremental learning steps. This is called linear programing and is advocated chiefly by Dr. B. F. Skinner of Harvard University. One of the bases of Dr. Skinner's programing is the constructed response. It is his belief that the student is forced to think more and learns more quickly when he has to write in the response rather than choose from a series of alternative answers. In other words, the program does not test, buy rather teaches by requiring a positive effort. By using the constructed response method, only the right response is reinforced, and there is no chance of an incorrect response being learned.[17]

Another basic kind of programed learning is advocated by Dr. Norman Crowder of the Western Design Division of the U. S. Industries. This type of programing is called branching. In a branching program, the response

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[16] Ibid.

[17] Ibid., pp. 137-158.

takes the form of a choice of various multiple choice answers. The student is more apt to err in this type of programing. The wrong answers suggested by the program are carefully chosen to correspond with popular misconceptions or frequent errors shown by experience to occur most often at that particular stage of the course.[18]

Programed learning may assume many forms, but provides in most forms these three basic advantages over other teaching methods:

1. It requires continuous, active student response at moments when student interest is strongest. Questions are provided which must be answered before new material may be attempted.

2. It supplies immediate confirmation or correction, thus leading the student directly or indirectly to a correction of errors.

3. The student determines his learning pace as he operates the program or device. This permits him to move as rapidly or as slowly as his interest and his comprehension level require. Since the student proceeds at his own rate of speed, individual differences are met to some degree.

Teaching Machines and Motor Skill Learning

There has been much basic research using auto instructional devices for the teaching of such subjects as mathematics, science, and foreign languages. Results have shown that teaching machines using programed learning are effective in increasing learning while saving instructional time.

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[18] Ibid., pp. 286-298.

Considerable industrial research has been carried out by such firms as Lever Brothers, International Business Machines, the General Telephone Company of California, and the Sandia Corporation. Each has sought to investigate programed methods for a number of reasons, including increased sales and production output, training of new employees, and in-service training of employees.[19]

Gordon Pask has done considerable research in the area of computer based machines of all types for the teaching of motor skills.[20] One of the original devices developed by Pask for this purpose is called a "Saki." It is composed of an electronic computer and is designed to teach the skill of card punching.

L. C. Silvern, speaking before the American Management Association in 1961, pointed out that industry's role in the development of projection media type teaching machines should be directed toward a number of areas including on-the-job motor skill training.[21]

The Hughes Aircraft Corporation has been responsible for motor skill research in the use of teaching machines

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[19]Theodore Dolmatch, Evolution in Training: Programed Instruction in Industry (New York: American Management Association 1962).

[20]Gordon Pask, "Electronic Keyboard Teaching Machines," Education and Commerce, No. 24 (1958), pp. 16-26.

[21]L. C. Silvern, "The State of the Art: Teaching Matching Technology," A paper delivered before the American Management Association, August 28, 1961.

for the instruction of handicapped persons employed in industry. Their "Videosonic" machine incorporates the use of filmed operation shown on the screen of a small machine which is hand operated and which, like Pask's "Saki," gives reinforcement to the operator and proceeds in step-by-step fashion.

The studies conducted thus far on motor skill learning by the military and industry have pertained to teaching machines, with the use of either projected media (films, filmstrips, slides) and/or computer based programing systems. These auto instructional devices have also proved of great value to the military and industry.

Programed Textbooks

The programed textbook is a simulated teaching machine. Its external appearance does not differ from an ordinary textbook, but its interior is quite different. In most programed textbooks, each page consists usually of three, four, or five panels. Each panel consists of a short phrase or sentence explaining a small step or part of the lesson. Also included in the panel is a sentence or phrase containing a missing word or words. This is called, in the language of some behavioral psychologists, a "constructed response." It is designed to test the student's knowledge of the information contained in the frame.[22]

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[22]Eugene Galanter (ed.), Automatic Teaching: The State of the Art (New York: Wiley and Sons, Inc., 1959), pp. 63-68.

The panels are not read from the top to the botton of the page as in an ordinary book. Only one panel is "read" and responded to before the student turns the page. The missing word or words of the frame are found on the top panel of the following page. In this way, the student can confirm his written response and continue on with the lesson.

For example, the student begins with the top panel on page 1; he reads and responds to it by filling in the constructed response. He turns to page 2 and confirms his answer on the top panel. He then reads and responds to the new material in this frame, confirms his answer by turning the page, and similarly continues to the end of the unit or chapter. Here he is instructed to return to page 1, respond to the second panel on each page, and so continue to the end of the chapter. Since each panel or step is numbered, this procedure is not confusing.

Programed textbooks possess the advantages of programed learning in general. They have been used most effectively in teaching factual information. Industry and the military have used programed textbooks for varied purposes including introductory and on-the-job training. Educators have used programed textbooks for factual learning of such subjects as foreign language, mathematics, and science.

Programed textbooks have some disadvantages in comparison with direct lecture teaching. Research findings indicate that direct lecture and demonstration have been more efficient than programed textbooks in teaching enrichment and appreciation of such subjects as history, literature, and the fine arts.[23]

With the general advantages of programed learning in mind, researchers list the following unique contributions of programed textbooks over other types of programed learning: (1) they are economical; (2) they are easily handled and transported; (3) they have a great similarity with familiar classroom materials (books, textbooks, workbooks); and (4) they are more readily available.[24]

Programed Textbooks and Motor Skill Training

At the present time, documented research on motor skill training through programed learning has been carried out by the military and industry on teaching machines, with the use of projected media (film, filmstrip, slide) and/or computer based programing systems. In most schools

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[23]F. Carpenter, "How Will Automated Teaching Affect Education?," The University of Michigan School of Education Bulletin, October, 1959, pp. 2-5.

[24]James D. Finn and Donald G. Perrin, Teaching Machines and Programed Learning: A Survey of Industry (Washington, D. C.: National Education Association Occasional Paper No. 3, 1962), pp. 10-18.

the use of these machines and programs for further research and teaching is limited due to cost and lack of availability. Increased use in schools of audiovisual devices, shop and business machines, and automated office devices has created a strong need for new and more effective motor skill training techniques.[25]

If the programed textbook, with its many unique advantages, could be found effective in teaching motor skills information in the classroom, the results could be of great importance to education.

Scope of the Problem

Our specific interest in this study is to determine the degree of factual and skills information learning on 16mm motion picture projector principles and operation which are acquired in training session by each of two methods:

1. Lecture with demonstration. (Instructor lecture with demonstration consisting of films, slides, transparencies, mock-ups, and a 16mm motion picture projector, followed by individual unguided student practice.)

2. Use of a written response programed textbook containing visual illustration of the verbal text, followed by individual unguided student practice.

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[25] J. Lloyd Trump, Images of the Future (Washington, D. C.: National Association of Secondary School Principals, N.E.A., 1959), pp. 22-81.

Hypotheses to be tested are:

1. Learning measured by scores on a post-test on motion picture projection principles will be significantly greater in a group using a programed textbook with visuals rather than in a group receiving a lecture with demonstration.

2. Learning measured by scores on a motion picture projector operation test will be significantly greater in a group using a programed textbook with visuals rather than in a group receiving a lecture with demonstration.

Expected end results are: (1) improvement in factual knowledge and applied motor skills through the use of programed textbooks over a lecture with demonstration; (2) knowledge of whether the reactions of students are favorable toward the use of programed textbooks for the teaching of motion picture projection principles and projector operation information.

Limitations of the Study

There are a number of limitations within the design and structure of this study which may affect the findings and conclusions to some degree.

Dr. Harry Silberman, in a recent review of research comparing programed instruction with conventional instruction, stated that in many conventional classes, students taking part in a research project which had a fixed training interval may not have received the same material or may not have made efficient use of their time. He pointed out that, in many cases, the experimental groups worked

only on test-relevant material while control groups covered a wider range of topics. The Hawthorne effect, he continued, may also have been operating.[26]

Every effort was made to control these factors by giving the students in both groups the same material. The sequence and time length for completion of the material was also carefully fixed and followed. It is possible that the conventional group, because of the nature of the lecture and varied use of lecture materials received some instruction irrelevant to the post-test items or in different sequence from the experimental group. As much as was possible, both groups worked on test-relevant material on projection principles and projection operation.

The groups were told that they are not in competition with each other, that the programed materials are presented as a learning experience, and that the constructed response sheet filled in by the experimental group would not be checked by name for error count. These steps were taken in order to counteract the Hawthorne effect as much as possible.

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[26]Harry F. Silberman, "Self-Teaching Devices and Programed Materials," Review of Educational Research, Instructional Materials: Educational Media and Technology (Washington, D. C.: National Education Association, April, 1962), pp. 185-187.

Silberman, in his review of similar research studies, pointed out that among many experiments reviewed, it was not uncommon to find very short programs administered in one or two hours to small samples of highly motivated students, who, after viewing the programs as a test, were immediately given a follow-up of short improvised quizes.[27]

The programed textbook used in this study was divided in two parts, one concerning projection principles and the other concerning projector operation. The first section on projection principles, 55 frames in length, was administered in a one hour time period. The variable of student motivation described earlier was scrupulously considered, and every effort was made to simulate a classroom learning situation. The lecture with demonstration group was given the same material as the experimental group in approximately the same time period. A post-test composed of items within the programed textbook and on the lecture with demonstration material was given to both groups immediately following the presentations.

The second section of the programed textbook on projector operation and consisting of 170 frames, was a highly-cued small-step explanation of the six steps involved in this particular operation. It duplicated as nearly as possible the lecture given by the instructor to the conventional group.

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[27] Ibid.

While the experimental and lecture with demonstration groups were carefully equated as to background and aptitude for the skill to be taught, there is a possibility that certain inaccuracies existed in the criterion instrument used, or that previous experience or background in this area was not properly allowed for.

Another problem related to the time period for the applied projector operation test. The test for both groups could not be given as a follow-up for the presentations on projector operation because of a lack of sufficient time in the training session and a shortage in the number of projectors available. The test was given within the next three days for both groups. It is accordingly possible that students were "contaminated" by outside factors, such as further reading or practice or, conversely, by lack of retention of the skill. Also, the transfer process for both groups could have been to some extent within this period of time.

Under ideal conditions, all students would have been given the training and practice sessions, followed immediately by all testing.

Definition of Terms

The following terms appear frequently and are defined as they relate to this study:

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Skill learning: Progress toward better performance in motor activity as a result of instruction and/or practice with the 16mm sound motion picture projector.

Motor activity: All specific and generalized movements involving motor coordination and better performance, resulting in improved motor coordination.

Teaching machines: Learning machines, self-instructional devices, or auto-instructional devices. This includes any device which can present systematically programed materials and make use of reinforcement.

Programed textbook: Printed in book form. Each page consists of three panels. Each panel consists of a short phrase or sentence explaining a small step or part of the lesson. Included in the panel also is a sentence or phrase containing a missing word or words. The panels are not read from the top to the bottom of the page. Only one panel is read and responded to before the student turns the page. The missing word or words of the frame are found on the top panel on the following page. In this way the student can confirm his written response and continue with the lesson. He then reads and responds to the new material in the frame, confirms his answer by turning the page, and similarly continues to the end of the unit of chapter. Here the student is instructed to return to page one, respond to the second panel on each page and continue to the end of the unit of chapter.

Cue: A word used interchangeably with "prompt" to mean any bit of information added to a program item to make it easier for the student to make the correct response.

Frame: A single step of a program usually containing information and a question to be answered.

Programed text with visuals: A carefully sequenced linear text, strengthened with pictorial illustrations consisting of either photographs or drawings. The constructed responses will be filled in by the student in the conventional manner but will be additionally reinforced by the visuals.

Feedback: A technique which gives the student (and eventually the teacher) immediate knowledge of the correctness of his answers to items in the program. This acts as a type of reinforcement to correct answers.

Step: The space between one item and another in a programed lesson.

Methodology

The experiment was conducted during the Winter term, 1962. The sample included undergraduate and graduate students enrolled in an undergraduate audiovisual education course at Michigan State University.

The experiment included the following phases:

1. The participants were divided into two groups by randomly choosing names from a class list. One group was designated as Group A (control). The second group was designated as Group B (experimental).
2. Two weeks prior to the training session, the groups were equated from information gathered on a background-experience questionnaire administered to all participants. Grade point averages were compared between the groups to determine if a homogeneity existed between the means. Experience and background information were compiled and students were classified as having either a mechanical or non-mechanical background. Determination was made from this questionnaire of those who had previously operated a 16mm motion picture projector and those who had not.
3. One week prior to the training session, an objective fill-in pre-test on motion picture projection principles was administered to all participants.
4. On the day of the training session the groups met in separate rooms. Group A (control) received a lecture

with demonstration on 16mm motion picture projection principles and projector operation. Group B (experimental) received the lesson through the use of a programed textbook with visuals. At the conclusion of the lesson on projection principles both groups took an objective fill-in post-test. This test was matched with the pre-test administered one week earlier. The second part of the lesson concerned 16mm motion picture projector operation. At the conclusion of the lesson the participants in both groups filled out a reaction questionnaire. Group A participants were instructed to return one of the following two days for a one hour unguided projector practice session. Group B participants were each provided with a Bell and Howell Model 540 projector following the training session for individual practice. All participants were instructed to return for a final projector performance test on the third day following the training session. Each projector test was administered separately and in private to each student on a Bell and Howell Model 540 projector.

5. A replication experiment was held during the Spring term, 1963. The procedures were duplicated as near as possible to the earlier experiment conducted during the Winter term, 1962.

CHAPTER II

REVIEW OF PERTINENT LITERATURE

Introduction

This review of research literature contains a careful listing and explanation of findings on motor skill learning as they relate to this study. The research design and methodology of this study further cite and apply the guidelines established by these findings in the areas of physical activity, ability, practice, and transfer as they relate to motor skill learning.

This review of research literature also contains a careful listing and description of pertinent studies on the use of educational media and programed learning for skill training. The problem, background, and important areas of this study further cite and apply these and other studies to the present one. Other studies, not described in this review, but cited in and applying generally to either the statement of the problem, design, background, or importance of this study, are listed in the Bibliography.

Motor Skill Research

Almost four hundred studies have been reported during the past thirty years dealing with physical activity as related to skill learning. The physical activity theory

states that motor skills are learned most successfully when a student actually engages in an activity directly or indirectly related to the skill.[28]

A number of related findings have emerged from the physical activity theory. Some of the more widely accepted ones are:

1. Individuals with higher levels of motor ability can learn motor skills more quickly and easily.[29]
2. Motor ability or aspects thereof are related to the learning of specific skills.[30]
3. Distributed practice is superior to massed practice in motor skill learning.[31]
4. Skill learning results from specific practice of the particular skill.[32]

In consideration of the preceding motor skill research findings, the following steps were taken in carrying out this

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[28]Dorothy R. Mohr, "The contributions of physical Activity to Skill Learning," Research Quarterly, Vol. 31 (May, 1960), p. 321.

[29]Roy M. Dorcus, "Performances of Athletes in Coordination Tests," Journal of Comparative Psychology, Vol. 3 (December, 1923), pp. 475-499.

[30]R. H. Burpee and W. Strolle, "Measuring Reaction Time of Athletes," Research Quarterly, Vol. 26 (March, 1955), pp. 28-35.

[31]Olive G. Young, "The Rate of Learning in Relation to Spacing of Practice Periods," Research Quarterly, Vol. 25 (May, 1954), pp. 231-243.

[32]Lois Dusenberry, "A Study of the Effects of Training in Ball Throwing by Children Ages 3-7," Research Quarterly, Vol. 23 (March, 1952), pp. 9-14.

research experiment:

1. As a part of the training session, all participants practiced with a 16mm motion picture projector.
2. The background of all participants was classified as either mechanical or non-mechanical, according to answers checked on a background questionnaire. This aided in determination of those students with and without motor skill ability. The groups were equated on the basis of background and previous knowledge of projector operation.
3. During the training session, frequent rest periods were given to all participants, according to a theory developed by B. R. Epstein.[33] This theory states that frequent rest periods during a training session will overcome possible negative effects of a single massed practice session in the learning of a motor skill.

Other motor skill research has been conducted on the effectiveness of the transfer from verbal media to the skill task itself. It has been found that positive transfer from verbal pretraining to motor performance shows a consistent decrease as the motor task complexity increased.[34] In a

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[33]B. R. Epstein, "Immediate and Retention Effects of Interpolated Rest Periods on Learning Performance," Teacher's College Contributions to Education, No.949 (1949).

[34]William F. Battig, "Transfer from Verbal Pretraining to Motor Performance as a Function of Motor Task Complexity," Journal of Experimental Psychology, Vol. 51 (1951), pp. 371-378.

related study, in which time was used as the measure of learning, it was found that verbal training did yield a significant amount of positive transfer to the performance of the motor task.[35]

It has seemed evident to many investigators of motor skill learning that the difficulty of motor tasks is to a large extent determined by the complexity of the training situation to which the subject must react, rather than by the demands made on his motor capacities.

In a study conducted by Gagne and Baker, the results indicated the considerable effectiveness of training on a pictured representation of the skill task.[36]

In consideration of the preceding motor skill research findings, a number of steps were taken in carrying out this research experiment. The lesson was made less complicated for all participants in both groups by dividing the programed textbook and the lecture with demonstration into two sections. These sections included motion picture projection principles and motion picture projector operation. In the programed textbook, to

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[35]Katherine E. Baker and Ruth C. Wylie, "Transfer of Verbal Training to a Motor Task," Journal of Experimental Psychology, Vol. 40 (1950), pp. 632-638.

[36]R. M. Gagne and Katherine E. Baker, "Transfer to a Motor Skill from Practice on a Pictured Representation," Journal of Experimental Psychology, Vol. 39 (1949), pp. 342-355.

further aid in simplifying the lesson, the two main sections were broken into a series of small interlocking steps, and each step was illustrated by a drawing or photograph. A number of educational media, including films, slides, and overhead projection transparencies, along with mock-ups and an actual 16mm motion picture projector, were used in the lecture with demonstration.

Educational Media and Motor Skill Research

The instructional motion picture film has been used extensively for research and experimentation in motor skill training. An explanation of film advantages and disadvantages in motor skill training has been given in the area of this study on the background of the problem. The findings in the following study further point out some advantages and disadvantages in the use of a film for motor skill training.

Vandermeer and Cogswell investigated the instructional effect of a film on the operation of a 16mm sound motion picture projector.[37] The problem was, that while the film up until that time, had been used to teach a number of simple skills, little research had been conducted with the

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[37]Abram W. Vandermeer and John Cogswell, "Instructional Effect of the Film, "How to Operate the Army 16mm Sound Motion Picture Set", Human Engineering Report, SDC 269-7-29, Special Devices Center, 1952, Part VI.

film to see how well a more complicated skill could be taught. The purpose of the investigation was to gather data pertaining to the effect of a motion picture film titled "How to Operate the Army 16mm Sound Projector Set" on (1) the development of certain skills in operating and maintaining the Army sound projector set, and (2) the modification of attitudes concerning the projector and the projectionist's job.

Four separate classes of 43 servicemen trainees, unfamiliar with projector operation, were used in the investigation. All of the experimental work was done during the first three hours of the course. The behavioral objective of the film was to demonstrate a number of projector operation procedures so that, without further instruction, the audience would feel competent to, and be able to, perform the operations directly on the projector.

A projector operation test and attitude questionnaire were devised to test the trainee's acquisition of the components of the skill in the behavioral objective of the film and to measure any shifts in the specific attitudes of the trainees.

In order to determine the extent to which the film contributed to the development of the skill in projector operation, the projector operation post-test was administered to each trainee within fifteen minutes after he

viewed the film. The same test was given to eleven randomly selected trainees before they had received any instruction on the projector. The projector operation post-test was administered individually and in private to each trainee.

Scores on the performance test formed the basis for appraising the film's contribution to projection skill development. The attitude questionnaire was administered to those seeing and not seeing the film, in an effort to determine the extent to which the film influenced attitudes regarding the projectionist's job.

The general findings of this study are (1) that trainees were able to perform many more of the skills required in the operation of the projector after seeing a film about the skill than they were able to perform before seeing it, (2) trainees were led to accept the attitudes toward the projectionist's job that were shown by the film, and (3) trainees were generally very well disposed toward the film as a help in their early stages of learning to operate the projector.

A major implication of the study cited by the investigators was that testing might be of greater value if it were conducted before the film reached its final state of production, so that the findings could result in modifications that would improve the film prior to its release. The investigators also cited a pacing problem in the use of films for skill training. All trainees were

forced to learn at the same rate of speed as the film was being shown.

Three-D materials have been used extensively for motor skill training. An explanation of advantages and disadvantages in the use of 3-dimensional teaching materials for motor skill training is given in the area of this study on the background of the problem. The findings in the following study further point out some advantages and disadvantages in the use of 3-dimensional teaching materials for motor skill training.

Vris investigated the relative efficiency of teaching principles versus specific training in a skill task.[38]

Two training procedures involving the teaching of "principles" and "specifics" were compared in order to determine their relative efficiency in producing a generalized response in motor skill learning. Vris compared various methods in the use of several modifications of the original equipment in the training situation including (1) the actual equipment, (2) a three-dimensional modification of the equipment, and (3) a two-dimensional diagram.

The motor task selected was the operation of 16mm motion picture projectors. Several reasons were given

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[38]Thomas Vris, "A Comparision of Principles Training and Specifics Training Using Several Types of Training Devices," Technical Report SDC 269-7-102, Special Devices Center, 1955, Part III.

for the selection of this task, including the fact that the task was predominantly three-dimensional in character.

A sample of 144 college students, unfamiliar with the operation of motion picture projectors, were selected as subjects, and were assigned to groups of four subjects within each group. The 36 groups thus formed constituted the sampling units of the experiment and were assigned at random to the eight experimental conditions.

The following conclusions were drawn:

1. Given a motor task involving complex equipment, it appeared that the operation of the specific equipment would be learned if the operation was demonstrated in either a specific fashion or supplemented by an explanation of the principles of the operation.

2. If the actual equipment or a three-dimensional modification of the actual equipment was used in the demonstration, it appeared that "principles" training was more effective than "specifics" training in yielding satisfactory performance on related equipment.

3. If a two-dimensional representation of the modified equipment was used in the demonstration, and if the required operation was predominantly three-dimensional in character, the results of this experiment tended to indicate that "principles" training was no more effective than "specifics" training.

4. "Principles" training with either the actual equipment or a three-dimensional modification of the

equipment was more effective than "principles" training with a two- dimensional representation when the task was predominately three-dimensional in character.

The investigator concluded the study with the statement that a specified operation in a motor skill would be learned if the operation was demonstrated on the actual equipment. When the common principles of the task were included in the training, performance on a related piece of equipment would be greater than when the training was merely a specific demonstration on the initial equipment. Furthermore, he pointed out that the degree to which principles training would be more effective would be dependent upon the nature of the task and the training equipment.

Some recommendations from the study were:

1. If it appeared likely that generalizable learning would be needed, principles of operation should be taught as well as the specifics of the task.

2. If the task were three-dimensional in character, a three-dimensional training device should be used.

3. Recommended that the training device be tested during the developmental stages upon an appropriate sample of trainees. Recommended the final form of the device not be considered complete until testing demonstrated that consistent performance errors no longer occurred.

Programed Learning and Skill Research

Gagne and Bolles described the factors in learning efficiency in a 1959 research report.[39] They stated that the military was growing interested in such complex skill tasks as identification (identifying a number of objects, events, or places by differentiating names or other responses), the following of procedures (teaching a pilot to follow procedures in the air, such as opening switches and checking gauges), and concept usage (guiding behavior by means of rules, such as use of the phrase "turn power off before opening cover").

Gagne and Bolles pointed out that the increasing use of automatic equipment has tended to decrease progressively the importance of simple motor skill learning in the armed forces.

Industry has also grown more interested in complex skill tasks. Many highly complex skills have been taught in industry by "adaptive" teaching machines.[40] Adaptive teaching machines are ones which adapt themselves automatically or through a computer control system to the

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[39] Robert M. Gagne and Robert C. Bolles, "A Review of Factors in Learning Efficiency," Automatic Teaching: The State of Art (New York: John Wiley and Sons, 1959), pp. 13-55.

[40] Institute for Communications Research, New Teaching Aids for the American Classroom (Palo Alto: Stanford University Press, 1959), pp. 151-159.

response of the learner, advancing or slowing his learning pace.

An example of the research and experimentation with auto instructional devices by the military is the description by L. J. Briggs of a device for affording active practice, with prompt feedback, in learning to diagnose malfunctions in an airborne fire control system. The machine includes a microfilm projector coupled to a unit containing synthetic components of the equipment system which the student is learning to troubleshoot.[41]

A number of other studies describing computer controlled machines and experiments are listed in the bibliography of this study and in Appendix I to the Lumsdaine and Glaser book Teaching Machines and Programed Learning.[42]

Summary

This review of pertinent literature contains a careful listing and explanation of research dealing with (1) motor skill learning and (2) the use of educational media and programed learning for skill training.

There has been much research on physical activity in motor skill learning. The physical activity theory

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[41] L. J. Briggs, A Troubleshooting Trainer for the E-4 Fire Control System (Lackland Air Force Base, Texas: Air Force Personnel and Training Research Center, July, 1956).

[42] Arthur Lumsdaine and Robert Glaser, Teaching Machines and Programed Learning (Washington, D. C.: National Education Association, 1960), Appendix I.

states that motor skills are learned most successfully when a student actually engages in an activity directly or indirectly related to the skill.

Some related findings are that (1) individuals with higher levels of motor ability can learn motor skills more quickly and easily, (2) motor ability or aspects thereof are related to the learning of specific skills, (3) distributed practice is superior to massed practice in motor skill learning, and (4) skill learning results from specific practice of the particular skill.

Other motor skill research showed that (1) positive transfer from verbal pretraining to motor performance shows a consistent decrease as the motor task complexity increases; (2) verbal training using time as the measure of learning does yield a significant amount of positive transfer to the performance of the motor task; (3) training on a pictured representation of the skill task brings an effective amount of transfer.

Two research studies, dealing with the use of educational media for the teaching of 16mm motion picture projector operation, were conducted for the military in the early 1950's. Vandermeer and Cogswell investigated the instructional effect of the film in operating a 16mm sound motion picture projector. Vris used a three-dimensional training device to investigate principles versus specific training in projector operation. It was found in the film

study that (1) inflexible film pacing forced trainees to learn at the same rate of speed; (2) the value of a film would be greater if it was tested and modified prior to its final production state. In the three-dimensional training device study it was found that (1) principles of operation should be taught as well as the specifics of the task; (2) if the task is three-dimensional in character, a three-dimensional training device should be used; (3) the training device should be tested in its developmental stages.

Gagne and Bolles stated in a research report in 1959 that the military was becoming less interested in simple motor skill learning and more interested in complex skill tasks.

A number of complex skill tasks have been taught by teaching machines which adapt themselves automatically or through a computer control system to the response of the learner.

CHAPTER III

METHODS AND PROCEDURES

Organizing and Constructing the Program

Before work was begun on the program, much literature about programs and program construction was consulted. This was done (1) to further acquaint the author with present programing techniques, and (2) to establish a rationale for the use of a particular programing technique.

A linear programing technique requiring constructed responses was chosen as the model for this experiment.

This decision was based on the following research and experimental findings:

1. Facts and skills have been successfully taught through the use of linear programs.[43]

2. Constructed responses afford a great deal of positive reinforcement for the learner. The learner usually writes a correct response and sees his response confirmed.[44]

3. Linear programs using constructed response modes have been successful in learning situations

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[43] T. F. Gilbert, "Some Issues Involved in Selecting an Automatic Teaching Device," A report to Bell Telephone Laboratories, September, 1958.

[44] E. B. Fry, "Teaching Machines: An Investigation of Constructed Versus Multiple-Choice Methods of Response," Automated Teaching Bulletin No. 1, December, 1959, pp. 11-12.

where time is a factor. (They are best used in training sessions with a set time limit.)[45]

The program contains the following characteristics:

1. The step size is small.

2. There are frequent review frames throughout the book.

3. Many of the early frames contain "cues" or "prompts."

4. Each page contains only three frames.

5. Constructed response confirmations are placed on the page, followed by the constructed response sentence or phrase.

These decisions were based on the following research and experimental findings:

1. Skill task training has been most successful when the operations and principles were broken into small steps. Success has also been maximized when steps have followed sequentially from the most simple operations to the complex.[46]

2. Success has been greater in skill training when terminal or review frames have been included within the program.[47]

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[45] Ibid.

[46] A. L. Irion, "An Investigation of Four Modes of Operation and Three Types of Learning Tasks on the Improved Subject Matter Trainer" (unpublished paper, Maintenance Laboratory, AFPTRC, Lowry Air Force Base, Colorado, 1957).

[47] F. F. Kopstein and M. Rockway, "Self-Tutoring and Problems in Training," Paper read at the Air Force Office of Scientific Research and the University of Pennsylvania Conference on the Automated Teaching of Verbal and Symbolic Skills, Philadelphia, December, 1958.

3. The use of "cues" and "prompts" placed at the beginning of units or sections has been most effective in step-by-step learning.[48]

4. There has been much success with programed textbooks when only three frames were included on a page. The greatest reason for the success has been the ease in reading.[49]

5. Temptation to "cheat" (pre-check the correct response) was minimized if the student needed to turn a page to check his constructed response.[50]

The months of June and July, 1962, were spent in organizing and writing the program. During this time, the author consulted frequently with experts in the field of programed instruction at Michigan State University. A number of classmate colleagues, involved in writing programs, also helped on less technical questions. These colleagues also assisted in pre-testing certain areas on the programed textbook. These tests influenced the original organization of the program material. The first draft of the program was completed without illustration of any kind. It was the original intent of the investigator, in fact, to test the book without illustration in a separate experimental group during the following January training session.

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[48]L. J. Briggs, A Survey of Cueing Methods in Education and in Automated Programs (Pittsburgh: American Institute for Research, Research Report, May, 1960).

[49]L. E. Homme and R. Glaser, "Relationships Between the Programed Textbook and Teaching Machines," Automatic Teaching: The State of the Art, edited by E. H. Galanter (New York: John Wiley and Sons, 1959), pp. 103-108.

[50]Ibid.

The first completed draft was assembled during the middle of August, 1962. Twenty copies were mimeographed and staple bound. The projection principles area of the book contained 78 frames. The projector operation area contained 181 frames. Preliminary tests were conducted on a mixed sample of office personnel in the Audiovisual Center, and on a number of East Lansing secondary and elementary teachers. The participants were also asked to list frames and areas which seemed unclear or overly complicated. The aim of this preliminary test was to locate frames and areas which needed revision.

The participants, collectively, found 23 frames which were unclear and in need of revision. A number of comments indicated that certain frames in the projector operation section of the program were not challenging to the student, due to their simplicity. A comment on almost every evaluation of the book indicated that the transfer of skills information from the book with no visuals to the projector was made with difficulty. Participants found, as for example, a number of projector parts which were described in detail in the book, but could not be located or relocated on the actual projector. This preliminary evidence seemed to point out that the programed textbook without visuals of any kind, presented many problems in teaching skills information.

A complete revision of the programed textbook was begun in late August, 1962, and completed by the end of September. The projection principles section of the book was confined to 55 frames, while the projector operation area was cut to 125 frames. The book was again mimeographed and staple bound.

The programed textbook was organized in the following manner:[51]

The motion picture projection principles area began on frame 1 and extended to frame 55. Within this area was included (1) the lesson objectives; (2) a definition and description of projectors, films, and motion picture screens; (3) an explanation of motion picture projection; (4) a description of motion picture sight and sound processes; and (5) explanation of projector mechanical areas. A series of review frames were included at the end of each section. A final review, at the conclusion of the motion picture projection principles area, covered all the material presented.

The motion picture projection procedure and projector operation area began on frame 56 and concluded on frame 223. Within this area was included (1) an explanation of projector setting up and checking out procedures, (2) an explanation of projector threading procedures, (3) an

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[51]See Appendix II.

explanation of projection operation procedures, (4) an explanation of operator showmanship and operational failures, and (5) an explanation of projector rewind and casing procedures.

A series of review frames were included at the end of each section on projector operation. A final review included all the material covered in the book.

In late September, the book was sent to a number of authorities in the field of programed learning for general comments on the organization of the book and for specific comments on areas which needed still further revision. Those authorities receiving a copy were (1) Dr. Aldo Bonura, Director of New Media, Scott Foresman Company, Chicago, Illinois; (2) Dr. P. Kenneth Komoski, Director, Center for Programed Instruction, New York, New York; (3) Dr. Seth Spaulding, Director, Educational Media Branch, U. S. Office of Education, Washington, D. C.; and (4) Dr. B. F. Skinner, Professor of Psychology, Harvard University, Cambridge, Massachusetts. All of the authorities sent back within two weeks a number of comments and suggestions. A synthesis of the suggestions are:

1. Steps should be made smaller in the projection principles area of the book. Fewer operations should be included in one step.
2. The frames in the program on the overall program goals should be written in line with the

suggestions in writing objectives outlined by Mager in his book, Preparing Objectives for Programed Instruction.[52]

3. A detailed table of contents should be included with the book.

4. A number of the constructed responses should be shortened to one or two words in the projector operation area.

5. Visuals should be included along with the verbal text.

As much as possible all suggestions were reviewed and applied in the book. New pages were mimeographed and inserted in the book to replace old ones.

A general interest in the programed textbook and the study was expressed by all the authorities.

Testing the Program

A series of program tests were set up in the fall of 1962 to determine the number and origin of frames in need of revision.

B. F. Skinner and other contemporaries in programed learning have set five per cent as a significant error rate. They contend that, if on a test of a linear program, five percent or more of the group make constructed response errors on a particular frame or frames, the frame or frames are in need of revision. Conversely, those frames, with

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[52]Robert F. Mager, Preparing Objectives for Programed Instruction (San Francisco: Fearon Publisher, 1962), pp. 10-13.

less than five per cent of the group making a constructed response error, can be assumed not to need revision.[53]

Students enrolled in an audiovisual education course were chosen for the initial testing because they had similar academic backgrounds to those who would carry out the final controlled experiment. A large majority of the class was completely unfamiliar with 16mm projector operation as determined by a background-experience questionnaire. For this reason, it was evident that previous experience would not distort the constructed response error rate. After each student had worked through the programed textbook, results were tabulated on the number of constructed response errors in each frame.

By application of the five per cent error formula (Table 1), it was determined that twenty-seven of the 223 frames in the program were in need of revision.

Revising the Program

The revision sequence followed in this order:

1. The frame was examined to determine its relationship to the lesson.
2. An examination of the incorrect constructed responses was made to determine if the errors

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[53]Abram Amsel, "Error Response and Reinforcement Schedules in Self-Instructional Devices," Teaching Machines and Programed Learning (Washington, D. C.: National Educational Association, 1960), pp. 506-517.

TABLE I

NUMBER OF SIGNIFICANT INCORRECT CONSTRUCTED RESPONSES PER FRAME

Frame Number	Incorrect Responses
34	5
36	7
37	6
45	15
86	6
88	8
89	9
95	5
96	5
106	4
113	8
114	5
132	4
141	4
143	8
144	4
159	4
161	6
169	7
171	4
182	4
196	5
198	5
201	5
211	5
217	5
218	4

made by all participants were the same, similar, or quite different.

3. The error source was investigated by comparing constructed responses to determine if the source originated in the wording and content of the frame or in the constructed response sentence.

The constructed response errors made by the participants were found to be quite similar. The problem areas were found to be quite varied, including: (1) too much subject content in a frame, (2) unclear wording of the frame and constructed response sentence, (3) too many constructed responses required per frame leading to general uncertainty about the frame, and (4) a need for "cues" and "prompts" in constructed response sentences.

An example is as follows: On frame 141 in the projector operation area of the book, the constructed response sentence read, "After the film has begun, the projectionist will most always have to _____ the projected image." The desired response was "sharpen." But a large majority of the participants wrote "adjust." After an examination of the material in the frame, it was discovered that stronger emphasis was placed on the word "adjust" than on the term "sharpen." The frame was re-written to emphasize the term "sharpen."

After a revision of the faulty frames, the entire book was checked for general weaknesses. To encourage and challenge the readers, certain sentences were inserted in review sections. Some examples are: (1) "How did you do

on this review?" and (2) "If you feel confident of the steps presented, move to the next section."

Re-Testing the Program

The revised programed textbook was further tested on a group of students enrolled in an audiovisual education course during the same quarter. A large majority of these students had no previous experience with 16mm projector operation as determined by a background-experience questionnaire. These results were significant, as with other experimental groups, because of their influence on the constructed response error rate. After each student had worked through the programed textbook, tabulation of error rate was again based on the Skinner five per cent significance level. Five of the 223 frames in the program showed a significant amount of constructed response errors (Table 2).

A check was made to determine the number of incorrect responses on frames re-written from the previous test. Only frame 34, with seven incorrect responses, fit this category. The other four incorrect responses were on frames which had previously had an insignificant amount of errors.

Further Revisions

The procedures used in revision of the first program test were applied again. After a careful examination of

TABLE 2

NUMBER OF SIGNIFICANT INCORRECT CONSTRUCTED RESPONSES PER FRAME

Frame Number	Incorrect Responses
34	7
36	4
39	5
125	3
129	5

incorrect responses, it was determined that (1) errors made by the participants were again quite similar, and (2) problem areas were again quite varied.

Frame 34, which showed a significant number of constructed response errors on both program tests, was re-examined. During the first revision of the frame, it was determined that the wording of the constructed response sentence was ambiguous and did not reflect the content of the frame. It was re-written to read, "As the film moves through the sound motion picture projector a light is directed through the sound track. This light comes from the _____ _____." By such responses as "exciter bulb," "sound light," and "sound lamp," it was evident that the participants understood the content of the frame. A frame of reference in the form of a word "cue" was needed to elicit the precise term required. For this

reason, a "cue," consisting of the first letter of the words "exciter lamp," was inserted. The constructed response sentence now read, "As the film moves through the sound motion picture projector, a light is directed through the sound track. The light comes from the e_____ l_____."

The other four frames, which showed significant constructed response errors, were carefully reviewed and changed.

Preliminary Program Findings

The participants in this second program text group also worked with a 16mm motion picture projector. Individual comments on the performance of every student were listed by the instructor. In addition, the students were asked to make written comments about the training technique.

Findings showed that transfer of skills information from the verbal programed textbook to the 16mm motion picture projector was poor.

Adding Visuals to the Program

In view of the preliminary program findings, work on the addition of visuals to the programed textbook began in late August of 1962. The book was to duplicate its verbal counterpart with the addition of visuals within each frame.

Visuals were added to the programed textbook (1) to give visual identity to the concepts, operations, and term descriptions; (2) to reinforce the general content; (3) to break up the reading material; and (4) to aid in motivating

the student by showing correct or incorrect projection procedures.

The following types of visuals were chosen:

1. Photographs were used to show projectors, projector parts, and projector operations.
2. Drawings were used to show motion picture principles, concepts, and related projection equipment and materials.

Visuals (photographs or drawings), approximately 2-1/2 inches by 2-1/2 inches in size, were placed within most frames of the program. Each page contained no more than three visuals per page. A number of small arrows were included on many of the photographs throughout the book to emphasize certain projector areas or operations. Most of the photographs were close-up shots demonstrating projection skills or projector parts. Most drawings depicted projection principles and projection materials.

The pictures were taken in the Audiovisual Center at Michigan State University with equipment and facilities which belonged to the Center. The drawings were done by artists on the Audiovisual Center staff.

The book was typed on bond paper, and the visuals were pasted into appropriate areas. In order to secure satisfactory quality in the visuals, a photo offset printing process was employed.

Testing the Program with Visuals

The book with visuals was tested in November of 1962 by a group of students similar to those in other experimental groups. A majority of the students were completely unfamiliar with projector operation. After working through the book, each student practiced with a projector. After completion of the practice period each student was tested by a projector operating proficiency test. Tabulation of constructed response errors was, as in the past, based on the Skinner five per cent significance level.

Preliminary Findings About the Program with Visuals

Only two of the 223 frames in the program showed a significant number of constructed response errors.

Some other findings were (1) greater success in the transfer of skills information from the programed textbook containing visuals to the 16mm projector, (2) a number of visuals with unclear relationship to the verbal text, and (3) a number of poorly reproduced visuals showing projector parts and operations.

Revising the Program with Visuals

Minor revisions were carried out on the verbal part of the program. Visuals were redone (1) to bring out greater detail on projector parts, principles, and operations; and (2) to strengthen their relationship

to the verbal text. The verbal portions of the book were retyped, and the revised visuals were inserted.

The revised programed textbook was submitted to the printers during the final days of November, 1962.

Consultations and Preparations

The experiment was set for the Winter term, 1963. The sample was to include the students enrolled in an undergraduate audiovisual education class at Michigan State University.

One hundred copies of the programed textbook with visuals were returned from the printers during the middle of December.

At this time, a number of consultations were held with the staff of the Educational Research Bureau in the College of Education. Mr. John Gordon, a graduate student in educational research, served as a consultant for the project.

A recommendation by the Research Bureau was that the verbal programed textbook be dropped altogether from the experiment. Previous experiments with the completely verbal book had proved conclusively that its use for the purposes of this experiment would be far less effective than the book with visuals. The recommendation was that only two groups be set up, one receiving the lecture with demonstration, and the other receiving the

lesson through the programed textbook with visuals. Permission was granted for the change by the investigator's guidance committee.

In connection with the experiment: (1) a background-experience questionnaire was prepared for use in equating the groups in the experiment by determination of individual academic achievement, general mechanical ability, and 16mm motion picture projector experience; (2) a pre- and post-test was prepared to determine the participant's knowledge of motion picture projection principles before and immediately following the training session; (3) a series of response sheets were prepared for use with each programed textbook; (4) a questionnaire was prepared to determine student reactions of the training methods; (5) a 16mm motion picture projector operation performance test was designed to measure the effect of the training sessions on both groups regarding projector operation.

The pre- and post-tests concerning motion picture projection principles were designed in the following way: (1) they covered motion picture projection principles presented in the lecture with demonstration and in the programed textbook; (2) they were objective, containing twenty sentences with missing words; (3) the post-test matched the pre-test. (This was accomplished by re-writing the sentences and changing their order.)

The response sheets contained a number of underlined blank areas, corresponding to the number of constructed response blanks in each frame of the programed textbook. Each underlined blank area contained the number of the corresponding frame in the programed textbook. Students were instructed to make their responses on these sheets, rather than on the book itself.

The projector operation performance test was based upon a checklist of the operations described in the lecture with demonstration and in the programed textbook. The checklist was developed by (1) listing the six major skill units of projector operation, and (2) breaking each major skill unit down into its component parts.

The Experiment

A total of 68 students participated in the experiment in the Winter term, 1963. The group consisted of both undergraduate and graduate students enrolled in an undergraduate audiovisual education course.

The following steps were carried out:

A. On the first class meeting, the participants were divided into two groups. This was done by randomly choosing names from a class list. The group to receive the lecture with demonstration was designated as Group A (control). The group to receive the experimental treatment was designated as Group B (experimental).

B. On this same day, all participants in the experiment were given the background-experience questionnaire and instructed to complete it. The factors considered in equating the groups were gathered from information obtained from the questionnaires.

C. During the second class meeting the objective pre-test was administered to all students jointly. They were instructed to complete the test, even though many were entirely unfamiliar with the material.

D. During the third class meeting, the groups met in separate rooms for the training sessions. The sessions began at 2:00 P.M. and were finished at 5:00 P.M. A break of approximately 15 minutes was given to both groups. The students in Group A (control), received the instructor lecture with demonstration. Demonstration of motion picture projection principles and 16mm motion picture projector operation was carried out with the following equipment and materials:

1. The motion picture films, "Facts About Projection," "Facts About Films," and "Care and Operation of the Bell and Howell Projector" were shown.
2. Mock-ups of 16mm motion picture projector parts were used, including the projector sound systems, the projector "claw," the projection system, and the projector threading system.

3. 2" by 2" slides were shown about motion picture projection principles, such as photographing of sound on film, the projector optical system, and the persistence of vision phenomena.
4. Bell and Howell Model 540 projector threading charts and 16mm motion picture film pieces (sound and silent) were given and explained to every student.
5. Transparencies were used on the overhead projector, demonstrating such techniques as film splicing, projector threading, and operation of the electrical system of the projector. The principle of persistence of vision, the use of proper motion picture screens, the use of proper film reel sizes, etc. were also demonstrated.
6. 16mm Bell and Howell and R.C.A. projectors were used in demonstration of principles and operation.

At the conclusion of the lesson on projection principles, Group A was given objective post-test on this area. At the conclusion of the second part of the lesson on projector operation, the participants filled out the reaction questionnaire. As a final step, they were instructed to return on one of the following two days for a one hour practice session with the Bell and Howell Model 540 16mm motion picture projector.

E. On the following two days, after the training session, the students in Group A (control), engaged in a one hour unguided practice session on the 16mm motion picture projector.

F. On the third and fourth days following the training session, all students in Group A returned for a final projector performance Test. The performance test, designed after one used by A. W. Vandermeer of Pennsylvania State University for motor skill competency testing, was administered individually and in private to each student. A Bell and Howell Model 540 16mm motion picture projector was placed in the room. The student was placed in position to operate the machine, and the instructor stood, operation performance test in hand, slightly to the right and behind him. After the student had been oriented to the situation, the instructor directed him to perform each of the major skill units in order. The student was required to tell what he was doing as he went through each step in the projection process. In the instructor's direction to the student, each major skill unit was referred to by name, and, if necessary, described in general terms, but the component skills were not named or described. For each component part of a major skill that the student could perform without "prompting," he was awarded two points. When the student failed to attempt any component part

of a major skill unit, he was instructed to perform it, and the name of the skill component (such as "open the gate") was used. If the student was then able to perform the designated skill component, he was awarded one point. If the student was unable to do the component skill after "prompting," he was given no points.

G. The students in Group B (experimental), were given the experimental lesson through the use of the programed textbook with visuals. Each participant was issued a book and instructed to complete the section of projection principles. At the conclusion of the projection principles section of the book each student was given the same post- test, as that given to Group A (control). At the conclusion of the post-test, each student was instructed to take a short break and begin work on the second part of the program on projector operation. Following the training session, each student was provided with access to a Bell and Howell Model 540 projector for individual practice. At the conclusion of the training and practice session, each student was instructed to fill out a reaction questionnaire.

H. On the third and fourth days following the training session, all students in Group B (experimental) returned for a final projector performance test. The performance rating criteria duplicated that used for Group A (control).

The Replication Experiment

A replication experiment was held during the Spring term, 1963, following the Winter term, 1963. The group consisted of 122 undergraduate and graduate students enrolled in an undergraduate audiovisual education course. The methodology and procedures used in the Spring term experiment duplicated as nearly as possible those used in the Winter term experiment. Tho only difference in this study was the size of the lecture with demonstration and the experimental group. Each of the two in the Spring term experiment consisted of 61 students as compared with 34 in each group in the Winter term experiment. Due to the larger size of the groups in the Spring experiment, Group A (lecture with demonstration) practice days were increased from two to three. It was also necessary to lengthen the number of projector performance test days from two to three.

Summary

A linear program requiring constructed responses was chosen as the model for the experiment. The characteristics of small step, frequent review of frames, use of "cues" and "prompt" limitation of three frames per page, and placing of constructed response confirmation on the following page were included in the program.

The program underwent three preliminary tests, using the Skinner five per cent error rate criteria, to

determine the number and origin of frames in need of revision. The findings showed (1) a steadily decreasing number of constructed response errors after each program revision, and (2) a poor transfer of skills information from the verbal program textbook to the 16mm projector.

In view of preliminary findings with the verbal programed textbook, visuals including drawings and photographs were added to each frame in the programed textbook. A test of the book with visuals showed (1) an insignificant amount of constructed response errors, and (2) a greater degree of success in the transfer of skills information from the book to the projector. A number of revisions were made in the visuals to clarify verbal relationships and to bring out greater visual detail.

Consultations with University research personnel resulted in elimination of the verbal programed textbook from the experiment due to the transfer problems already recorded. In connection with the experiment, a background-experience questionnaire, a matched pre- and post-test, a programed textbook response sheet, a reaction questionnaire, and a projector performance test were composed.

Sixty-eight students participated in the experiment in the Winter term, 1963. Thirty-four students received the lecture with demonstration while the

thirty-four remaining students worked through the programed textbook. The groups were equated through use of a background-experience questionnaire administered two weeks before the training sessions. Before and immediately following the training sessions, a matched projection principles test was administered to all participants. At the conclusion of the training sessions, each student completed a reaction questionnaire. After individual unguided projector practice sessions, a final projector operation test was administered to all participants.

A replication experiment was held during the following term. The procedures duplicated as nearly as possible those used in the experiment one term earlier.

CHAPTER IV

PRESENTATION OF FINDINGS

This chapter includes a compilation of findings (1) for the original experiment held during the Winter term, 1963, and (2) for the replication experiment held during the following term, 1963.

The Winter Term Experiment

Sixty-four undergraduate and four graduate students were divided into two groups with thirty-four participants in each group. Names were chosen from a class list. Odd numbered names were placed in Group A, and even numbered names were placed in Group B. Group A received the lecture with demonstration (control) lesson, while Group B received the programed textbook (experimental) lesson.

Equating the Groups

The undergraduate groups were equated on the basis of (1) information concerning the background and skill experience of all participants, (2) academic major, (3) grade point average, and (4) previous knowledge of projection principles. Two of the four participating graduate students were placed in each group.

A breakdown of academic major areas for undergraduate participants in the experiment included 58

education majors, three communication majors, and three business majors. Forty-five of the education majors specialized in elementary education, ten in secondary education, and three in other areas including higher education and industrial arts. A comparison of academic major areas indicated a relatively equal division between each group (Table 3).

TABLE 3

COMPARISON OF MAJOR AREAS OF STUDY OF 64 UNDERGRADUATE PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS

Group	Number	Elem. Edu.	Sec. Edu.	Other Edu.	Commun.	Business
A	32	23	6	1	1	1
B	32	22	4	2	2	2

A "t" test of significance was used to test differences in academic achievement means between the two groups. The academic achievement means showed 2.34 with a variance of 1.01 for Group A (control), and 2.32 with a variance of 1.03 for Group B (experimental). Computed "t" equaled 1.00 against a tabled value of 2.04 at 32 degrees of freedom. These figures indicated no significant difference in the means at the five per cent level of confidence (Table 4).

No significant difference at the five per cent level of confidence was found in the groups concerning mechanical

or non-mechanical backgrounds. A chi square of .64 was computed against a tabled value of 3.84 at 1 degree of freedom (Table 5).

TABLE 4

MEAN GRADE POINT AVERAGE TO WINTER TERM 1963 OF 64 UNDERGRADUATE PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS

Group	Number	Mean	Variance	t
A	32	2.34	1.01	1.00*
B	32	2.32	1.03	

*Not significant.

The "t" value at 32 degrees of freedom equals 2.04 at the 5% level of confidence.

TABLE 5

SUMMARY OF INDICATIONS OF PRIOR EXPERIENCE INVOLVING MECHANICAL APTITUDES AND INTERESTS OF 68 PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS

Groups	Number	Mechanical	Non-Mechanical	X^2
A	34	3	31	.64*
B	34	1	33	

*Not significant.

The X^2 value at 1 degree of freedom equals 3.84 at the 5% level of confidence.

No significant difference at the five per cent level of confidence was found in the groups concerning previous skill experience. A chi square of .83 was computed against a tabled value of 3.84 at 1 degree of freedom. (Table 6).

TABLE 6

SUMMARY OF INDICATIONS OF PRIOR SKILL EXPERIENCE OF 68 PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS

Group	Number	Experience	Little or No Experience	X^2
A	34	8	26	.83*
B	34	5	29	

*Not significant.

The X^2 value at 1 degree of freedom equals 3.84 at the 5% level of confidence.

An objective pre-test, given one week before the training sessions, matched the groups on previous knowledge of motion picture projection principles. The test showed Group A (control) to have a mean score of 4.78 with a variance of 4.01 and Group B (experimental) to have a mean score of 4.85 with a variance of 4.03. A "t" test of significance was used to determine the differences between the test score means of the two groups. Computed "t" equaled 1.01 against a tabled value of 2.03 at 34 degrees of freedom. These figures indicated no significant difference in the means at the five per cent level of confidence (Tables 7 and 8).

TABLE 7

COMPARISON OF PREVIOUS KNOWLEDGE OF PROJECTION PRINCIPLES OF 68 PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS

Group	Number	Mean	Variance	t
A	34	4.78	4.01	1.01*
B	34	4.85	4.03	

*Not significant.

The "t" value at 34 degrees of freedom equals 2.03 at the 5% level of confidence.

TABLE 8

PRE-TEST SCORES ON PROJECTION PRINCIPLES TEST OF 68 PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS*

Scores	Number	
	Group A	Group B
0	4	1
1	0	1
2	2	0
3	4	6
4	4	10
5	10	6
6	3	3
7	5	2
8	0	4
9	2	1
	N= 34	N= 34

*Highest possible score--20.

On the basis of the preceding information, the two groups were considered equated for the purposes of this experiment.

The Projection Principles Post-Test

Immediately following the projection principles training sessions, the participants in both groups completed the projection principles post-test. The results were positively skewed, with 16 of the 34 participants in Group B (experimental) scoring 20 correct responses or 100% on the test. The lack of normality in the test score range indicated a need for use of the non-parametric median test. The median test showed a chi square of 37.16, indicating a significant difference in learning in favor of Group B (experimental) at the five per cent level of confidence (Tables 9 and 10).

On the basis of these results, it appeared that the hypothesis--that learning measured by scores on a post-test

TABLE 9

COMPARISON OF KNOWLEDGE GAINED ON PROJECTION PRINCIPLES BY 68 PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS

Group	Number	Median	Interquartile Range	X^2
A	34	12.5	14.5	37.16*
B	34	18.5	20.0	

*X^2 at 1 degree of freedom is significant at the 5% level of confidence.

on motion picture projection principles would be significantly greater in a group using a programed textbook with visuals than in a group receiving a lecture with demonstration--was substantiated.

TABLE 10

POST-TEST SCORES ON PROJECTION PRINCIPLES TEST OF 68 PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS*

Scores	Number	
	Group A	Group B
8	1	0
9	2	0
10	2	0
11	9	0
12	8	0
13	3	0
14	3	3
15	3	3
16	2	3
17	0	4
18	1	5
19	0	0
20	0	16
	N= 34	N= 34

*Highest possible score--20.

The Projection Performance Post-Test

Following the training session on projection operation, the participants in both groups completed a projector performance test. The mean score of Group A (control) was 56.32 with a variance of 14.21, and the mean score of Group B (experimental) was 57.97 with a variance of 13.26.

An "F" test was employed to determine whether the variances of the two sets of data could be considered homogeneous. An "F" ratio of the two variances gave a figure of 1.00. Tabled value of "F", with entry at 31 degrees of freedom at both scales, was slightly greater than 1.76. The "F" ratio of 1.00 indicated that the variances of the two sets of data could be considered homogeneous. Therefore, a "t" test of the differences of the means was applicable to these test results. The "t" test gave a ratio of 1.02. This ratio was not significant at the five per cent level of confidence. From these results, it was evident that the hypothesis in this study, stating that learning measured by scores on a motion picture operation test would be significantly greater in a group using a programed text-book than in a group taught by a lecture with demonstration, was rejected in favor of a null hypothesis. No significant difference existed in the skill learning achieved by the two groups (Tables 11 and 12).

The Reaction Questionnaire

At the conclusion of the training session, participants in both groups completed a reaction questionnaire (Tables 13 and 14). This questionnaire elicited from each student his reactions toward the particular teaching method used. Certain questionnaire statements were the same for both groups while other statements were added for Group B (experimental) in relation to the programed lesson.

TABLE 11

COMPARISON OF KNOWLEDGE GAINED ON PROJECTOR OPERATION BY 68 PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS

Group	Number	Mean	Variance	F	t
A	34	56.32	14.21		
				1.00	1.02*
B	34	57.97	13.26		

*Not significant.

The "t" value at 34 degrees of freedom equals 2.03 at the 5% level of confidence.

TABLE 12

POST-TEST SCORES ON PROJECTOR OPERATION TEST OF 68 PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS*

Scores	Number	
	Group A	Group B
37	0	2
38	1	2
40	0	1
41	0	2
47	4	0
48	3	0
49	3	0
50	2	0
51	2	0
52	2	0
55	2	0
57	1	0
58	2	1
59	0	2
60	1	1
62	2	3
63	1	3
64	0	0
65	5	7
66	0	1
67	0	1
68	0	3
69	2	2
70	0	2
71	3	1
	N= 34	N= 34

*Highest possible score--82.

TABLE 13

REACTIONS OF 68 PARTICIPANTS TO TWO TYPES OF PROJECTION PRINCIPLES AND OPERATION TRAINING ON THE 16MM SOUND MOTION PICTURE PROJECTOR WINTER TERM 1963*

Reactions	Group A	Group B
1. In this training session on projector principles you used a programed textbook or were given a lecture with demonstration.		
The lesson was hard to follow.	14	0
The lesson was easy to follow.	1	23
Some parts were easy, and others hard.	19	9
2. Do you feel you could operate a motion picture projector?		
Not at all.	0	0
With much practice.	13	26
With limited practice.	18	6
With no practice.	2	0
3. In your general opinion your score on the post-test in relation to the pre-test was:		
Lower.	0	0
About even.	1	0
A little better.	23	2
A good deal better.	9	30
4. The Projection principles training session was:		
A constructive learning experience with little wasted time.	17	30
A partial learning experience with some wasted time.	18	1
A poor learning experience with much wasted time.	3	0

*Administered following completion of the training session. Not all participants responded to every question.

TABLE 14

REACTION OF 34 EXPERIMENTAL GROUP PARTICIPANTS TO TWO TYPES OF PROJECTION PRINCIPLES AND OPERATION TRAINING ON THE 16MM SOUND MOTION PICTURE PROJECTOR WINTER TERM 1963*

Reaction	Group B
1. Section I of the programed textbook dealt with 16mm motion picture projection principles. On this section you learned:	
Nothing.	0
Some of the principles described.	4
A good many of the principles described.	23
All of the principles described.	5
2. Section II of the programed textbook dealt with 16mm motion picture projector operation. On this section you learned:	
Nothing.	3
Some of the operations described.	22
A good many of the operations described.	8
All of the operations described.	0
3. Which statement more nearly fits your feelings about the use of a programed textbook?	
I would like to use one again.	29
I have no particular feelings either way.	3
I would not like to use one again.	0

*Administered following completion of the training sessions. Not all participants responded to every question.

A tabulation of responses to the questionnaire indicated the following differences and similarities between reactions of the control (lecture with demonstration) and experimental (programed lesson) groups with respect to the procedures followed:

1. One-half of Group A (control) said the lesson on projection principles was "hard to follow," while the other half said, "some parts were easy and others were hard."

   Three-fourths of Group B (experimental) participants said the lesson was "easy to follow," while one-fourth said, "some parts were easy and others hard."

2. Approximately two-third of Group A felt they could operate a projector "with limited practice" at the conclusion of the lesson on projector operation. The remaining one-third generally favored "with much practice."

   Two-thirds of Group B felt they could operate a projector at the conclusion of their lesson "with much practice," while one-third said, "with limited practice."

3. Approximately two-thirds of Group A said they had done "a little better" on the projection principles post-test as compared with the pre-test, while the remaining one-third said, "a good deal better."

   Group B almost unanimously said they had done "a good deal better" on the projection principles post-test in comparison to the pre-test.

4. Approximately one-half of Group A said the training session on projection principles was "a constructive learning experience with little wasted time," while the other half favored "a partial learning experience with some wasted time."

Group B almost unanimously said the projection principles training session was "a constructive learning experience with little wasted time."

In addition to the reactions secured from both groups, the following responses were obtained from the group using the programed lesson (Group B):

1. Three-fourths of the group felt that "a good many" principles of projection were learned, while one-fourth were split between "some of the principles described" and "all of the principles described" in the training session on projection principles.

2. One-quarter of the group felt "a good many of the operations described" were learned about projector operation, while the other three-quarters of the group felt either "some of the operations described" or "none of the operations described" were learned in the training session on projector operation.

3. When asked their opinion about the use of a programed textbook, the group almost unanimously agreed that "They would like to use one again."

Other Findings

A general record of time on both training sessions was compiled. One hour and twenty minutes was used by the instructor in the lecture with demonstration on projection principles. One hour of lecture with demonstration by the instructor and one hour of individual projector practice was used for the projector operation training session. The combined Group A (control) (lecture with demonstration and individual projector practice) training session took three hours and twenty minutes.

The Group B (experimental) participants were instructed to record their beginning and ending times on the two sections of the programed textbook. Times recorded on the projection principles area included individual practice. The group average time for the projection principles area was fifty minutes with a range of 35 to 72 minutes. The average group time taken for projector operation was two hours and ten minutes with a range of one and one-half hours to two hours and forty-five minutes. The combined Group B training session time took an average of three hours. It should be noted that no instructor was required during the experimental group training session.

The participants in Group B (experimental) were encouraged at the conclusion of their training session to make written comments concerning any portion of the lesson. Representative comments were as follows:

> "Couldn't relate what I learned in the book to the projector."
>
> "The pictures in the book didn't help me to understand what I saw on the projector."
>
> "I couldn't remember all the facts in the book when I worked with the projector."
>
> "As I worked along with the projector and the book, I could guess at the next step on the projector without referring back to the book."
>
> "When I began work with the projector, I could not remember many of the things in the programed textbook."
>
> "Could do a number of the operations described in the book, but couldn't relate the 'sprocket guards' and 'exciter lamp.'

"I could rewind and project according to the book, but could not thread."

"Wish we would have worked with the projector before using the programed textbook."

"Learned the projection principles all right, but had trouble operating the projector."

"I learned a lot, but I don't know how long I'll remember it all."

A majority of opinions stated difficulty in transfering skills information from the programed textbook to the 16mm projector during the training session. The students seemed to infer that a lack of frame of reference for projector parts and operations made transfer difficult from the book with visuals to the 3-D projector.

The Spring Term Replication Experiment

A replication experiment was held during the following Spring term to measure the reliability of the findings. The methodology and procedures duplicated as nearly as possible those used in the experiment the preceding term.

One hundred and seventeen undergraduate and five graduate students were divided into two groups of 61 participants each.

The groups were matched from facts gathered on a background-experience questionnaire and from a projector principles pre-test. Of the 117 undergraduate students participating in the experiment, tabulations showed (1) a relatively equal division of academic areas between the

groups (Table 15); (2) no significant difference in academic achievement means of the two groups after use of a "t" test of significance at the five per cent level of confidence (Table 16); (3) no significant difference in the groups concerning mechanical or non-mechanical backgrounds after use of a chi square test at the five per cent level of confidence (Table 17); (4) no significant difference in the groups concerning previous skill experience using a chi square test at the five per cent level of confidence (Table 18); (5) no significant difference between test score means of both groups concerning projection principles using a "t" test of significance at the five per cent level of confidence (Tables 19 and 20).

Immediately following the training sessions on projection principles, the participants in both groups completed a projection principles post-test. The results showed a positive skew, similar to the one occurring in the original experiment one term earlier in favor of the programed lesson group (Group B). Of 61 participants in Group B (experimental), 19 scored 20 correct responses or 100% on the test. A median test showed a chi square score of 42.81, indicating a significant difference in learning in favor of Group B (experimental) at the 5 per cent level of confidence (Tables 21 and 22). This essentially duplicated the results found with respect to projection principles training during the preceding term.

TABLE 15

COMPARISON OF MAJOR AREAS OF STUDY OF 117 UNDERGRADUATE PARTICIPANTS IN INEXPERIMENTAL AND CONTROL GROUPS IN REPLICATION STUDY

Group	Number	Elem. Edu.	Sec. Edu.	Other Edu.	Commun.	Business
A	58	31	19	3	3	2
B	59	28	23	4	2	2

TABLE 16

MEAN GRADE POINT AVERAGE TO WINTER TERM 1963 OF 117 UNDERGRADUATE PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS IN REPLICATION EXPERIMENT

Group	Number	Mean	Variance	t
A	58	2.37	1.02	
				1.01*
B	59	2.35	1.00	

*Not significant

The "t" value at 32 degrees of freedom equals 2.00 at 5% level of confidence.

TABLE 17

SUMMARY OF INDICATIONS OF PRIOR EXPERIENCE INVOLVING MECHANICAL APTITUDES AND INTERESTS OF 122 PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS IN REPLICATION EXPERIMENT

Group	Number	Mechanical	Non-Mechanical	X^2
A	61	5	56	
				.58*
B	61	4	57	

*Not significant.

The X^2 value at 1 degree of freedom equals 3.84 at the 5% level of confidence.

TABLE 18

SUMMARY OF INDICATIONS OF PRIOR SKILL EXPERIENCE OF 122 PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS IN REPLICATION EXPERIMENT

Group	Number	Experience	Little or no Experience	X^2
A	61	8	53	
				.69*
B	61	6	55	

*Not significant.

The X^2 value at 1 degree of freedom equals 3.84 at the 5% level of confidence.

TABLE 19

COMPARISON OF PREVIOUS KNOWLEDGE OF PROJECTION PRINCIPLES OF 122 PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS IN REPLICATION STUDY

Group	Number	Mean	Variance	t
A	61	4.65	4.01	
				1.03*
B	61	4.69	4.00	

*Not significant.

The "t" value at 61 degrees of freedom equals 2.00 at the 5% level of confidence.

TABLE 20

PRE-TEST SCORES ON PROJECTION PRINCIPLES TEST OF 122 PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS IN REPLICATION STUDY*

Scores	Number	
	Group A	Group B
0	5	3
1	2	2
2	3	2
3	5	2
4	9	17
5	7	12
6	13	7
7	9	6
8	6	4
9	2	4
10	0	3
	N= 61	N= 61

*Highest possible score--20

TABLE 21

COMPARISON OF KNOWLEDGE GAINED ON PROJECTION PRINCIPLES BY 122 PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS IN REPLICATION STUDY

Group	Number	Median	Interquartile Range	X^2
A	61	12.01	15.06	
				42.81*
B	61	16.05	20.00	

*X^2 at 1 degree of freedom is significant at the 5% level of confidence.

TABLE 22

POST-TEST SCORES ON PROJECTION PRINCIPLES TEST OF 122 PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS IN REPLICATION STUDY*

Scores	Number	
	Group A	Group B
7	1	0
8	5	0
9	5	0
10	6	0
11	7	0
12	10	0
13	5	10
14	1	6
15	5	6
16	7	7
17	3	6
18	4	5
19	2	2
20	0	19
	N= 61	N= 61

*Highest possible score--20.

Following the training sessions on projector operation, the participants in both groups completed a projector performance test. An examination of the means revealed they were extremely close. For this reason, a "t" test of significance was not conducted. It seemed reasonable to assume that no significant difference existed in the degree of skill learning achieved by the two groups (Tables 23 and 24). This essentially duplicated the results found with respect to projection training during the preceding term.

At the conclusion of the training sessions, participants in both groups completed a reaction questionnaire. This questionnaire elicited from each student his reactions toward the particular teaching method used. Certain questionnaire statements were the same for both groups, while other statements were added for Group B (experimental) concerning the programed lesson.

Results for both groups showed that:

1. A majority opinion in Group A (control) upon conclusion of the training session, was that they could operate a motion picture projector "with limited practice."

   Majority opinion in Group B (experimental), concerning ability to operate a projector at the conclusion of the training session, indicated that much practice would be required.

2. A majority of participants in Group B felt that they had done "a good deal better" on the projection principles post-test than on the pretest. The results on the projection principles post-test upheld this opinion.

TABLE 23

COMPARISON OF KNOWLEDGE GAINED ON PROJECTOR OPERATION BY 122 PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS IN REPLICATION STUDY

Group	Number	Mean	Variance
A	61	56.22*	14.66
B	61	56.36*	14.35

*Similar means indicating possibility of no significant difference in learning.

TABLE 24
POST-TEST SCORES ON PROJECTOR OPERATION TEST OF 122 PARTICIPANTS IN EXPERIMENTAL AND CONTROL GROUPS IN REPLICATION STUDY*

Scores	Number	
	Group A	Group B
48	3	1
49	0	1
50	1	1
51	2	2
52	0	3
53	4	4
54	3	2
55	0	1
56	2	2
57	0	1
58	8	2
59	5	9
60	0	3
61	0	5
62	9	0
63	2	0
65	4	2
66	0	2
67	5	4
68	5	4
69	4	4
70	0	2
71	4	4
	N= 61	N= 61

*Highest possible score--82.

The participants in Group A (control) felt that on post-test scores in relation to pre-test scores they had only done "a little better." The results on the projection principles post-test upheld this opinion.

3. Group A felt the training session on projection principles was "a partial learning experience with some wasted time."

   Group B felt unanimously that the training session was "a constructive learning experience with little wasted time."

4. Majority opinion in Group A was that the lesson on projection principles was "hard to follow."

   A majority in Group B felt the projection principle lesson was "easy to follow."

The following statements are a result of separate questions asked only to Group B (experimental) in addition to the original questions.

Group B (programed textbook) felt the following about the training sessions:

1. "A good many principles described" were learned in Section I of the programed textbook dealing with motion picture projection principles.

2. "Some of the operations described" were learned in Section II of the programed textbook dealing with motion picture projector operation.

3. "I would like to use one again" when asked their opinion about the use of a programed textbook.

These questionnaire reactions either duplicated exactly or were closely similar to those obtained in the original experiment one term earlier.

The combined Group A (lecture with demonstration and individual projector practice) training session took three hours and fifteen minutes. Group B participants average

time for the training session was three hours with a range of one hour and fifty-five minutes to three hours and fifty minutes. These times were near to those obtained in the original experiment one term earlier. It is again worthy of note, that no instructor was required during the experimental group training session.

A majority of written comments by participants in Group B (experimental) stated difficulty in relating skills information from the programed textbook to the 16mm motion picture projector during the training session. These comments were generally similar to those made by the participants in Group B (experimental) in the original experiment one term earlier.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The study investigated the effect of a programed textbook on student learning regarding 16mm motion picture projection principles and projector operation.

Factual and skill learning were measured in a training session by two alternative methods: (1) lecture with demonstration, followed by individual unguided student practice, and (2) use of a written response programed textbook containing visual illustration of the verbal text, followed by individual unguided student practice.

The study also investigated student reactions regarding the methods used in the training session.

It was hypothesized that learning, measured by scores on a post-test on motion picture projection principles, would be significantly greater in a group using a programed textbook with visuals than in a group receiving a lecture with demonstration. This hypothesis was supported by the results of this study.

It was further hypothesized that learning, measured by scores on a motion picture projector operation test, would be significantly greater in a group using a programed textbook with visuals than in a group taught by a

carefully developed lecture-demonstration method. This hypothesis proved insupportable with the materials and methods used in this investigation.

A linear programed textbook containing photographs or drawings on each frame was chosen for the experiment. A review of research indicated that facts and skills can be successfully taught through the use of linear programs, and that drawings and photographs can increase learning when used with verbal text. The characteristics of small step, frequent review of frames, use of "cues" and "prompts," limitation of three frames per page, and placing of constructed response confirmations on the following pages were included in the program.

After its completion in the fall of 1962, the program underwent a number of tests. Revisions were made in the verbal text to minimize constructed response errors, and in the drawings and photographs to strengthen verbal relationships and to heighten visual clarity.

Sixty-eight students participated in the experiment in the Winter term, 1963. The students were divided into two groups. The group to receive the lecture with demonstration was called Control Group A. The group to receive the programed textbook lesson was called Experimental Group B.

The equality of the groups was ascertained from facts gathered on a background-experience questionnaire

including academic major, previous grade point average, background, and experience. An objective projection principles pre-test administered one week before the training session established the equality of both groups on previous knowledge of motion picture projection principles.

Immediately following the training sessions on projection principles, the participants in both groups completed a projection principles post-test. Results showed a significant difference in learning in favor of Group B, which received the programed lesson.

The amount of time used by both groups during the training sessions was recorded. The programed textbook group took less overall time to complete the projection principles part of the training session, but took about an equal amount of time as the control group in completing the projector operation part of the training session. No instructor was required to be present, however, for the programed textbook group during the training session.

Following the training session on projector operation and individual practice sessions, the participants in both groups were given a projector performance test. The results showed no significant difference in mean test scores of the two groups. It

appeared probable from these results that no significant difference existed in the motor skill learning achieved by the two groups.

At the conclusion of the training session, the participants in both groups completed a reaction questionnaire concerning the training session methods. Combined results for both groups showed (1) Group A (control) felt at the conclusion of the training session that they could operate a projector "with little practice," while Group B (experimental) felt less confident; (2) Group B (experimental) felt confidence in their knowledge of projection principles at the close of the training session, while Group A (control) showed less confidence in this area. This suggests that the programed materials used were more appropriate and effective for the learning of principles (an intellectual activity) than they were for the learning of projector operation (a mechanical skill). This seems supported by the fact that a majority of the written comments by participants in Group B (experimental) stated difficulty in transferring skills information from the programed textbook to the projector during the practice session.

A replication experiment was held during the Spring term of 1963 to test the reliability of the findings. Findings either showed exact duplications or were closely

similar to those obtained in the original experiment one term earlier.

Conclusions

The following conclusions are made from findings in the original and replication experiments:

In a training session concerning factual learning about projection principles:

1. A programed textbook with visuals can increase factual learning beyond that achieved in a lecture with demonstration.

2. Time can be saved by the use of a programed textbook with visuals over a lecture with demonstration.

3. Students, using a programed textbook with visuals, will generally react more favorably toward this method for the learning of projection principle information than students receiving a lecture with demonstration.

These conclusions are drawn from the following findings: (1) the programed lesson group obtained a significantly higher median gain on the projector principles post-test and finished the training session in less time than the lecture with demonstration group; (2) a tabulation of responses on a questionnaire given to all participants immediately following the training sessions indicated that students using the programed textbook with visuals generally reacted more favorably to their method for the learning of projection principles facts than the group receiving the lecture with demonstration.

In a training session on projector operation followed by individual unguided projector practice:

1. There will be no significant difference in the amount of information learned about skills through the use of a programed textbook with visuals or a lecture with demonstration.

2. There will be little difference in over-all training session time through the use of a programed textbook with visuals or a lecture with demonstration. But the programed textbook method can save considerable instructor time.

3. Students using a programed textbook with visuals will generally be less favorable toward this method for learning projector skills information than will students receiving a lecture with demonstration.

4. The students using the programed textbook with visuals will find difficulty in transferring skills information from the programed book with visuals to the 16mm motion picture projector.

These conclusions are drawn from the following findings: (1) no significant difference on projector operation post-test score means and little difference in training session time were found through the use of a programed textbook with visuals followed by individual projector practice, and a lecture with demonstration followed by individual projector practice; (2) no instructor was needed for the programed textbook group during the training session; (3) a tabulation of responses on a questionnaire given to all participants immediately following the training sessions, indicated that students using the programed textbook with visuals generally were less favorable to this method for the learning skills

information about projector operation than the lecture with demonstration group were to the latter method; (4) a compilation of written statements by the participants in Group B (programed textbook), in relation to the projector operation training session, indicated general difficulty in transferring skills information acquired from the programed textbook with visuals to the 16mm motion picture projector in the practice session.

Recommendations

A number of observations can be made relative to this study. It was found that when students used the programed textbook with visuals for the learning of principles (an intellectual activity), they learned more in less time and reacted more favorably to the method employed than did the lecture-with-demonstration group. But when the students used the programed textbook with visuals as a step toward learning projector operation (a mechanical skill), they reacted unfavorably to the method and showed no advantage over the other group in actual learning of projector operation or in training session time. It appears that a major reason for this outcome arises from the basic problem of attempting to learn details about a skill prior to actual work on the skill itself. Although an attempt was made to anticipate this difficulty in the nature and number of programed items developed for the skills part

of the experiment, it was not successful. This lack of success in transfer of skills information to skill learning in this instance may have been due to some extent to the use of the programing technique itself and/or to the method by which it was combined with other elements in the teaching-learning situation.

In setting up, carrying out, and reporting this study, the investigator became aware of a number of methods which might have minimized or overcome the transfer problem. Many of the written comments made by the Group B (programed textbook) participants, following the training session, indicated that if the students had been allowed to work with the projector before or during their use of the book, a frame of reference would have been established for the verbal and visual descriptions therein. This suggests the desirability of another study which would focus upon the relative effectiveness of several ways of employing a given set of resources, such as a visualized programed book, lecture-demonstration, and individual practice, in skills training.

Results on the projector operation post-test indicated that students with some prior knowledge of projector operation or with some slight mechanical aptitude or prior experience were able to make the transfer more easily and in less time. Research should be conducted with the programed textbook with visuals to determine

how it may be more effectively used with students who possess varying degrees of mechanical aptitude and/or skill experience.

A problem inherent in the use of drawings or photographs as visuals in the programed textbook was the limitation of still photographs in conveying ideas involving motion as an important element in the learning to be accomplished. There appears to be a good possibility that needed skills information could be more readily learned and transferred to skills learning if appropriate motion picture clips were incorporated in the system along with the programed book and the other elements suggested above. Clearly, the determination of materials and methods to be used must begin with a careful analysis of the skills to be taught. How this analysis can best be carried out in terms of media and methods applications is a subject worthy of considerable investigation by itself.

At the present stage of the art of visualization of concepts to be learned, the selection of materials and media must be made largely on the basis of experience and judgment of persons who are competent both in the field of the media and in the teaching-learning process working with experts in the subject or content field to be taught. How specific learning can best be implemented for specified groups of learners and with what educational media and methods is an

area still wide open for significant investigation. The study reported in this dissertation has been one attempt in that direction.

APPENDIX I

BACKGROUND QUESTIONNAIRE

Name _____

Undergraduate _____ Male _____ Major _____

Graduate _____ Female _____ Grade Point Av. ___

Fill in the following questions as accurately as possible. Where "yes" and "no" questions are asked, please circle the correct response.

Hobbies

1. If you have a hobby (avocation) please state it. _____

_____

2. In your opinion would you classify it mechanical or non-mechanical? (Yes) (No) Qualify your answer if necessary. __

_____

3. State any other present or past hobbies. _____

_____

4. In your opinion would you classify any of them mechanical or non-mechanical? (Yes) (No) Qualify your answer if necessary. _____

_____

5. Does anyone in your family have a hobby or avocation that is mechanical in nature to which you are closely familiar? (Yes) (No) If so, what? _____

_____

Background

Put the following number in front of the particular skill described that best fits your classification.

1. I am able and have operated.

2. I have operated but not for a long period of time and would need "brush up" instruction.

3. I have closely observed operation but have never done so myself.

4. I am completely unfamiliar with the operation.

( ) 1. Heavy machine equipment (lathes, drills, etc.)

( ) 2. Industrial weaving looms and machines

( ) 3. Television repair equipment (soldering iron etc.)

( ) 4. Office equipment (mimeograph, ditto, other duplicating)

( ) 5. Typewriter (touch system)

( ) 6. Automobile repair parts and machinery

( ) 7. Sewing machines (any types)

( ) 8. Any type of still camera

( ) 9. Any type of motion picture camera

( ) 10. Any type of slide projector

( ) 11. Overhead projector

( ) 12. Opaque projector

( ) 13. Microprojector

( ) 14. Tape or Wire recorder

( ) 15. Disc recorder

( ) 16. Record player or Hi Fi Set

( ) 17. 8mm home motion picture projector

( ) 18. 16mm motion picture projector

( ) 19. 35mm motion picture projector

PRINCIPLES

of

16mm Motion Picture Projection

PRE-TEST

Fill in the missing word or words.

1. The mechanism used to project sound motion pictures is the _____.
2. The three most common film millimeter sizes are ____, ____, ____.
3. Sound motion picture film speed is ____ frames per second.
4. The ability of the eye to see the image for a brief time after it has disappeared is called _____.
5. A sound _____ is located on one side of every sound film.
6. The _____ system is a mechanism for passing light through a series of rapidly changed still photographs recorded on the film.
7. The _____ system is a mechanism for moving the sound track portion of the film between a constant light source and a photoelectric cell in order to reproduce sound.
8. Sound is activated in a projector by the _____.
9. The _____ receives the sound impluses from the amplifier and reproduces them as they were recorded earlier.
10. _____ film contains perforations on both sides.
11. _____ film contains perforations on only one side.
12. A film approximately 20 minutes in length would be wound on a number _____ size film reel.
13. Two common motion picture screen types are the _____ and the _____.

14. The _____ type screen is best utilized in longer more narrow rooms because it gives a direct bright image in front but drops off in brightness on the sides.

15. Films are always wound on _____.

16. While 35mm films are used most commonly in commerical theatres, _____ are used in schools.

PRINCIPLES

of

16mm Motion Picture Projection

NAME _____

POST-TEST GROUP _____

Fill in the missing word or words.

1. While 35mm films are used most commonly in commercial theatres, _____ are used in schools.

2. Films are always wound on _____.

3. We would choose a _____ motion picture screen for for a narrow room because it gives a bright image in front while dropping off in brightness on the sides.

4. _____ and _____ are two common types of motion picture screens.

5. A film approximately 10 minutes in length would be wound on a number _____ size film reel.

6. _____ film contains perforations on only one side.

7. _____ film contains perforations on both sides.

8. The _____ receives the sound impulses from the amplifier and reproduces them as they were recorded earlier.

9. A mechanism for moving the sound track portion of the film between a constant light source and a photoelectric cell in order to reproduce sound is called a _____ system.

10. A mechanism for passing light through a series of rapidly changed still photographs recorded on the films is called a _____.

11. We know in a projector that sound is activated by the _____.

12. On every piece of sound film a sound _____ is located on one side.

13. _____ is the ability of the eye to see the image for a brief time after it has disappeared.

14. _____ frames per second is the speed for sound motion picture film.

15. Films are measured in millimeters and the three most common sizes are ____, ____, ____.

16. The _____ is the mechanism used to project sound motion pictures.

PERFORMANCE RATING SCALE

16mm Motion Picture Projector Operation

Name _____ Group _____

The purpose of this scale is to check the number of steps shown in the programed textbooks or described in the lecture that the student can perform.

STEP	SCORE	STEP PARTS
Setting Up	_____	Connect the electric cord
	_____	Adjust projector height
	_____	Uncase projector
	_____	Snap up arms
Checking Out	_____	Test line (motor)
	_____	Test lamp
	_____	Clean lens and aperture
	_____	Pre-focus projection lens
	_____	Turn on amplifier switch
	_____	Check to see if exciter lamp is lit and test for sound
Threading	_____	Place film on feed reel
	_____	Pull off approximately five feet of film
	_____	Swing lens mount (gate) open
	_____	Open sprocket guards
	_____	Place film under front roller and on top of first sprocket wheel
	_____	Engage film in sprocket teeth and close sprocket guard
	_____	Place film in guide rails in front of aperture opening
	_____	Check the snugness of the film in the guide rail
	_____	Close lens mount (gate)
	_____	Thread film under loop restorer
	_____	Thread film over top of lower sprocket wheel
	_____	Close sprocket guard
	_____	Place film under top stabilizer roller and around sound drum
	_____	Place film over next stabilizer roller and under lower sprocket wheel

STEP	SCORE	STEP PARTS
Threading	_____	Place film under lower rollers
	_____	Pull film tight and engage in lower sprocket teeth
	_____	Close final sprocket guard
	_____	Attach in clockwise direction to take up reel
	_____	Check threading completely
Projection	_____	Check silent-sound switch to see if it is set correctly
	_____	Check forward-reverse switch to see if it is set correctly
	_____	Start projector in the sequence: line, lamp, volume
	_____	Sharpen (adjust) projection lens
	_____	Stop projector in the sequence: volume, lamp, line
Rewinding	_____	Support take up reel and lift up into rewind position
	_____	Strip film from back reel and thread it on underside of front reel so reel can move counterclockwise
	_____	Turn line (motor) switch to reverse
	_____	Press down high speed rewind button
Casing	_____	Pack arms under case
	_____	Disconnect power cord and rewind inside case
	_____	Put cover on projector

PRINCIPLES AND OPERATING PROCEDURES

16mm Motion Picture Projector

Response Sheet

FRAME

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
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APPENDIX II

PRINCIPLES

and

Operating Procedures

16mm Motion Picture Projector

Name _____
Group _____

Reaction Questionnaire

Circle the number before the most appropriate response.

1. In this training session you were exposed to lecture, demonstration and film.

   1. The lesson seemed distracting and hard to follow.

   2. The lesson seemed logical and easy to follow.

   3. Some areas of the lesson were distracting and hard to follow while others were not.

---

2. In your general opinion your score on post-test in relation to the pre-test was:

   1. lower

   2. About even

   3. A little better

   4. A good deal better.

---

3. Do you feel you could operate a motion picture projector?

   1. Not at all

   2. With much practice

   3. With limited practice

   4. With no practice

---

4. This entire training session was:

   1. A constructive learning experience with little wasted time.

   2. A partial learning experience with some wasted time.

   3. A poor learning experience with much wasted time.

PRINCIPLES

and

Operating Procedures

16mm Motion Picture Projector

Name _____
Group _____

Reaction Questionnaire

Circle the number before the most appropriate response.

1. To what extent have you used programed materials for learning before?

   1. Many times
   2. A few times
   3. Never

---

2. In this training session you used a programed textbook.

   1. The lesson seemed distracting and hard to follow.
   2. The lesson seemed logical and easy to follow.
   3. Some areas of the lesson were distracting and hard to follow while others were not.

---

3. In explaining or relating the verbal text, the accompanying pictures and illustrations were:

   1. No help
   2. Little help
   3. Some help
   4. A great help

---

4. There were frequent reviews in this book.

   1. They seemed helpful
   2. Some were helpful and others not
   3. They did not seem necessary

---

5. The constructed responses in this book seemed:

   1. In some areas quite hard and in others quite easy.
   2. All too hard
   3. All too simple

---

6. Section I of the programed textbook delt with 16mm motion picture projection principles. On this section you learned:

   1. Nothing
   2. Some of the principles described but not many.
   3. A good many principles described.
   4. All of the principles described.

---

7. Section II of the programed textbook delt with 16mm motion picture projector operation. On this section you learned:

   1. Nothing.
   2. Some of the operations described but not many.
   3. A good many operations described.
   4. All of the operations described.

---

8. For the intricate operations described (e.g., threading, projection) you would:

   1. Leave them the way they are.
   2. Break them down into smaller steps.
   3. Combine them into larger steps.

---

9. Do you feel that you could operate a motion picture projector?

   1. Not at all
   2. With much practice.
   3. With limited practice.
   4. With no practice.

---

10. In your general opinion your score on the post-test in relation to the pre-test was:

   1. Lower
   2. About even
   3. A little better
   4. A good deal better.

---

11. This entire training session was:

   1. A constructive learning experience with little wasted time.
   2. A partial learning experience with some wasted time.
   3. A poor learning experience with wasted time.

---

12. Which statement more nearly fits your feelings about the use of a programed textbook?

   1. I would like to use one again.
   2. I have no particular feelings either way.
   3. I would not like to use one again.

APPENDIX III

THE FOLLOWING PAGES ARE SAMPLES
TAKEN FROM THE ORIGINAL
PROGRAMED TEXTBOOK

PRINCIPLES

and

OPERATING PROCEDURES

16mm Motion Picture Projector

A Programed Textbook

This is a programed lesson about the principles and operating procedures of the 16mm sound motion picture projector. Upon completion of this book you should be able to not only thread and operate a 16mm motion picture projector but apply the principles of motion picture projection. This lesson is written in programed text form. (Written text followed by a constructed response blank) These constructed response blanks are designed to give the student the greatest amount of feedback from the preceding text.

Each page consists of three panels. The sequence of the panels is not from the top of the page to the bottom as in conventional textbooks, but from one page to the next. Only one panel is read or responded to before the student turns the page. The student will begin with the top panel on page 3, respond to it, turn to page 4 to get his answer confirmed on the top panel, go to the top panel of page 5, respond to it, confirm his answer by turning the page, and so on, to the end of the unit. There he will be instructed to return to page 3 and respond to the second panel on each page, as he did previously with the top panel. Each of the panels are numbered in sequence throughout the book so as to minimize possible confusion.

This lesson is broken into two sections, each having a special significance in acquainting the student with the overall lesson. The steps are small so as to reduce the chance of error. If errors do occur the student will be asked to re-read the preceding section until he is certain he has mastered the principles and procedures described. There will be frequent review sections.

As a further source of stimulation for the student most of the frames in this book are illustrated either by actual photographs of equipment and operations or by drawings.

The lesson is broken into the following two areas:

1. Motion Picture Projection Principles

2. Motion Picture Projector Operation and Projection procedures

With this explanation we will begin our programed lesson. Remember to proceed at your own rate of speed. If you are uncertain of a frame, review it before going on.

Good Luck!

This lesson is about Projection principles and projector operation and procedures. Upon completion you should know why a motion picture moves, how it talks and how to successfully project one.

1-1-1-1-1

In our discussion of picture motion, sound and projection we are referring to p_____, o_____, and p_____.

77-77-77-77-77

DIAGRAM

The threading track on all projectors is similar, however, there are some differences according to makes and models. Obviously we cannot show you all the threading diagrams. Therefore we will show you the threading operation on one specific model. We remember from our lesson earlier, that a thorough knowledge of the operation of one projector model, is a good basis for _____.

REWINDING

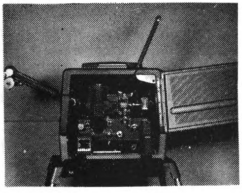
153-153-153-153-153

On the tail end of most films rented from libraries we will see the phrase "do not rewind after last showing." These are instructions from the film library itself. When the film is returned it is rewound by a film inspector who will check the film as it is rewinding.

Therefore, after the last showing of a film from a library we do not _____ it.

PRINCIPLES
OPERATION
PROCEDURES

2-2-2-2-2

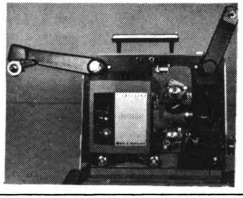


The mechanism used to project sound motion picture films is called a sound motion picture projector. A camera takes the pictures on film; a recorder records the sound on film; the projector shows the filmed pictures and reproduces the filmed sounds.

Therefore, when we think of showing a sound motion picture film we think of a _____.

ANY (ALL)

78-78-78-78-78



Let us use for our example, the Bell and Howell Filmosound Specialist, Model 540. We have already set up and checked out the projector according to our previous lesson. At this point, we are ready for th_____.

154-154-154-154-154

REWIND

We realize also that if the film is damaged in any way we will note this so that the film inspector will be alerted. A notation of either a break in the film or torn sprocket holes is most important.

Therefore upon return of every library loaned film it will not be re_____ and a slip listing film d_____ will be included.

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