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ABSTRACT

If students have control over learning devices such as tape recorders, do they learn more? That was the question which this experiment tried to answer using three different situations. In situation A, the subject had no control over the tape playback once the lesson had been started. In situation B, the subject could stop the lesson to take notes or to do something else. In situation C, the subject could stop or replay the lesson any time he chose. Each subject listened to two tapes and then took achievement tests on the material. Results showed that students who could control their tape recorders learned more. A significantly positive correlation between learning achievement and the number of times the learner used the controls was found. Also, the addition of individual controls for pacing the instruction significantly aided learning. Most of the subjects preferred the situations where controls were available and disliked the absence of controls. A large majority of the students said they plan to seek audiotape learning situations in the future. The study raises the issue of the optimum format for presenting audiotape information. (Author/JK)

A STUDY OF THE EFFECTS OF STUDENT CONTROL OF AUDIO TAPE LEARNING EXPERIENCES (VIA THE CONTROL FUNCTIONS INCORPORATED IN THE INSTRUCTIONAL DEVICE)

by

Robert A. Senour

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CHAPTER I

Introduction

The effects of the population explosion, the information explosion and the shortage of trained teachers on educational practices have caused much concern among students, the general public and educational planners. These effects have compounded the already formidable task of the educational planner who is concerned not only with mass instruction, but also with individual learner needs, interests, desires and abilities. It seems that if the student is to keep up with the increasing volume of information, an instructional method more effective than the lecture must be incorporated in instructional design.

Many instructional planners have turned their attention to various forms of media (i.e., radio, television, motion pictures, audio tape) to store and transmit information. Stress has been placed upon recognizing individual student needs, interests and abilities (Skinner 1968). Instructional materials and devices currently are being marketed which manufacturers claim will increase the speed of instruction while individualizing instruction. As a result, educators are faced with the problems of validating these claims and determining the best materials and devices to fulfill the instructional needs of each student within the constraints of limited budgets and increasing student populations (Edinger 1969). Educational researchers, as a result of these problems, have begun to investigate the design, development and employment of instructional information in a matter that is compatible with the individual learner's needs, desires

and abilities (Stolurow 1964).

Currently there is an emphasis upon using "a systems approach" in the selection and employment of instructional devices. The systems approach first made an appearance in the development and production of the Polaris submarine. A system called Program Evaluation and Review Technique (PERT) was used to produce this ship. The PERT system involves a systematic and constant re-evaluation of time and costs in the production cycle. This system was looked on at first as the panacea (Cook 1966). Manufacturers of instructional devices have added the name "information systems" to their teaching devices. These information systems have proved to be more efficient, in terms of time, in presenting instructional materials. The programmed text, developed and researched by B. F. Skinner, has proven to be as effective and more efficient, in relation to time, than conventional instruction for certain subject areas (Hughes and McNamara 1961). Researchers began converting the programmed text to information systems presentation, as was done by John Coulson at the System Development Corporation (Coulson 1962).

Educators need help in establishing a decision model for making required choices among instructional devices being marketed by manufacturers. This help is needed if educators are to make the best possible use of their resources in solving the problems posed by the population and information explosion and the continuing shortage of trained teachers.

Design and Use of Information Systems

Many systems have been developed permitting the learner to access stored information. The textbook is an example of such a system although

it is not generally considered a system. An information storage and retrieval system usually is a mechanical and/or electrical device for rapid storage and retrieval of information. In designing an information storage and retrieval system to be used for instructional purposes, three basic considerations must be taken into account. First, information (subject matter) should be stored in a form that makes it readily accessible to the learner. Second, stored information should be retrievable in a display form (i.e., print, pictoral, auditory, etc.). Third, it should provide the capability for the learner to selectively control the display of the information (Glaser 1964).

Several systems have been developed to provide the learner access to stored information. The simplest approach involves issuing the learner the instructional materials and devices (i.e., print, microfilm, motion pictures, slides, audio tape, etc.) off the shelf and directing him to a station that contains the equipment needed to transform the stored information back into a form perceived by the learner. This might take the form of note taking, student drawn pictorials, etc.

More sophisticated information systems enable the student to remotely access many stored instructional programs. A most recent development has been the Dial Access Information Retrieval System. (Stewart 1969). A D.A.I.R. system allows the learner to access information stored in a central program source via telephone lines simply by dialing in a specified set of code numbers using a conventional dial telephone or touch-tone control mechanism. Once the student has started the device he no longer has any control over the presentation. In present systems the student

cannot stop the device for note taking nor repeat any section he might desire. The transmission of the information utilizes telephone lines and an audio tape playback machine. To this date, according to the DAIRS newsletter, the lessons to be played back are generally verbal and exercise the audio channel of the learner (Stewart 1969).

Other media-- filmstrips, 16 mm projectors and single concept cartridges-- could be triggered by a high frequency pulse placed on the audio tape. The playback of video tape is possible using similar techniques and is available in a few institutions on an experimental basis. Prior to the development of information systems, research is needed to determine if the much higher cost is justified in these much more sophisticated retrieval systems. The cost estimate for an available Ampex video system is five times greater than for one which retrieves only audio. As more institutions install and use D.A.I.R.S., more methods and procedures are being developed for integrating the system in the processing and retrieving of information. Initially, the D.A.I.R. systems were used primarily for instructional purposes. Even this instruction was an adjunct to in-class room instruction. More recently, materials developed for D.A.I.R.S. have been constructed with the objective of accomplishing the entire instruction for a particular course on a D.A.I.R. system. Another possible use of the D.A.I.R.S. would be for retrieval of materials for reinforcement of classroom instruction. That is, to amplify or reindentify information previously given in the classroom. In any event, the number of institutions purchasing and employing D.A.I.R.S. as a regular part of their instructional programs is increasing at an

accelerated rate (Stewart 1969).

Information Storage and Retrieval

Information stored on audio tape as a learning resource is currently in wide use. For example, Oakland County Community College in Michigan has designed a large portion of it's program in the independent study format. Audio tape lessons serve as the basic instructional mode for many courses. Students report to the learning center and receive instruction via audio tape lessons in individual learning carrels. Postelwaite at Purdue University and Druger at Syracuse University have developed basic courses in introductory Botany and Biology which employ audio tape as the primary instructional medium (Postelwaite 1969).

Several departments including anthropology, English, humanities, instructional technology, political science etc., are currently using and/or developing audio tape lessons for the D.A.I.R.S. installation at Wayne State University in Detroit, Michigan. D.A.I.R.S. installations in addition to being installed in institutions of higher learning, have recently been installed in K-12 settings. One of these is the Oak Park system in Illinois. This system, once it is completed, will permit the student to exercise control over the program he has selected for study. Control on this system will permit the student individual control over the pace, the sequencing and number of repetitions of the program he has selected (Ampex 1968).

The basis for establishing the need for the data that shall be generated by this study revolves around the consideration of the existing and future means of providing the interface between the learner and the subject matter. The term "interface" refers to the methods or procedures

used to place the student in contact with the instructional objectives.

> Glaser (1966) states that:
> since the manipulation of subject matter events is the primary means by which the student learns, the manipulation should take place on the basis of a wide range of display modes.

The audio tape playback controls described above are examples of both display and response modes which will provide a means by which the student may manipulate subject matter presentations.

> Glaser goes on to suggest that:
> These modes are dictated by subject matter characteristics and requirements of the learning process and are made possible by the application of modern engineering developments in display and response technology.

Traditionally, the primary means of accomplishing this interface has been the teacher alone or the teacher using instructional materials. Therefore, the primary source of subject matter information for the learner has been, and largely still is, the teacher and a limited use of instructional materials directly manipulated by the teacher. Thus, with the exception of print as an information source, the learner has not been provided the opportunity to use other information sources i.e. films audio tape, video tape, filmstrips, etc., independent of the teacher.

The utilization techniques developed for the various media have been limited by the media having been designed to be used by teachers or equipment experts in the presentation of information (subject matter) to groups of learners. In the past, and even today, this concept of the teacher using instructional materials and equipment in the presentation of information has dominated the thinking of instructional

materials and equipment designers and producers. It has also shaped the teacher's view on the employment of media in the teaching-learning process. This trend in thinking evolved into the concept of "teaching aids." It has continued to flourish in an educational setting dominated by the group instructional patterns that have evolved from the need to educate the masses.

The educational planner is attempting to meet the educational needs of an ever increasing student population. He is attempting to do this in a social environment characterized by an acceleration of information accumulation and an increased rate of change in the needs of society. The educational planner is also faced with the perplexing problem of attempting to provide for the individual differences of the learner (i.e., learner rate, ability, desires, etc.). To meet these needs, educational planners have devised several approaches to instruction including combinations of large, medium and small grouping patterns. Two approaches receiving recent consideration are independent study and individualized instruction. These two approaches lend themselves to meeting the individual needs and differences of the learner. One of the prime characteristics of these approaches is that at least part, if not most, of the time the learner may study independently. In this setting, the "teacher alone" or "teacher with media" no longer functions as the primary means of providing the interface between subject matter and learner.

In these approaches, the student is afforded the opportunity of accessing subject matter information through the direct use of instructional materials and equipment. That is, the learner has an opportunity

to handle, manipulate and control the instructional materials and equipment. In this setting, the instructional materials (print, media, films, filmstrips, audio tape, video tape, etc.) become the primary subject matter information sources while the hardware (microfilm readers, projectors, tape recorders, etc.) provides the interface between the learner and the subject matter.

The concept of learner use of instructional materials and equipment as a learning experience provides a basis for the evolution of the concept of "learning aids." The basic difference between the so-called "teaching aids" and "learning aids" is the intended user (one who controls or manipulates the medium). In the design of instructional equipment, the designer must consider the user, and the user's purposes. If instructional equipment and materials are to be used by the learner to gain access (provide the interface) to and maintain control over (manipulate) the subject matter stored in the system (i.e., on microfilm, audio tape, video tape, etc.), then one of the primary concerns of the designer should be the control functions provided to the learner which permits him to gain access to, and manipulate, the presentation of the stored information (subject matter).

If the function of the learner oriented use of media is to provide effective learning experiences for the learner, then the control functions provided by the equipment should facilitate learning. That is, the control functions should provide the learner with a means to employ a maximum variety of learning skills (i.e., note taking, etc.). In discussing the problem in the design of teaching methods, Travers states:

> The systematic design of learning conditions involves the planning of the child's environment in such a way that the impact of stimuli has the maximum effect in promoting learning in the directions that are specified in the objectives. All objects and events that exert control over the learning of the pupil must be incorporated into the design. The main events that exert control over the learning of the pupil are the behaviors of the teacher, and the main objects that exert such control are the pieces of educational equipment provided (Travers 1967).

When the learner is in the independent study mode, he may attempt to utilize audio tape lessons as a means to learn subject matter content. In this setting, the audio tape lesson and the associated playback equipment assumes the role of the teacher. It therefore must provide for the learner's responses to the impact of the stimuli being presented. It must, in essence, attempt to provide for any desired learner response which will promote maximum learning. For example, if the "impact of the stimuli" being presented stimulates the learner response "note taking," then the playback system should facilitate the application of this learning skill. Therefore, any information display system designed for optimizing learning experiences should incorporate the control functions needed to provide for the learner's desires to apply his individual learning skills.

Importance of the Study

The most economical dial access information retrieval systems which utilize audio tape as a storage mode do not permit individual learners to maintain control over the program they have selected. This kind of information retrieval system is the most prevalent in use today. The locations are noted in Stewart's Newsletter (Stewart 1969).

As the employment of audio tape lessons as a learning resource

continues to increase, much more research is needed to determine the best design for lessons to be presented via D.A.I.R.S.. The functional characteristics of the playback equipment which will facilitate learning need to be determined. Research is needed to ascertain:

1. What controls should be provided to allow the individual learner to manipulate the information being presented?
2. How should lessons for audio tape retrieval be designed to facilitate learning?
3. What types of information may be effectively transmitted via audio tapes?
4. How much input i.e., student's time, content development time, cost of instructional devices and evaluation time, is justified by how much output i.e., the measured increase of the student's achievement and learning?

This study investigates question number one. Results of this study may also reveal information on questions two, three and four. Although the form in which information is stored and retrieved is important, this study will seek to determine the effects of providing or denying the learners with a means of selectively controlling the retrieval and presentation of stored information (subject matter). Specifically, this study shall focus on the effects of providing the learner with a means of control for selecting the pace and number of repetitions of the audio tape lessons (information) since knowledge of machine characteristics is a prime need.

Lumsdaine and Glaser (1960) have both devoted much time and energy to studying the interaction of the learner's behavior with the subject matter. Specifically, Lumsdaine suggests that the student be allowed to control the rate of presentation and be permitted to continually evaluate

his performance and appraise his achievement (Lumsdaine 1964). It would seem that the effect of really doing something about individual differences in education has potentially revolutionary significance not only for classroom management but for the total school organization. The auto-instructional methods and devices may represent the most important innovation in education since the advent of the textbook (Glaser 1966).

William Allen states that "no single variable in audio visual use has been studied as intensively as that of student participation and no other variable has elicited a more general confirmation as a means of facilitating learning" (Allen 1960). More student participation is in effect what manufacturers of learning systems are attempting to emphasize with the inclusion of the controls and gadgets on the new generation of hardware. Considering Allen's comment, made in 1960, (and the search of the literature conducted for this study,) it appears evident that a research study that will explore the relationship between pause, stop and the repetition of audio tape lessons is needed. It also appears evident that a study is needed to determine if the controls mentioned above are worth the increased cost in relation to their contribution to the learner's achievement.

Audio tape playback equipment represents but one type of stimulus presentation system. The control functions of the system provide the learner with a means of responding to the stimuli being presented. Specifically, the controls provide stimulus manipulation capability by facilitating the pacing of information presentation. This may be

accomplished by utilizing the stop/start and replay controls on the instructional devices.

What is the value of providing audio tape playback controls in terms of cost effectiveness of the audio tape playback system? This can be determined by comparing the output, which is learner achievement, to the input which is the cost of equipment, cost of preparation of the instructional materials and the student's time. Another consideration might be the affective learning that occurs. For example, it may be found that gain scores on the achievement measures might not change for the experimental from the control group, but because the student was able to control the instruction he might begin to involve himself in learning more than he had previously. The affective nature or approach to learning may change positively from an investment in instructional media controls. Stop, rewind and replay are standard control functions on an ordinary tape recorder.

However, the first generation audio playback systems were designed to facilitate mass distribution of audio tape information from a single tape source. Generally the learner has little or no control over the program once it has been selected and is in progress. The most common use of such a system has been in teaching foreign languages. They are most often called language laboratories. With this type of system the instruction and progress of the program is most often instructor controlled. Another more advanced system permits several students to access a single program source. However, the students are not able to exercise any control over the presentation of the materials. They simply start

it and turn it off once the lesson is completed.

There are other systems which have individual control functions in each learning station. These systems limit mass distribution of the programs and increase the cost to an estimated five times D.A.I.R.S. presently in use. In such systems, the information from a master tape is transferred to a slave deck in a learner carrel by means of a dial system similar to the Bell Telephone system. Once the information is transferred to an individual learning carrel, the learner has individual controls for stopping, pausing and rewind/replay capability for controlling the pace of the presentation. The question still remains: Is the expense incurred in providing the learner with a means of controlling audio tape lessons justified? Hardware manufacturers have designed such systems and are attempting to sell them, with some success, to educators.

The cost, as mentioned, is astronomical. This study is intended to provide at best some emperically tested data upon which the educator and educational equipment designers can make decisions and predictions concerning the design characteristics of audio tape information retrieval and/or distribution systems.

Statement of the Problem

This study is primarily exploratory in nature. The purpose of this study will be two-fold. First, it will represent an effort to design and develop an experimental facility and procedures by which hypotheses related to the design of effective audio tape information retrieval systems may be emperically tested. Second, the facility will then be

used to emperically test a set of hypotheses related to the instructional value of providing the learner with various means of controlling the playback of audio tape lessons.

This study seeks to determine if providing the learner with the ability to selectively control the presentation of the audio tape lessons has any significant effect on achievement. This study shall focus on the effects of providing the learner with the ability to control the presentation of audio tape lessons by utilizing the control functions provided by the audio tape playback system. The playback control functions that shall be considered will provide the learner with the ability to:

1. Pause or hold the audio tape presentation in place whenever desired.
2. Stop and replay any segment of the audio tape presentation as desired.

Additionally, an attempt will be made to determine the psychological effects of providing control functions on the learner. The objectives of this study are to seek answers for the following general questions:

1. What are the effects on achievement of providing learners with the ability to stop and/or replay segments of audio tape lesson on their learning (achievement) from audio tape lessons?
2. What are the effects of denying (not providing) learners the ability to stop and/or replay segments of audio tape lessons on their learning (achievement) from audio tape lessons?

The answers to the following specific questions are of particular interest:

1. Will denying these controls (stop and/or replay) produce significantly lower levels of learner achievement as compared

to a situation that does provide these controls?

2. Will providing these controls (stop and/or replay) produce any significant gains in learner achievement as compared to a situation which denies them?

3. Will there be any significant differences in learner achievement from audio tape lessons in a situation that provides:

   a) No controls

   b) Stop only control

   c) Stop and/or replay controls

4. Will students use the control functions provided? How often?

5. In the learner's opinion

   a) What will the controls provided accomplish?

   b) Will the control functions be desirable or necessary to help him learn from the audio tape lessons?

   c) If given a choice will he choose to learn from audio tape lessons again in the future?

   d) If given a choice which type of audio tape playback system will he prefer to use?

      1. One which provides no control over the playback?

      2. One which provides stop only control?

      3. One which provides stop and replay controls?

   e) Will the students avoid using audio tape lessons if the playback system provides:

1. No control over playback?
2. Only stop control over playback?
3. Stop and replay control over playback?

HYPOTHESES

This study was designed to test the following null hypothesis. The hypothesis is stated in the null form. No significant changes in achievement by the subjects will result as a consequence of providing control functions on the audio tape playback equipment. In the following hypotheses T_1, T_2, T_3, and T_4 are used to represent the group achievement scores for the four treatments. Refer to page 18 #3 for symbol description.

Null;

H_o	$T_2 = T_1$	No difference exists between the two treatments
	$T_3 = T_1$	No difference exists between the two treatments
	$T_3 = T_2$	No difference exists between the two treatments
	$T_3 = T_4$	No difference exists between the two treatments

Alternate;

H_1	$T_2 > T_1$	A statistically significant positive score increase will be found between the two treatments
	$T_3 > T_1$	A statistically significant positive score increase will be found between the two treatments
	$T_3 > T_2$	A statistically significant positive score increase will be found between the two treatments

$T_3 > T_4$ A statistically significant positive score increase will be found between the two treatments

The level of significance $\alpha = .05$

A list of the null and alternate hypotheses concerning the use of the control functions and achievement follows:

1. Comparing use of stop control and achievement

   H_o There is no significant correlation between frequency of use of the stop control and achievement scores

   H_1 There is a significant positive correlation between the number of times the learner elects to use the pause control and achievement scores

2. Comparing use of replay control with achievement

   H_o There is no significant correlation between the number of times the learner elects to use the replay control and achievement scores

   H_2 There is a significant positive correlation between the number of times the learner elects to use the replay control and their achievement scores

3. Comparing amount of replay time utilized and achievement

   H_o There is no significant correlation between amount of replay time utilized and achievement scores

   H_3 There is a significant positive correlation between the amount of replay time used by the learner and his achievement scores

The findings to these questions may add to the emperically tested data upon which instructional systems designers and users may make defensible and effective decisions concerning the design and utility of an information retrieval system using the auditory channel as a means

of communicating stored information to the learner.

General Statement of Design

This study attempts to gather evidence which would permit the rejection of the null hypotheses as previously stated. A brief description of the design follows:

1. Subjects will be randomly assigned to each treatment in the design.
2. Each subject will be required to take two different audio tape lessons.
3. For lesson one, subjects will be assigned to one of four treatments. Treatments vary only in the amount of playback control provided (Treatment 1 - no control; Treatment 2 - stop only control; Treatment 3 - stop and/or replay control; Treatment 4 - limited to 19 minutes interacting with the lessons).
4. For lesson two, the treatments remain the same, however, subjects will be shifted to different treatment situations. For example, those students who were permitted to use controls in lesson I will be shifted to the no control treatment situation in lesson II.
5. Achievement scores for each subject will be used to determine a mean for each group on which the tests of significance will be conducted.

Assumptions

It is assumed that the same common subject matter elements exist in each treatment for each lesson and are available to each subject. It is assumed that there are no content restrictions due to age, education nor other developmental limitations.

Limitations

The generalization of the results of this study may be somewhat limited. This is due in part to the nature of the population. All subjects were students enrolled in a College of Education. Because of this, their sensitivity to instructional procedures may be different from other populations.

Summary of the Problem

This study seeks to determine the effectiveness of audio tape playback systems permitting students selective control of lesson presentation as compared to systems permitting no controls as indicated by achievement test scores on a post instructional test.

Summary

In this chapter the author has attempted to indicate the need for a research study on the functions of controls on instructional devices. Information systems are multiplying at a tremendous rate. Each new one being marketed is more sophisticated than the last. Educators facing increased student populations and an information explosion are buying expensive information retrieval systems with a minimum of information upon which to justify their choice. Vendors are marketing more complex systems with virtually no research data to substantiate their position.

This study seeks data to provide data for both.

In chapter II the results of the current literature search plus the establishment of a rationale are found. In chapter IV the results of the data collection are reported as outlined in chapter III. The data were collected to answer the following general question:

> What controls should be provided to allow the individual learner to manipulate the information being presented in order to increase achievement?

In chapter V, implications for educators and hardware vendors are considered, and recommendations are made for further study of issues raised in this study.

CHAPTER II

Rationale for Investigation of the Literature

The primary concern of this study centers around determining the effects on learner achievement of audio-tape lessons when he is provided or denied selective control over the presentation or playback of the lesson. The search of the literature was directed to identify relevant research related to investigations dealing with learner controls on instructional media.

Literature Search

A review of the literature revealed that no research has been reported that deals directly with effects of providing or denying the learner selective control over the playback of audio tape lessons. The need for research on the design characteristics of audio tape playback equipment was pointed out by Lumsdaine (1963) in his discussion of audio instruction. He suggests that the effectiveness of audio instruction depends not only on the availability of recorded materials, but also on the design characteristics of the equipment. Glaser (1966) in a report of his study on the means of providing for student interface with subject matter postulates that this interface is a function of two aspects:

a) The stimulus response properties of the subject matter.

b) The learning requirements of the behavior being taught.

He asserts that the responsive relationships between subject matter display and manipulation of it by the learner is an essential aspect of the student-subject matter interface.

Saettler (1968) in summarizing his conclusions about the factors pertinent to the design and selection of educational media suggests that we need criteria and procedures whereby we may match a medium to the

requirements of the learner. He maintains that research should be directed towards the relative effectiveness of modes of presentation as they relate to the content of the instructional message, to the communicator and learner characteristics and to the physical and psychological aspects of a particular medium.

Glaser (1966) indicates that he believes "the responsive relationship between subject-matter display and manipulation of it by the learner is one of the essential aspects of the student-subject-matter interface. A student learns by manipulating the objects and concepts in his environment. The environment is responsive to his manipulation and in some way the student is informed of the results of his manipulations."

The premise for Glaser's study is that the manipulation of the subject matter is the primary means whereby the student learns.

The Technological Development Project, under the direction of James Finn, has produced a series of papers which review the history of educational technology (Anderson, 1961; Saettler, 1961), available teaching machine devices and programmed materials (Finn & Perrin, 1962), the use of audiovisual instrumentation (Finn, Perrin & Campion, 1962), and design problems involved in development of instructional equipment (Leverenz & Townsley, 1962). In special supplements to the Audiovisual Communication Review, behavioral scientists have considered the implications of learning theory (Meierhenry 1961). These writers and others indicate an increasing concern of audiovisual specialists for defining more rigorously the principles underlying their work.

They are saying that experiments which contribute to a usable

science of instructional media must seek to reveal the influence of specific factors in design or use of the media. These factors should define reproducible characteristics of the instructional stimulus and response features that can be incorporated in future instructional devices.

The human engineering approach to training problems, which grew out of the training psychology developed during World War II, recognized the importance of human design factors in defining the course of learning. In the human engineering context, the study of learning assumes a subordinate role, for the primary features of human design that define sequencing or patterning psychology focused attention on intrinsic determinants of learning (Gagne 1965). As the devices and systems of education have become more complex and refined, the instrumentation of the educational process has come to present the same kind of problems that are met in designing machines for human work. The design must be conceived in terms of the kinds of devices to be used in addition to the instructional materials to be presented.

If the instructional materials are linear in nature, then the student must be provided with the capability of stopping or repeating any section of the instruction at any time of his choosing without having to repeat the entire sequence. Smith and Smith (1966) state that the "techniques of human education are useful as they extend the learner's control of his behavior and the environment." They go on to say that because educational learning is concerned almost entirely with instrumental and symbolic behavior, it is dependent on devices which mediate instrumental and symbolic control.

Audio-Tape As A Learning Resource

Sticht (1968), in a study of listening and reading test performance, reported that (1) listening was as effective as reading in transmitting information at three difficulty levels for both average and low aptitude subjects; (2) reading and listening performance of the average aptitude groups surpassed that of low aptitude groups; and (3) there were individual differences such that some subjects did better by listening than by reading and vice-versa. When the study was re-run with time compressed speech to permit listening rates equivalent to silent reading rates, the results indicated that for both normal and time compressed speech, comprehension increased as aptitude increased.

Another interesting finding indicated that repeated listening of a compressed selection which was presented twice, in the same amount of time required to present the uncompressed message twice, did not improve the peak comprehension of high or low aptitude subjects. In reviewing his findings, Sticht concluded that: (1) certain materials may be presented as effectively through listening as through reading for men of both average and low aptitudes; (2) moderate degrees of speech compression may improve the listening efficiency (amount learned per minute of listening); (3) the rate of speech is the primary limiting factor in the comprehension of listening selections subjected to more than about 40% compression, when based on a speech rate of 175 wpm used with materials that are fairly high in redundancy; and (4) because listening efficiency may improve with the use of time compressed speech, the time saved may be used to selectively reinforce certain aspects of the material. Present

results, however, suggest that mere repetition of materials alone may not increase peak comprehension.

Lovitt (1968) studied the "Operant Preference of Retarded and Normal Males for Rate of Narration" and found that normal boys generally preferred the 180 (normal) wpm rate while the retarded boys all rejected the normal speech rate in preference to either time expanded or time compressed versions. Lovitt is careful, however, to point out that additional research in this area is needed.

Nolan (1968) reported a study entitled "Active and Passive Listening Under Conditions of Normal and Compressed Speech Rates." An interesting aspect of these studies was the fact that all subjects (N = 120) were blind students from grades 4-7 and 9-12. Learning of three different subject areas (literature, social studies, and science) was tested. The audio-taped Lessons were designed along three modes of listening: (1) continuous listening (2) listening interrupted for 45 second periods at four evenly spaced intervals during which the subjects were instructed to mentally review what was just heard and (3) listening interrupted for four-minute periods at four equally spaced intervals during which the subject made notes of what he had just heard (using a braille writer). In addition each listening mode was divided into two subgroups, one which listened to material presented at a rate of 175 wpm and a second listened at a rate of 275 wpm.

All listening passages were selected for appropriateness for use at the grades involved. The normal playing time for each was about 13 minutes. All subjects were immediately tested for comprehension following

each listening. The results of these studies indicated that students who actively participated in the listening process through periodic mental review or note taking made higher comprehension scores than those who took only a passive part. The most surprising finding was that students listening at compressed rates generally comprehended as well as those listening to materials that were presented at a normal rate.

Design and Use of Audio-Tape Play/Record Equipment

The literature dealing with recordings for instruction, including their use in the language laboratory, is almost all of a descriptive sort. No research studies on specific factors governing the effectiveness or the effects of instruction by audio-tape were to be found.

Mathieu, however, in an article in AUDIOVISUAL INSTRUCTION, June, 1964, makes a plea for the incorporation of a pause control. He suggests that this would represent a decisive step in breaking away from the concept of students marching in uniformly measured steps through instructional materials. This first step would free the student from a pace pre-determined for the instructional program by the leveling law of the average.

Theuma (1968) in discussing a better design for student-operated tape recorders maintains that the purpose of equipping a booth with a tape recorder or the facilities to control a recorder installed in a remote rack is to give the student full control over his learning materials. The control functions called for would provide the learner with the opportunity to: stop and hold the program in place, skip back and replay segments of the tape, record his responses on the tape, replay

and evaluate his responses and skip forward into the program. Theuma also suggests the need for human engineering research studies that would reveal the size, color, shape and location of the control buttons which would minimize wasted time and effort on the part of the learner when he used them. Again no research was cited to support this position.

Lumsdaine (1964) makes a plea for the interaction of the learner's behavior with the subject matter. Specifically, he requests that the student be allowed to control the rate of presentation for continual evaluation of his performance and appraising his achievement. Lumsdaine maintains that the effect of really doing something about individual differences in education has potentially revolutionary significance not only for classroom management but for the total school organization. He summarizes by suggesting that auto-instructional methods and devices may represent the most important innovation in education since the advent of the textbook.

Kraner (1963) compared the effects of two methods of presenting instructions. In one method the instructions were read aloud. In the second they were given from a tape recorder. The instructions given from a tape recorder were found to increase achievement in English development. However it was noted that in this study the device was not controlled by the student but by the instructor.

Lorge (1964) found in teaching French that the type of equipment used influenced the results of instruction. The group that had a record-playback capability generally achieved better results than a group which had no record-playback capability. Again in this study, the instructor

controlled the playback.

Ofiesh (1968) reported a study which attempted to determine student and faculty attitudes toward 12 types of instructional media including audio-tape, audio-tape recorders, and Dial Access Systems. A structured questionnaire and attitude scale were administered to 435 students and 150 faculty members at five universities and colleges having operational dial access systems. The questionnaire was augmented by a structured interview. The students' attitudes showed the highest score (positive attitude) toward: films, textbooks, dial access systems, carrels, audio-tape recorders in that order. The faculty, on the other hand, showed positive attitudes toward: audio-tape recorders, audio-tapes, carrels, slides, slide projectors, in that order. All of the media mentioned were rated in the "very positive" category. The responses from the structured interviews served to corroborate the data obtained on the original questionnaire. However, no attempt was made in this study to determine the effects of student control over the media used.

The review of the literature also revealed that only one presently operational dial access audio information retrieval system permits the student to exercise any control over the replay or selective interruption of the lesson presentation. This single facility designed and developed by the Ampex Corporation has been installed in the Oak Park and River Forest High School in Illinois. This system has only been in operation since the fall of 1968. As yet, no research has been reported indicating the relative merits of the system. In most other operational dial access laboratories the selective interruption and replay capabilities remain

with the instructor responsible for the operation of the hardware.

One of the important influences of Skinner's work has been a greater emphasis upon management of efficient learning conditions designed to study effects, achievement and learning. Holland (1965) reported a study that supports the idea that an overt response increases achievement. Providing for student control over the presentation of stimuli is, in a sense, a means of providing an overt response to that stimuli. When the learner elects to utilize the control function, he is, in fact, responding to that stimuli.

William Allen states in the Encyclopedia of Educational Research that "no single variable in audio visual use has been studied as intensively as that of student participation; and no other variable has elicited a more general confirmation as a means of facilitating learning" (Allen 1960). More student participation is in effect what vendors are attempting to emphasize with the inclusion of the controls and gadgets on the new generation of hardware. It appears evident that some research studies are needed to determine if the controls do in fact make a significant contribution in facilitating learning.

CHAPTER III

In chapter III the method of research, the population and the procedure for completing the research will be detailed. The data collection, processing and analysis procedures will also be included in this chapter.

Method of Research

The method of research used was experimental in design. The procedure was to administer the pre-test to the control groups (P_1, P_2, P_3) to obtain the base line data. Following this, the four treatments (T_1, no control; T_2, stop control; T_3, stop and/or replay control; T_4, spent 19 minutes listening to lesson content) were administered. Subsequent to the treatments, each subject was given a post test on the content lesson. The following is a model of the research design. This design follows the Solomon four group design outlined by Campbell and Stanley (Gage 1963).

The Research Design

Treatments	Groups	Pre-test	Treatment	Post-test	Questionnaire
T_1 no control	A		X	X	X
T_2 Stop only control	B		X	X	X
T_3 stop/replay control	C		X	X	X
T_4 limited to 19 minutes	D		X	X	X
	P	O	O	O	O

The X's indicate the sequence for the experimental groups.
The O's indicate the sequence for the control groups.

The subjects for all groups were assigned to the various groups at

random. Numbers were assigned to the 196 subjects. A random numbers table was used to assign each subject to a particular group. In this manner other extraneous variables were assigned randomly to different groups to prevent biasing the data. A split-half reliability check was conducted on the content tests with the pilot group (Thorndike 1961).

Population

The population for the study were 196 students in all the sections taking basic courses in the Department of Instructional Technology in the College of Education at Wayne State University during the winter quarter, 1968. Some selectivity already was present in the groups because of the nature of the courses taken and the college in which these courses were offered. In order to generalize the results to another population it is necessary to repeat this study with subjects chosen from other populations.

The basic course was elected by both undergraduate (Juniors and Seniors) and graduate students. Therefore, subjects ranged from college Juniors to post-masters level. There were 157 undergraduates and 39 graduate students. Four subjects were post-master's students. Fifty-six subjects were male.

Procedure

In this study the independent variables were the control functions provided the learner as a means of selectively controlling the playback of audio-taped lessons.

The independent variables were:

T_1, no control (could not stop the machine)

T_2, stop only control (could only stop the machine)

T_3, stop and/or replay control (could stop and/or replay on the machine)

T_4, group spending 19 minutes listening to lesson content with all controls available.

The experimental design was set up to investigate the effects of the independent variables on the post test achievement scores.

In this design, one group (P) received the pretest and the post-test while the remaining groups (A, B, C, D) received only the post-test. This procedure attempted to eliminate pre-testing experience from biasing post-test data. The data generated from pre-test groups (P-1, P-2, P-3) was used to provide a basis for determining a relatively unbiased achievement gain score for the post-test-only groups (A, B, C, D). A separate experimental group (D) was established using 34 subjects. This separate group was given instructions to spend 19 minutes with the instructional device going over the content. This was an attempt to isolate the variable of time. A comparison was made between subjects who used the controls, thus had unlimited time, and subjects who had a fixed amount of time. This latter group is the separate control group henceforth designated T-4.

Two trials using different audio-taped lessons were conducted. Trial I was used to determine the effects of the independent variable on achievement. In Trial II the subjects were shifted from their assigned mode in Trial I to a different mode which either contained more controls or less controls than they had experienced in Trial I. This was correlated with the numbers of subjects who elected to use controls, how

much the controls were used, which control was used more often than another and what effect time spent on the lesson effected the achievement score.

For example, a subject taking lesson one in Trial I which had stop control in Mode B, was shifted to Mode C for lesson two in Trial II. In this example the subject had more controls available (stop/replay) in Trial II than were available for Trial I (stop only).

For Trial I (lesson one), the five groups were designated as follows:

Groups

Group P - pre-post test group

Group A - no controls

Group B - stop control only

Group C - stop and/or replay control over replay

Group D - limited to 19 minutes listening to lesson content

Group P consisted of subjects who received both the pre and post tests. Group P was subdivided into three groups.

For trial I the assignments of groups to experimental situations were as follows:

P_1 - assigned to no control experimental situation T-1.

P_2 - assigned to stop control only experimental situation T-2.

P_3 - assigned to stop and/or replay control experimental situation T-3.

Group A was assigned to experimental situation T-1 (no playback control)

Group B was assigned to experimental situation T-2 (stop control only)

Group C was assigned to experimental situation T-3 (stop and/or replay control)

Group D was assigned to listening to the lesson content for 19 minutes T-4.

Graphically the design of Trial I (lesson 1) may be represented as follows:

Table I

A Chart Depicting the Design of Trial I

Treatments	T-1	T-2	T-3	T-4
Experimental	P_1	P_2	P_3	
Groups	A	B	C	D

Where: Trial I - Audio-taped lesson I

Experimental treatments

T-1 - no control of playback

T-2 - stop control only

T-3 - stop and/or replay only

T-4 - subjects spends 19 minutes in treatment T-4.

Experimental Groups for Trial I

P_1, P_2, P_3 - pre and post achievement test program

A, B, C, D - post achievement test only groups

P_1 and A - no control

P_2 and B - stop control only

P_3 and C - stop and/or replay control

The procedure for trial I for each group occurred as follows. All P groups were pre-tested, listened to the lessons and were post-tested. Groups A, B, C listened to the lessons then were post-tested on subject matter. Group D spent 19 minutes listening to the lesson and were post-tested on subject matter.

In Trial II the subjects were split in all groups except P and shifted to a different treatment to determine the influence of more or less controls and time on the achievement scores. Groups A, B and C were split to form Groups A_1, B_1 and C_1 respectively. These groups were assigned to the experimental situation as follows:

A shifted to treatment T-2

A_1 shifted to treatment T-3

B shifted to treatment T-1

B_1 shifted to treatment T-3

C shifted to treatment T-1

C_1 shifted to treatment T-2

Graphically, the design of Trial II is represented by table (II).

Differences between trials occurred only in the subject matter of lesson presented and the treatment to which they were exposed. All P groups (P_1, P_2, P_3) however, experienced the same treatment in both Trials I and II.

Table (II) represents the graphic representation of the design for Trial II.

Table (II)

Graphic Representation of Trial II Design

	Trial II			
Treatments	T_1	T_2	T_3	T_4
Group P	P_1	P_2	P_3	
Group A		A_1	A_2	
Group B	B_1		B_2	
Group C	C_1	C_2		
Group D				D

Where: Trial II Audio-taped lesson 2

Experimental treatments:

T-1 no control

T-2 stop control only

T-3 stop and/or replay control

T-4 subject spends 19 minutes in treatment C

Experimental groups for Trial II:

P_1, P_2, P_3 - experience same control feature as in Trial 1

A-0 - no control, Trial I
stop control, Trial II

A-1 - no control, Trial I
stop and/or replay control, Trial II

B-0 - stop control only, Trial I
no control, Trial II

B-1 - stop control only, Trial I
stop and/or replay control, Trial II

C-0 - stop and/or replay control, Trial I
no control, Trial II

C-1 - stop and/or replay control Trial I
stop only control, Trial II

For Trial II the sequence of events experienced by the subjects was exactly as outlined for Trial I (page 5). Differences between trials occurred only in the subject matter of the lesson presented and the treatment to which they were exposed.

For the control or P groups the subjects were given the pretest to determine their knowledge of the content prior to receiving any treatment. This was done to collect base line data for the variables extraneous to the content. After taking the pretest, the subjects were given the treatment. The P group was post-tested just to complete the cycle as closely to that as the other subjects. Their post-test scores were not used.

Written directions were handed to each subject as he entered the assigned carrel. The directions included, in addition to specifics for each mode, a statement that a post test was to be given subsequent to each presentation and the subject was permitted to take notes if he desired.

The measures used to determine the effects of the independent variables on the subject's achievement scores were locally prepared pretest and post-test. The tests were designed specifically to measure the subject's knowledge of the content of the audio-taped lessons presented. The test was administered in accordance with the procedures outlined in

the "Soloman Four-Group Design" (Soloman 1949).

The pre-post test for lesson one consisted of 13 true-false items and 11 multiple choice items. The 11 multiple choice items contained 5 choices each. The pre-post tests for lesson two consisted of twenty multiple choice items with 6 choices each. Care was taken to prevent the sequential presentation of the test items. Each test was designed so that all items were presented logically within the test. This arrangement of the items within each test was intended to preclude the possibility of biased responses based on subject response to a previous item. The randomization of items in the tests was an attempt to eliminate providing cues to the subjects for the selection of the correct choice.

The lesson content used in the study was most applicable to the students participating in the study, as most were preparing for a career in teaching and ultimately in selecting and using media and instructional materials.

Audio-taped Lesson Materials

The lessons for this study were chosen for their relevance to the course in Instructional Technology. Subjects were informed that the audio-taped lessons were part of the independent study phase of the course. They were told that they would be tested on the contents of the lessons.

Lesson I consisted of a narrative prepared from Leslie S. Briggs' article, "A Procedure for the Design of Multimedia Instructions." (1967) A professional narrator was secured to insure that subjects would perceive the taped lessons as being professionally prepared for instructional

purposes.

Lesson I, if played without interruption, was twelve minutes long. The subject matter, in Lesson I, was compatible with the objectives of the course and its general distribution precluded the probability that the student would have prior knowledge of its content.

Lesson II was a narrative prepared from Chapter 2 of Robert M. Gagne's book entitled, "The Conditions of Learning" (Gagne 1965). The same professional narrator was used to make this tape. Lesson II, if played without interruption was fourteen minutes long. The subject matter in Lesson II was chosen with the same consideration as outlined for Lesson I.

Audio Tape Playback Equipment Modification

Three study carrels were set up in the Learning Resource Laboratory with standard tape recorders and headsets. Wallensak Model T-1500 tape recorders were selected, for ease of modifying to collect the data and providing various levels of playback for the subjects.

In carrel one the tape recorder was fixed with screws to prevent the subject from attempting any control of the presentation of the lesson or it was begun. These modifications provided the means for implementing Treatment I, "no control."

In carrel two, the tape recorder was modified with a clip-on device to prevent the subject from replaying or rewinding. Thus the subject was able, by depressing "stop," to selectively interrupt the audio-taped lesson. A micro switch attached to a digital counter was connected to the stop key to record each time a subject elected to stop the lesson. Printed directions in carrel two instructed the subject that, "If he

wished, he could stop the taped lesson by depressing the "stop" key as often as he desired."

In carrel three the tape recorders' "play", "stop", and "rewind" levers were left intact. A micro switch attached to a counter was connected to the "stop" lever to register the times a subject elected to stop the lesson. Another micro switch attached to a different digital counter was connected to the "rewind" lever. Also connected to this micro switch was an electric timer. When the "rewind" lever was moved into rewind position, the micro switch was tripped, in turn, tripping the digital counter and starting the electric timer. The electric timer continued to run until the "rewind" lever was returned to the neutral position. The digital counter totaled the number of times the subject elected to rewind to replay segments of the audio-taped lesson.

Printed directions in carrel three instructed the subject that, "If he wished, he could stop and/or replay the taped lesson by depressing the 'stop' key and moving the rewind key to the left as often as he desired."

Nature of Data Collected

For treatment I the post-test score was reocrded for each subject. The time for treatment was constant for both lessons because the subjects were not permitted to interrupt or repeat the lesson in this treatment mode. For treatment II, the post-test score and the number of times the subject elected to stop, plus the total time spent listening to the lesson, were recorded for each subject. The tape recorder in mode B was engineered with a counter to record the number of times each subject elected to stop

the recorder. A monitor recorded the start and stop times from a clock above each carrel to obtain total time in treatment for each subject.

For treatment III the tape recorder was engineered with an addition of two counters and a clock with a sweep second hand. One counter tallied each time a subject elected to stop the recorder; the second counter tallied each time a subject elected to reverse the tape recorder to repeat any segment of the lessons. The clock was activated each time a subject elected to replay any segment of the lesson. It started when the subject began rewinding, and stopped when the subject returned the tape recorder to the play position. Thus, total time of replay was collected for each subject. In the following table the X's depict the data collection requirements.

Table III

Data Collection Requirements for the Groups by Treatment

Groups	Number of Stops (T-2)	Number of Stops and Replays (T-3)	Total Time
A			X
B	X	X	X
C	X	X	X
D	X	X	X

Data was collected for each of the groups where it is indicated by the X in the column.

Data Gathered

The following data were gathered for each treatment and trial (lesson).

General:

1. Time required to complete lesson.
2. Controls used (or not used) for treatments T_1, T_2, T_3 and T_4.
3. Subject's post trial (after trial II) opinion data.
4. Subject matter pre- and post-test data for groups P_1, P_2, P_3 only (both trials).
5. Subject matter post-test data only for groups A, B, C, D (trial I) and A_1, B_1, C_1, D_1 (trial II).

Specific selective control function utilization data were collected as follows:

Treatment 1 (no control over playback)

1. Achievement scores for subjects with no control compared to achievement scores for some subjects with control capability on a different trial.

Treatment 2 (stop control only over playback)

1. Number of times subjects elected to use stop control.

Treatment 3 (stop and/or replay control over playback)

1. Number of times subjects elected to use the stop control.
2. Number of times subjects elected to use replay control.
3. Amount of replay time utilized by subjects.

Treatment T_4 (all controls-limited to 19 minutes interacting with the lesson)

1. Number of times subjects elected to use the stop control.
2. Number of times subjects elected to use replay control.

Processing the Data

Initially the response sheets were divided for lessons one and two. Data sheets were developed for recording student number, mode, stops (T-2), stops, rewinds, time of rewind, post-test scores and total elapsed time for treatment (T-3). This information was collected for each subject for each lesson. After this information was recorded for each student it was transferred to IBM coding sheets. The data was then punched onto a standard hollerith 12 row 80 column card. The card's information was read into an IBM 360/65 computer. The information was sorted by (treatments) and mean achievement gain scores were computed for each treatment.

Data Analysis

Subjects' achievement test gain scores for each treatment in each trial were determined by subtracting pre-test scores of the control group from the post-test scores of the experimental groups for each treatment. This was done to eliminate biasing post-test data by pre-testing experiences and to assure that the two means were, in fact, independent measures. The mean gain score for each treatment was then subjected to the "t" statistic to determine if these gain scores were statistically different from those which would have occurred by chance.

"F" tests were used to determine an analysis of variance for between group means (Games and Klare 1967). The "F" test statistical technique was used to determine if the mean gain scores for each group were statistically different from those which would have occurred by chance. The "t" tests were used to test the hypothesis of no difference between treatments within groups. "F" tests were used to test the hypothesis of no difference between treatments between groups. A .05 level of confidence was chosen for both tests.

Data gathered on the frequency of use of the controls were compared with gain scores on the achievement tests to determine if there were any correlations between the use of the controls provided and achievement gain scores. Correlations were computed for the following factor: Frequency of use of control functions and achievement scores. The Pearson Product Moment Correlation technique was used to determine the degree of correlation between student use of control functions and level of achievement (Ferguson 1966).

The effects of providing or denying controls to subjects on achievement, as reflected on a post-test, are presented in four tables. Table IV indicates the mean scores for the pre-test and post-test groups. These are separated for trials I and trials II.

These mean scores were computed from the scores taken from the post-test achievement measures. The gain scores resulted from subtracting each subject's score from the pre-test mean score, derived from the "P" group scores, and computing the mean. Table V indicates the independent "t" analysis results of gain scores between groups for each trial. The "t" scores were computed following the parametric "t" test as outlined in Games and Klare (1967). The "t" statistic was used to determine if the mean post-test achievement scores were significantly different from the base line mean scores obtained from the "P" groups on the pre-test. "F" tests were used to determine an analysis of variance between groups for the population. This statistic was used to determine if any variance between group means was not due to chance. The results are reported in Table VI.

Table VII reports the results of using the Pearson Produce Moment Correlation technique to determine the degree of correlation between student use of control functions and level of achievement. A short review of the study follows for ease in reporting the data.

One hundred ninety six subjects took part in an experimental situation where controls for pacing instruction were installed on tape recorders. These controls permitted the subjects to pause, stop or rewind audio-tape lessons during playback. Each subject was directed

through two lessons (trials). There were three experimental situations; no control, stop, and stop and/or rewind. With the exception of the control group each subject was shifted from one experimental situation for lesson I (trial I) to a different experimental situation for lesson II (trial II).

All of the subjects were students in courses offered in the Department of Instructional Technology in the College of Education. The data reported in this chapter results from information taken from counters and timers attached to each tape recorder to record the number of times and amount of time subjects elected to use the controls placed on the instructional tape recorders and from results obtained from pre- and post-tests administered to the subjects. The data from these sources were organized and studied in an attempt to ascertain whether controls on the instructional tape recorders had any significant effect on achievement.

Library programs in an IBM 360/65 computer were used to process the data to determine "t" scores. The "t" scores were obtained from applying the "t" statistical technique to independent measures to determine if the achievement scores obtained from within the groups were significantly different from those which would have been obtained by chance.

"F" tests were used with the data to determine an analysis of variance between groups for the population. This was an attempt to determine if any variance between group means was not due to chance alone. The Pearson Product Moment Correlation was used to determine the degree of relationship between the subject's use of the control functions and

their level of achievement as indicated on the post tests (Ferguson 1966). The following is a diagramatic description of the experimental modes and groups for each lesson (trial).

Trial I	Audio-Taped Lesson I
	Experimental Treatments
T - 1	No control or playback
T - 2	Stop control only
T - 3	Stop and/or replay control
	Experimental Groups
Group	Description
P_1, P_2, P_3	Pre- and post-achievement test groups
A, B, C	Post achievement test only minutes for the lesson
D	Post test only utilizing 19 minutes for the lesson
P_1 and A	No control
P_2 and B	Stop only control
P_3 and C	Stop and/or replay control
Trial II	Audio-Taped Lesson II

In trial II the experimental modes and groups remained the same. However, the subjects were shifted as follows.

Trial I		Trial II
Group P	No change	P
A	Shifted to	B
B	Shifted to	C
C	Shifted to	A
D	No change	D

Analysis of Subject's Achievement Data

The data generated resulted from responses by the subjects to the pre and post treatment subject matter achievement tests for each audio tape lesson. This portion of the study was designed to attempt to ascertain whether:

1. Providing subjects with various means of selectively controlling the playback of audio tape lessons has any significant effect on achievement.
2. What was the degree of relationship between specific control functions provided (stop and/or replay) and achievement.
3. If subjects will use the control functions provided.

The units of intervals between the scores on the post tests are assumed to be equal. This assumption was based "on the relation of equivalence which has the logical characteristics of being transitive and symmetrical" (Selltiz 1964). The assumption is that the difference between the first and second individual is equal to the difference between the second and third, and so on. Thus the data gathered was analyzed using parametric statistical procedures.

To answer the question, "Did significant learning occur in any of the treatments?" the pre-test data generated by the pre-test groups was analyzed to determine the mean pre-test score for the population. Subjects were randomly assigned to the treatment groups. The scores obtained from the (P) or pre-test group on the achievement tests were used as a base line score for the remainder of the experimental groups. This method of obtaining base line data from a separate group prevents the biasing of the post-test groups by pre-testing. This experimental design is outlined by Campbell and Stanley in Gage (1963). Table IV indicates the mean pre-test score for the (P) groups. The pre-test mean score for lesson I was 8.1; for lesson II it was 5.5. Post-test achievement mean scores were determined for all experimental groups. The post-test mean achievement scores for lesson I were 13.8 for group A; 14.3 for group B; 15.8 for group C; 14.8 for group D. For lesson II the mean achievement scores were 11.7 for group A; 13.2 for group B; 13.8 for group C; 13.6 for group D. The post-test mean scores are also reported in table IV.

To determine if achievement had occurred as a result of the subjects exposure to the audio-tape lessons the mean achievement scores of the base line group or (P) group were subtracted from the calculated mean scores of the experimental groups. The mean achievement gain scores for lesson I were 5.7 for group A; 6.2 for group B; 7.7 for group C; 6.7 for group D. For lesson II the mean achievement gain scores were 6.2 for group A; 7.7 for group B; 8.3 for group D.

A series of parametric "t" tests, as outlined in Games and Klare

(1967), were used to determine if the mean gain scores for the experimental groups were significantly different from that which would have been obtained by chance. This analysis was intended to determine if, within each group, significant learning occurred as a result of the treatment. An analysis of the results indicate that statistically significant results were found for groups B, C and D for lesson I. Results for group A were not statistically significant for lesson I. For lesson II groups A and C were found to be statistically significant; groups B and D were not. Table V reports the results of the "t" test analysis.

To determine if the variation between obtained mean achievement gain scores for each experimental group were significantly different from each other and not due to chance, a series of parametric "F" tests as outlined by Games and Klare (1967), were conducted. This analysis was intended to identify which treatment, if any, indicated significant gains in learning.

The mean achievement scores of group B were compared to group A. The sequence followed in the same order for both lessons. The mean achievement scores of group C were compared to group A. The mean achievement scores of group D were compared to group C. Table VI indicates that the results for all group comparisons for both lessons I and II were found to be statistically significant with the exception of the B-C comparison for lesson II. Table VI reports the results of these comparisons.

The relationship between specific control functions provided, and

subject achievement was investigated by employing the Pearson Product Moment Correlation technique as outlined in Ferguson (1966). This analysis was used to determine the degree of correlation between student use of the control functions provided and level of achievement. The initial correlation attempted to distinguish the relationship between the number of times the subjects elected to stop the lesson presentation (treatment T-2) and the level of achievement or gain score. This correlation was .33 for lesson I and .24 for lesson II. The next correlation attempted was between the stop and replay function, in treatment T-3, and the subject's achievement or gain score. This correlation was .29 for lesson I and .27 for lesson II. In treatment T-3 the stop and replay functions were both available to the subject for interacting with the lesson presentation. This correlation was .27 for lesson I and .30 for lesson II. In T-C the subject's number of stops and number of replays were transformed to a single variable (STPR) before comparing them to the subject's achievement or gain score. This correlation was .24 for lesson I and .34 for lesson II. This data is reported in table VII.

Table IV indicates the mean scores of the pre-test and post-test groups for trials I and II. The highest possible score on Lesson I was twenty four. The highest possible score for Lesson II was twenty. The range of scores achieved on Lesson I extended from three to twenty. The range of scores achieved on Lesson II extended from two to seventeen.

Table IV

Mean Scores from Pre and Post tests plus Gain Scores

Trial Group I	Pre-Test	Post-Test	Gain Score
Lesson I	- $\bar{x}$	- $\bar{x}$	- $\bar{x}$
P	8.1	N/A	N/A
A		13.8	5.7
B		14.3	6.2
C		15.8	7.7
D		14.8	6.7
Trial Group II	**Pre-Test**	**Post-Test**	**Gain Score**
Lesson II	- $\bar{x}$	- $\bar{x}$	- $\bar{x}$
P	5.5	N/A	N/A
A		11.7	6.2
B		13.2	7.7
C		13.8	8.3
D		13.6	8.1

Table V indicates the "t" analysis of gain scores for within group analysis. The mean scores are given along with the computed t score. The t values and the confidence level are included. The results are reported by lessons and groups.

Table V

"t" Test Analysis of Gain Scores Within Groups

Trial I

Lesson I

Group	N	Mean Scores	Computed "t" Score	t Value	Confidence Level	S*	NS*
A	44	13.8	1.64	2.02	.05		NS
B	57	14.3	2.28	2.02	.05	S	
C	62	15.8	3.85	2.00	.05	S	
D	34	14.8	4.66	2.04	.05	S	

Trial II

Lesson II

Group	N	Mean Scores	Computed "t" Score	t Value	Confidence Level	S*	NS*
A	43	11.7	2.03	2.02	.05	S	
B	46	13.2	0.98	2.02	.05		NS
C	62	13.8	3.13	2.00	.05	S	
D	34	13.6	1.36	2.04	.05		NS

* NS - Not Significant
* S - Significant

Table VI indicates a between group comparison for trial groups for Lesson I and Lesson II. The computed F ratio and the F value are included along with the confidence level. The data are reported by lessons and groups.

Table VI

F test Comparison of Achievement Gain Scores Between Groups

Compared Trial Groups	Computed F Ratio	F Value	Level of Confidence	S*	NS*
Lesson I					
A - B	2.72	1.61	.05	S	
A - C	14.85	1.59	.05	S	
B - C	5.22	1.56	.05	S	
C - D	2.79	1.67	.05	S	
Lesson II					
A - B	4.10	1.65	.05	S	
A - C	9.80	1.59	.05	S	
B - C	0.97	1.59	.05		NS
C - D	1.84	1.71	.05	S	

* NS - Not Significant
* S - Significant

Table VII indicates the correlation co-efficients for the correlation between achievement scores and control functions. The control functions for which data was computed were stops, replay and STPR*. This last is a variable transformed from stop and replay and correlated with achievement. The table also shows the groups, N and correlations by lesson.

*STPR is transformed variable from stop and replay.

Table VII

Pearson Product Moment Correlation Co-efficients Showing Correlation Between Achievement and Control Functions for Lesson I and II for Groups B and C

	Achievement Score	Control Functior	N	Correlation Co-efficient
Trial I				
Lesson I				
Group B	14.3	Stop	57	.33
Group C	15.8	Stop	62	.29
		Replay		.27
		STPR		.24
Trial II				
Lesson II				
Group B	13.2	Stop	46	.24
Group C	13.8	Stop	62	.27
		Replay		.30
		STPR		.34

The base line mean score obtained from the "P" groups was 8.1 for lesson I. A mean score of 15.8 was obtained by group C. This is the highest score obtained on the post-test. A 7.7 mean gain score was obtained by group C which had all the controls available. On lesson II the base line mean score obtained from the "P" groups was 5.5. Again on lesson II the highest post-test mean score was obtained by group C which had all the controls available for use. These results were taken

from table IV. Table V indicates that all groups except A exceeded the predicted t value on lesson I. On lesson I groups A and C exceeded the predicted t value while groups A and D did not.

The F test reported in table VI indicates that for lesson I all group comparisons exceeded the predicted F value. In lesson II the comparison of groups A and C did not exceed the predicted F value. All other group comparisons exceeded the predicted F value. The Correlation Co-efficients reported in table VII indicate a positive correlation between the use of the control functions and an increase on the post-test achievement scores.

CHAPTER V

Summary

This study was conducted in order to seek data concerning the effects of control devices on audio tape playback systems and to gather data from which to draw inferences concerning selected hypotheses relative to students use of these controls during lesson presentation.

The investigation was conducted in an attempt to answer the following specific questions:

(1) Will providing these controls (stop and/or replay) produce any statistically significant gains in learner achievement as compared to a situation which denies them?

(2) Will denying these controls (stop and/or replay) produce a statistically significant lower level of learner achievement as compared to a situation that does provide these controls?

(3) Is there a statistically significant difference in learner achievement towards audio tape lessons that provides:

(a) No controls

(b) Pause only control

(c) Stop and/or replay controls

(4) Will students use the control functions provided? How often?

(5) In the learner's opinion

(a) What did the controls provided accomplish?

(b) Were the control functions desirable or necessary to help them learn from the audio-tape lessons?

(c) If given a choice would they choose to learn from audio-tape lessons again in the future?

(d) If given a choice which type of audio-taped playback systems would they prefer to use with audio-tape lessons?

(1) One which provides no control over the playback?

(2) One which provides pause only control?

(3) One which provides stop and replay controls?

(e) Would the students avoid using audio tape lessons if the playback system provided either:

(1) No control over playback?

(2) Only stop control over playback?

(3) Stop and replay control over playback?

This study was designed to test the following null hypothesis. There will result no significant changes in achievement by the subjects as a consequence of providing control functions on the audio tape playback equipment. In the following hypotheses T_1, T_2, T_3, and T_4 are used

to represent the group achievement scores for the four treatments.

Refer to page 18 #3 for symbol description.

Null;

H_o $T_2 = T_1$ No difference exists between the two treatments

$T_3 = T_1$ No difference exists between the two treatments

$T_3 = T_2$ No difference exists between the two treatments

$T_3 = T_4$ No difference exists between the two treatments

Alternate;

H_1 $T_2 > T_1$ A significantly positive score increase will be found between the two treatments

$T_3 > T_1$ A significantly positive score increase will be found between the two treatments

$T_3 > T_2$ A significantly positive score increase will be found between the two treatments

$T_3 > T_4$ A significantly positive score increase will be found between the two treatments

The level of significance $\alpha = .05$

The following is a list of the null and alternate hypotheses concerning the use of the control functions and achievement:

1. Comparing use of stop control and achievement

   H_o There is no significant correlation between frequency of use of the stop control and achievement scores

   H_1 There is a significantly positive correlation between the number of times the learner elects to use the stop control and achievement scores

2. Comparing use of replay control with achievement

   H_0 There is no significant correlation between the number of times the learner elects to use the replay control and achievement scores

   H_2 There is a significantly positive correlation between the number of times the learner elects to use the replay control and their achievement scores

3. Comparing amount of replay time utilized and achievement:

   H_0 There is no significant correlation between amount of replay time utilized and achievement scores

   H_3 There is a significantly positive correlation between the amount of replay time used by the learner and his achievement scores

Answers to the questions listed above are numbered in the same sequence:

1. Statistically significant results were found for the groups in the experimental situations where more controls were available.
2. Lower levels of achievement were found for those situations denying subjects use of controls.
3. Increasingly higher post-test achievement scores were found for each situation providing more controls.
4. Subjects will use control functions. It was not determined how often subjects would use the controls.
5. The controls provided the subjects increased access to the instructional materials.

a. Subjects indicated on a post-test questionnaire that 84% desired the experimental situation where controls were available.

b. Subjects indicated that 75% would choose to learn from audio tape lessons in the future.

c. If given a choice subjects would choose a device that provides stop and replay controls.

d. Subjects indicated that they would avoid instructional devices without control functions.

The null hypotheses for the treatments were rejected and the alternatives accepted. The hypotheses for the control functions are listed in the same order as above.

1. The analysis indicated a positive correlation between the frequency use of the stop control and achievement scores.

2. The analysis indicated a positive correlation between the frequency use of replay control and achievement scores.

3. The analysis indicated a positive correlation between the amount of replay time utilized and achievement scores.

For a summary of the procedures refer to page 31 in chapter III.

Conclusions

Under conditions similar to those of this study, it may be concluded that:

(1) Data collected indicated that providing control functions (stop and/or replay) will aid learner achievement as compared to a situation which denies them use of controls.

(2) Data collected indicated that lesser achievement by the learner resulted from a situation where no controls were provided.

(3) Data collected indicated a statistically significant difference in learner achievement in a situation which provides:

(a) Stop only control

(b) Stop and/or replay controls

(4) Data collected indicated that there was a statistically significant correlation between learner achievement and the number of times the learner elects to use the controls.

(5) Data collected indicated that mean scores for D group, which spent 19 minutes interacting with the lesson content, increased more than B group but did not increase as much as C group.

This latter finding indicates that time spent is a major factor in learning but individual control of the instruction adds an even greater dimension for the learner.

In lesson I the group without controls (A) was the only group whose gain scores were not statistically significant. In lesson II the gain

scores were not statistically significant for groups B and D. It may also be concluded that learner's achievement is increased when controls on learning devices are present and used.

Implications

The implications of this study seem to suggest that educational planners and manufacturers of instructional devices should consider the control mechanisms available on the devices as important additions to the systems. It appears that the control devices, although three to five times more expensive, are important components of learning devices.

The data suggests that when more controls are available for learners to use for pacing the instruction the more achievement increases when these controls are used. The data also suggests that control devices on audio retrieval systems provide a better means of aiding the student in the individualizing of his instruction. Those learners who desire to stop and/or replay segments of audio-tape lessons can do so at the moment they elect thus providing each individual control over the instruction.

From the conclusion that time spent increased achievement but that individual control of the pacing of the instructional materials added an even greater dimension seems to be another indication that individualizing instruction increases achievement. One of the principles of programmed instruction, that dealing with self pacing of instruction for increasing the potential for learner's achievement, was reinforced with the findings from this study.

Emperical Findings

From responses taken from a post-test questionnaire 84% of the subjects indicated that they preferred the experimental situations where controls for pacing the instructional material were available. From the same questionnaire 75% of the subjects responded negatively to the experimental situations where controls were denied them. In response to another question on the questionnaire 75% of the subjects stated that they would actively seek audio-tape learning in the future. A higher percentage of subjects responded positively to more controls than the percentage responding negatively to fewer controls indicating a student desire for more control over the pacing and presentation of instructional materials from an audio-tape retrieval system.

The investigator found that note taking, which was suggested in the instructions read by each subject prior to entering the experimental situation, was used by some but not by others. Many students stated that they did not take notes because they had the capability of going over the instructional lesson as much as they desired so why take notes. Others stated that they never take notes while others stated that they try to take notes on everything that an instructor states. This was interesting because most orientations to college freshmen include a suggestion that the note taking capability for every student must be developed if the student hopes to be successful in college courses. It appears that more controls on instructional devices could replace note taking for some students.

Future Research

The population for this study were students in the College of Education. A replication of the study should be conducted with subjects from other Colleges and Universities. Further research is needed to determine if learning of different kinds of instructional materials are affected by use of controls on learning devices.

If individual learning systems are to become better understood research will be needed to determine how many learners use, and in what way, control mechanisms on learning devices. This finding could have great impact upon the design and construction of instructional materials.

The proliferation of learning systems, some with control devices and most without, raises questions related to information transfer. Much research is needed about the verbal transmission of information if the quality of the materials and the best use of learning devices is to actually aid the learner in dealing with the information explosion. It is hoped that the information derived from this study will make a contribution to the general body of knowledge on the effectiveness of instructional devices to be used by students and educators.

APPENDIX I

The Post Treatment Test For Lesson I

Last Name_____

Student #_____

TEST

LESSON I:

1. The lesson deals with the construction of media. T_____ F_____
2. The lesson is an attempt to help teachers improve their subject matter. T_____ F_____
3. One of the steps for selecting media for use in the classroom was identifying the type of learning for each objective of the instruction. T_____ F_____
4. Research studies indicate that there are prescribed times when to use certain media. T_____ F_____
5. Limiting assumptions regarding the conditions available for instruction include:
   A. The assumption of conditions of learning.
   B. The assumption of adequate testing methods.
   C. The assumption of use of existing means for individualizing instruction.
   D. All of the above.
   E. None of the above.
6. Writing specifications for media specialist would require that the teacher be trained in such things as scripting for filmed instruction, etc. T_____ F_____
7. The lesson pointed out that there is a need for new types of audio-visual equipment. T_____ F_____
8. The lesson makes a plea for the capability for random access of stimulus (instructional) materials. T_____ F_____

9. Follow-up work, as pointed out in the lesson, would include controls for programming skill for validating choices of media that were made. T_____ F_____

10. The author of this lesson made it clear that there is a systematic strategy for deciding by which media the various elements of instruction should be presented. T_____ F_____

11. All educational courses require several types of learning and thus require a variety of types of stimuli to be presented. T_____ F_____

12. The author of this lesson makes a plea for more diversification in the instructional materials developed. T_____ F_____

13. The author listed eight steps in the procedure for sequencing of course objectives. T_____ F_____

14. Selecting and defining the objectives of instruction and stating them in terms of behavioral outcomes expected for students was one of the procedural steps for the prescription of the media to by employed. T_____ F_____

15. The capability of using different media in a sequential, effective procedure is dependent upon the development of equipment permitting rapid automatic turning on and off of several pieces of equipment. T_____ F_____

16. The author states that the national economy can support increased educational cost:

    A. Because the Gross National Product is continually increasing.

    B. Because of the increase in a tax paying population.

C. Because of the advent of technology.

D. Because of the economy of the system analysis recommended in the lesson.

17. A procedure for developing course objectives include:

A. Sequencing the objectives in such a way that component or prerequisite knowledge is acquired prior to more complex learning.

B. Identifying for each objective the type of learning represented.

C. Identifying tentatively the optimum medium for presenting each stimulus described in the preceding step.

D. Selecting and defining the objectives of instruction and stating them in terms of behavioral outcomes expected for students.

E. All of the above.

F. None of the above.

18. The strategy for design of instructional materials is based on the existence of several types of learning. T_____ F_____.

19. The author believes that improved instruction is dependent upon programmed use of all kinds of media. T_____ F_____.

20. The author believes that capability for instructor monitoring and overriding so that individual difficulties with audiovisual equipment may be remedied with the assistance of the instructor is of prime importance in instructional media. T_____ F_____

21. According to the author, the procedure for selecting media incompasses the abilities of how many of the following:

A. Curriculum directors

B. Teachers

C. Educational psychologists

D. Media specialists

22. The author suggested that Dr. B. F. Skinner has proposed the most defensible technical and theoretical basis regarding human learning.

T_____ F_____

23. The procedure for design of multi-media instruction places emphasis on the A) presentation mode, or B) the response mode. _____

24. Described in this lesson is a method for improving instruction which is virtually impossible to accomplish in an educational institution today. T_____ F_____

APPENDIX II

The Post Treatment Test For Lesson II

LESSON II

INSTRUCTIONS:

Answer all questions on the answer sheet in the spaces provided. Select the choice that you think best answers the question. Please do not make any marks on the test booklet!

1. Which of the following is arranged in the proper ascending (lower to higher level) order of learning tasks:

   A) signal learning
      multiple discrimination
      verbal association

   B) verbal association
      signal learning
      multiple discrimination

   C) multiple discrimination
      concept learning
      principle learning

   D) concept learning
      multiple discrimination
      principle learning

   E) they are all equal, therefore none of the above is correct

   F) I don't know

2. "This type of learning requires the internal events usually called thinking" describes:

   A) Concept Learning

   B) Principle Learning

   C) Problem Solving

   D) Verbal Association

   E) All of the above

   F) I don't know

Lesson II

3. The most important class of conditions that distinguishes one form of learning from another is its:

   A) type

   B) process

   C) prerequisites

   D) difficulty level

   E) content

   F) I don't know

4. All learning is:

   A) Essentially the same

   B) Exactly the same

   C) Similar in some respects but different in others

   D) Sequential in nature

   E) None of the above

   F) I don't know

5. Which of the following is/are <u>not</u> a prerequisite of concept learning:

   A) Principle learning

   B) Signal learning

   C) Multiple-discrimination

   D) Verbal association

   E) None of the above

   F) I don't know

6. This type of learning functions to control behavior in the manner suggested by a verbalized rule of the form: "If A, then B" where A and B are concepts. Which type of learning is this?

Lesson II

A) Concept learning

B) Problem Solving

C) Principle Learning

D) Verbal Association

E) All of the above

F) I don't know

7. "The learner acquires a capability of making a common response to a class of stimuli that may differ from each other widely in physical appearance" best describes:

A) Multiple-Discrimination Learning

B) Concept Learning

C) Signal Learning

D) Principle Learning

E) Verbal-Association

F) I don't know

8. Which of the following is/are a prerequisite to signal learning:

A) Verbal Associations

B) Stimulus-response Connections

C) Multiple Discriminations

D) All of the above

E) None of the above

F) I don't know

9. "The individual learns to make several different identifying responses to as many different stimuli, which may resemble each other in physical appearance to a greater or lesser degree" best describes":

Lesson II

A) Problem Solving

B) Principle Learning

C) Verbal Association

D) Stimulus-Response Learning

E) Multiple Discrimination Learning

F) I don't know

10. Which of the following is/are prerequisites to concept learning:

A) Stimulus-response Connections

B) Verbal Associations

C) Multiple Discriminations

D) All of the above

E) None of the above

F) I don't know

11. This type of learning involves "learning of chains that are verbal". Which type is it?

A) Multiple Discrimination

B) Concept Learning

C) Problem Solving

D) Verbal Association

E) Chaining

F) I don't know

12. Varieties of learning are distinguishable from each other in terms of:

A) The conditions required to bring them about

B) The mental process involved

Lesson II

C) Difficulty of the learning task

D) All of the above

E) They are not distinguishable

F) I don't know

13. "What is acquired is a chain of two or more stimulus-response connections" describes:

A) Signal Learning

B) Multiple Discrimination

C) Concept Learning

D) Principle Learning

E) Chaining

F) I don't know

14. Which of the following is the highest level of learning activity:

A) Principle Learning

B) Concept Learning

C) Problem Solving

D) Multiple-Discrimination

E) They are all equal

F) I don't know

15. "The learner acquires a precise response to a discriminated stimulus" would be an appropriate description of:

A) Signal Learning

B) Chaining

C) Verbal Association

D) Concept Learning

Lesson II

E) None of the above

F) I don't know

16. Which of the following is the lowest level of learning activity:

A) Signal Learning

B) Verbal Association

C) Stimulus-Response Connections

D) Chaining

E) They are all equal

F) I don't know

17. "The individual learns to make a general, diffuse response to a signal" would be an appropriate definition of:

A) Verbal Association

B) Signal Learning

C) Stimulus-Response Learning

D) Chaining

E) None of the above

F) I don't know

18. There are _____ types of learning

A) 2

B) 7

C) 12

D) 8

E) 5

F) I don't know

Lesson II

19. "Which of the following is/are a prerequisite of problem solving:

A) Concept Learning

B) Principle Learning

C) Verbal Association

D) Stimulus-Response

E) All of the above

F) I don't know

20. The specific topic of this lesson was:

A) Psychology of Education

B) Conditions of Learning

C) Instructional Systems Design

D) Varieties of Learning

E) I don't know

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