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Research Product 81-25a

A LEARNING-BASED MODEL FOR MEDIA SELECTION: DESCRIPTION

SIMULATION SYSTEMS TECHNICAL AREA

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U.S. ARMY RESEARCH INSTITUTE for the BEHAVIORAL and SOCIAL SCIENCES

U. S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

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This report describes a new media selection model developed as part of a project aimed at improving procedures available for media selection in connection with U.S. Army training. The model addresses factors of learning effectiveness by means of a flowchart which permits successive exclusion of media from an initial candidate set. Derivation of the model focused particularly upon principles of human learning which affect decisions about media, in particular the nature of instruction.

Item 20 (Cont'd)

The proposed model is described with consideration of some of the apparent limitations of guidelines for media selection in the Instructional Systems Development (ISD) model. Difficulties experienced in the use of these guidelines provided a part of the reason for developing the new model. A description is given of the method of use of the new model and its incorporation into the ISD procedure. Benefits that may be derived from use of the model are also indicated.

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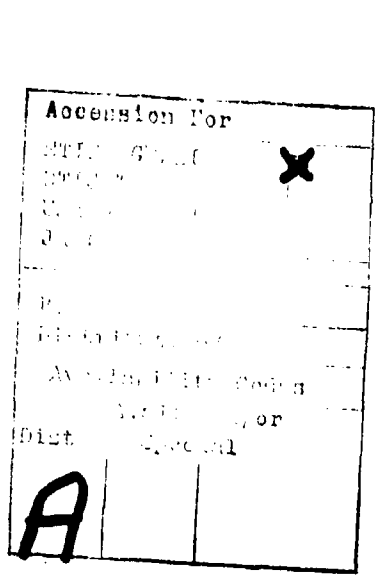

A LEARNING-BASED MODEL FOR MEDIA SELECTION:

DESCRIPTION

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Training and Education
Training Simulation

FOREWORD

The research leading to the development of these Research Products was begun under RDTE Project Number 2Q762772A764, ARI FY 78 and 79 Work Program (Training and Education). The results of these efforts were fed into subsequent research conducted under RDTE Project Number 2Q263744A795, ARI FY 80 Work Program (Training Simulation). The final research was conducted by the Learning Systems Institute of Florida State University under contract number MDA 903-80-C-0218.

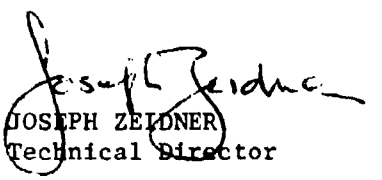
The research had as its major objectives to assess current models and the state of the art in selection of alternative instructional delivery systems, to determine the type and extent of problems encountered in applying existing models, and to recommend changes and improvements.

The research is directly responsive to the expressed needs of the Army Training Support Center (ATSC) of the Training and Doctrine Command (TRADOC).

Research Product 81-25A describes the theoretical background of the research in selection of Instructional Media.

Product 81-25C presents the Model itself, its attendant flowchart, and Users Guide.

Mr. T.J. Houston of the Simulation Systems Technical Area served as COR for this research.



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A LEARNING-BASED MODEL FOR MEDIA SELECTION: DESCRIPTION

EXECUTIVE SUMMARY

Requirement:

This report describes a project that was conducted in order to collect information about instructional media selection procedures and problems in the U.S. Army and to recommend means of improving the media selection process.

Procedure:

In order to identify procedures and problems, four Army schools were visited and 29 instructional developers who made media selection decisions were interviewed. After procedures and problems were identified, a new media selection model was developed. The model was revised several times. The first revision was based upon feedback from 12 instructional designers (eight faculty and four graduate students) at Florida State University who were asked to review the model. Subsequent revisions were based upon formative evaluation data collected from six graduate students in instructional design, six instructional developers at Fort Gordon, and five instructional developers at Fort Rucker.

Findings:

A systematic means of selecting media is rarely used. An existing media selection model that is perceived as too complex often leads to the selection of media based on convenience and the developer's intuition and experience. However, the majority of Army instructional developers who reviewed the new media selection model indicated that there was a high probability that it would be used on the job.

Utilization of Findings:

Whether instructional developers in the Army use the model depends largely upon whether the model is properly disseminated. If the model is disseminated properly, it could have a very positive effect upon the media selection procedure used in the Army.

A Learning-Based Model for Media Selection: Description

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A Learning-Based Model for Media Selection: Description

Introduction

Selecting appropriate media for the delivery of instruction is an essential step in the process of instructional development. The requirements of training for the great variety of military specialties include a different set of instructional events for each specialty. These events may potentially be provided by a simple medium like a printed page, or by a complex one like a simulator, either of which may be thought of as a supplement to a message delivered by an instructor's voice. The set of diverse instructional events that are needed for training may be furnished more or less well, and more or less completely, by any given medium. Consequently, the selection of media is likely to have a substantial influence on training effectiveness.

How should instructional developers go about selecting the media that will be used to deliver a particular segment of training? A number of media selection models and guidelines have been developed in the attempt to answer this question. One set of guidelines, those contained in phase III.2 of the Interservice Procedures for Instructional Systems Development (Branson, Rayner, Cox, Furman, King, & Hannum, 1975), has been adopted for use by instructional developers of U.S. Army training.

There is some evidence to suggest that the media selection guidelines of the Instructional Systems Development (ISD) model are among the best available (Braby, 1973). However, as the following quote indicates, some limitations of these guidelines have also been pointed out:

> It must, however, be recognized that the ISD is only a conceptual framework, and has all the limitations inherent in any model, however excellent its intentions and broad its scope. As a model, it provides guidelines--an extended sequence of "what to do," not a blueprint for action which specifies "how to do it." The proliferation of elaborate flowcharts and diagrams may give a misleading sense of precision. Especially in the hands of a typical, untrained instructional development "apprentice," the superficiality of the ISD becomes apparent. Further, some evidence (Montemerlo, 1975) suggests that the model is not sufficient to change the performance of a novice into that of an expert. (Army Research Institute, 1979, p. 1)

A recent informal survey of 29 instructional developers at four Army schools revealed that many of them believed that certain portions of the ISD guidelines were not specific enough, while at the same time other portions of the guidelines were too detailed. It was stated that many of the terms used in the guidelines needed to be more adequately defined, and that more examples were necessary. Some of the developers considered that too many learning categories were used, and that, in general, the guidelines could be simplified and condensed.

A substantial number of the instructional developers interviewed gave it as their belief that the ISD guidelines should be revised or replaced. Eighty percent of the developers stated that, at the least, the guidelines should be revised. More than fifty per cent of the developers considered it preferable to have new media selection guidelines developed.

It would appear, therefore, that certain limitations of the ISD guidelines are made evident not only by an analytical examination of their contents, but also by evidence obtained from the field users of these guidelines. These circumstances make desirable an effort to develop a new procedure for media selection which addresses training situations in terms as specific and well defined as possible. At the same time, the procedure should be concise and simple to employ.

A Rational Basis for Media Selection

A number of reviews have been made of procedures and models for media selection (Levie, 1977; Heidt, 1978). These prior efforts make it apparent that certain features of such procedures are held in common. Typically, they begin with a list of media features related to the requirements of media in training programs, to identify a list of media features related to these requirements. Usually, then, there is included a more specific set of features that are related to particular kinds of training, or to types of training objectives. Practical factors which arise in the course of instructional planning, such as cost and availability, are given consideration in such models. As a final step, criteria are given for media selection, often based upon a series of ratings.

The media selection model to be described here takes full cognizance of these generally encountered features. In addition, it may be noted that primary consideration is given to learning effectiveness. The implicit proposal of the model is that questions of relative effectiveness for learning can be decided upon by using a simple flowchart procedure. The flowchart presents a model based upon the principle of successive exclusion, in other words, a procedure for narrowing the range of media possibilities under consideration by an instructional designer. Upon completion of the procedure, those media which are not effective for learning will have been excluded from the set designated as "candidate media." The procedure thus yields a set of media for the final choice, rather than a single medium. Other "practical factors" must then be given consideration in arriving at a final selection.

Media Appropriateness for Learning

A single medium, or a combination of media, is chosen to aid the delivery of training. The choice of media must be appropriate for the particular training which is being planned, and for the training system that will be employed to deliver the instruction. Given these conditions, an instructional medium is most likely to be chosen to meet certain practical requirements. Among these are (1) the availability of the medium at the training site; (2) the expected cost of development or purchase; (3) the speed with which development (of hardware, courseware, or both) can be accomplished; (4) the convenience offered by the medium to training managers or instructors; and (5) the costs of operation and maintenance.

However, criteria such as these, it turns out, cannot be weighed in isolation. If this were so, training of every sort would have chosen for it the most inexpensive and maintenance-free media such as printed texts, audio-tape voice recordings, or the diagrams made by an instructor on a chalkboard. It is evident that some kinds of training are helped by media which are a bit more complicated than that. For example, the field stripping of a rifle is not learned from printed text, or from an instructor's oral directions (although these may both be present); it requires a medium which displays the parts to the trainee, and allows him to practice manipulating them. The procedures of trouble-shooting a piece of electronic equipment are not likely to be thoroughly learned from voice recordings or printed texts--they too are helped by a medium which displays the electronic parts, circuits, or modules and shows their functioning. The operation of many kinds of modern weapons requires precise responding to

control panels; training for this kind of proficiency is also aided by media more complex than low-cost printed texts and spoken directions.

So, although costs, availability, and convenience factors are of undoubted importance in the selection of media, that doesn't mean they should be first to be decided upon. Quite the contrary procedure is likely to be best. First consideration should be given to media appropriateness for learning. When designers of training are satisfied that one or several media are appropriate for the desired training job, and that several other media are not, then they can confidently proceed to make decisions on the basis of the practical considerations of cost, availability, and convenience.

An appropriate medium is one which can be shown, by rationale from theory or from practical evidence, to contribute to training effectiveness beyond what would result from the unaided personal efforts of a motivated learner. Decisions about media appropriateness have to do with those conditions provided by a medium which will support internal learning processes. Some further assumptions made by the present model are described in the following section.

Assumptions of the Model

The model has been developed with cognizance of several circumstances under which the selection of media should occur. These conditions are nearly always desirable, but it would perhaps be optimistic to call them typical. Some of the major assumptions reflecting these conditions are described in the following paragraphs.

The instruction setting. It is assumed that the setting for instruction has been previously specified, and is known as an entry condition for using the model's procedure. Thus, instructional settings such as classroom with instructor, individual student self-instruction, students in isolated locations receiving broadcast instruction, and the like, are considered to be pre-determined conditions for instruction. These are system decisions, which are presumed to precede the process of media choice.

The scope of instruction. The instructional designer is assumed to have in mind a particular scope of instruction for which media will be chosen. Usually, this instructional piece is a "module" or "segment," rather than an entire course. For example, for a course in radar equipment maintenance, initial media decisions are likely to be made for segments such as (a) interpreting electronic diagrams; (b) using test instruments; (c) routine maintenance; (d) troubleshooting, and other tasks which together make up a total course. Naturally, though, if the model identifies media candidates for segments of instruction, a subsequent decision must deal with the question of what is best for the course as a whole.

Objectives of instruction. The model assumes that instruction has been planned and specified in terms of objectives (Mager, 1975; Gagne & Briggs, 1979). The model cannot deal with instruction identified only by topic names ("introductory Spanish," "double-entry bookkeeping"). It is assumed that the outcomes of the instruction have been identified as human performances made possible by learning.

Domains of learning outcome. The assumption is made that objectives of the instruction can be, and have been, classified as the learning outcomes (a) verbal knowledge, (b) mental skills (sometimes called procedural

knowledge), (c) cognitive strategies, (d) attitudes, and (e) motor skills (Gagne, 1977; Gagne & Briggs, 1979). Classifying objectives in this manner has the effect of reducing the goals of an instructional module to a manageable number, while at the same time giving recognition to the frequent occurrence of more than a single expected outcome for any particular instructional unit. The implications of this assumption for media selection are crucial; for example, media for changing attitudes need to have different characteristics from those which teach mental skills.

Events of instruction. Still another important assumption derived from learning theory and research is the idea that media provide external conditions which activate and support internal processes of learning. The latter processes occur in a succession of stages during any single act of learning. Thus, the external stimulation provided by media (or more generally, by any instruction) is organized as a set of instructional events designed to support the learning processes which are active during each learning stage (Gagne, 1974; Gagne & Briggs, 1979). One instructional event, for example, may be designed to enhance the perception of features of the situation, while a later event may be intended to provide cues for recall of what is being learned.

Basis for the Model in Research and Theory

The primary source on which the rational derivation of the present model depends is systematic knowledge of human learning as revealed by scientific research and theory. Many recently published volumes provide descriptions of cognitive learning theory, and of the research studies which relate to this type of theory. Prominent among these are a series of hand-

books edited by Estes (1975, 1976, 1978a). Instructional principles based upon the general model of learning processes involved in these theories are described by Gagne (1977) and by Gagne and Briggs (1979). Although these latter works are not intended to be the sole references for such principles, they nevertheless must be frequently cited as being most directly relevant to the media selection model.

The choice of learning theory as a basis for rational derivation of the model obviously means that other groundings have been rejected. While it is evident that several other characteristics of media cannot be ignored, they do not appear to have been entirely successful as bases for the generation of positive media selection procedures. This includes such a variety of categories pertaining to media attributes as mode of sensory stimulation (Romiszowski, 1977), physical nature of stimulation (Bretz, 1971), type of learning experience (Dale 1969), function with respect to the learner (Tosti & Ball, 1969), or some combination of these (Anderson, 1976; Kemp, 1975).

The principles of learning involved in the derivation of the media selection model are of two main sorts. First, they embody distinctions among categories of what is learned. It is supposed that learned entities make possible the exhibition of several different categories of performance by the learner. Thus, when they have completed their learning, human learners have acquired lasting <u>capabilities</u> to carry out certain performances (Gagne, 1977). These categories of performance represent <u>learning outcomes</u>, and may conveniently be spoken of as such. A second set of learning principles pertains to the external events which stimulate the learner and which, according to theory, perform the function of supporting internal

learning processes. These occasions of stimulation are referred to as events of instruction (Gagne, 1977; Gagne & Briggs, 1979). Which of these events a given medium is best able to provide is a matter of direct relevance to media selection.

Learning outcomes. The five kinds of learning outcomes distinguished by Gagne (1977) and Gagne & Briggs (1979) imply the need for different instructional treatments, some of which are best provided by one group of media, some by another.

Mental skills are most easily exemplified by simple mathematical operations, for instance, quarters as fractional parts of a whole. In presenting this related set of rules (four quarters equal a whole, two quarters equal a half, etc.), visuals can perform several learning support functions, to be described in a subsequent section. However, the most important characteristic of intellectual skills learning, so far as media are concerned, is their requirement for precise corrective feedback. Instruction must be so arranged that the learners make responses (such as "½") which can be followed by feedback that comunicates precisely "correct," "incorrect," or "correct in a specified part." Thus, regardless of what other media characteristics are being employed, the overriding requirement in teaching intellectual skills is for interactive operation, as provided, for example, by programmed instruction or by computer-based instruction. When display media such as radio or TV are employed, interactive operation may be attained by using supplementary workbooks or other printed materials. Such materials, for example, formed an integral part of the project which successfully taught arithmetic by radio (Searle, Friend, & Suppes, 1976).

Verbal knowledge forms the largest part of most instruction. For example, training in conservation of the physical environment consists of knowledge about geographic features of the land, soil, water, rivers, forests, animals and their habits, the growth of crops, and many related matters. When learners acquire organized knowledge of this sort, the kind of performance they are expected to exhibit is one of stating the knowledge in such a way as to convey its essential meaning. This sort of performance implies the restatement of general ideas, sometimes called schemata (Bransford, 1979), but not the recall of specific facts in verbatim form. Since verbal knowledge is exhibited in this relatively imprecise form, it is possible also for the feedback for correct performance to be similarly imprecise. That is to say, for verbal knowledge, feedback needs to contain a message such as "you have the right general idea," rather than "you are exactly correct."

The relaxation of the need for feedback precision makes possible the use of a wider range of media for verbal knowledge than is the case for intellectual skills. Feedback which does not need to be precise can be delivered in a number of ways by media which do not possess true interactive properties. For example, after first encouraging viewers to try saying the major causes of motor vehicle accidents, a TV or movie presentation can then assure them, "If you mentioned drunkeness and speeding, these are two of the main causes. Others are (A) and (B)." Such feedback may be presumed to be reasonably effective for verbal knowledge learning, even though it (a) has a non-specific form, and (b) bears no precise relation to the responses actually made by individual viewers. Feedback of this imprecise sort is, as previously noted, ineffective for the learning of mental skills, and this is the basis for differential media requirements.

Cognitive strategies of "learning to learn" and problem solving may be acquired and practiced by way of media presentations. A number of strategies have been described as aids to learning and remembering (O'Neil, 1978). When practice in problem solving is the aim of instruction, although the acquiring of new cognitive strategies may be intended, mental skills (rules, concepts) are normally involved in arriving at problem solutions. For this reason, the main requirement on media is the provision of precise feedback following learner performance. Media having interactive properties are therefore required.

A fourth kind of learning outcome, motor skills, can be aided substantially in initial stages of learning by media presentations which permit the learner to imitate the procedure. In effect, the procedure, sometimes called an "executive subroutine" (Fitts & Posner, 1967), is a mental skill; consequently, requirements for feedback precision are the same as those previously described for that type of outcome. Once the basic procedure is learned, improvement in the smoothness and timing of motor skills depends upon direct practice of the movements themselves. For such improvement, kinesthetic feedback from the involved muscles is essential. Somehow, the learner must practice the movements that comprise the actual performance. Accordingly, what is needed as a medium is the "real situation" (as in driving), the real equipment (as a rifle), or a realistic simulator (as for hovering a helicopter).

The fifth type of learning outcome, attitude, often is readily established or altered with the help of media. Attitudes are learned internal states that influence choices of personal action. Examples are attitudes of "choosing a career in the Army," "choosing golf as a participant

sport," "choosing to avoid harmful drugs." Thus, the presence of an attitude is not inferred from the learner's performance itself, but rather from the choices he makes of actions of which he is capable. According to one prominent line of theory (Bandura, 1969), attitudes are most readily established through the agency of a human model. The choices communicated by the human model are imitated by the learner, and vicariously reinforced. The model may be an actual human being, or an animated figure who exhibits human characteristics (e.g., Smokey the Bear, Snoopy). The essential media characteristic for attitude learning is the display of a human model in the process of making the desired choices, and the model's satisfaction with the consequences of those choices. Evidently, this requires the display of human action, and thus implies a preference for those media which show movement. The advantages of television for the purpose of establishing or changing attitudes are immediately obvious.

Events of instruction. Another major theoretical strand providing a basis for the media selection model consists of the successive steps in external stimulation of the learner that support internal processes of learning. These steps are called events of instruction, and according to Gagne and Briggs (1979) they occur in the following approximate order:

1. gaining attention;
2. informing the learner of the objective;
3. stimulating recall of prerequisite learnings;
4. presenting the stimulus material;
5. providing "learning guidance";
6. eliciting the performance;

7. providing corrective feedback;
8. assessing the performance; and
9. enhancing retention and transfer.

As Gagne (1974, 1977) has shown, these events can be rationally derived from the general model of cognitive learning theory. Thus, for example, "stimulating recall of prerequisite learnings" translates directly into cognitive learning theory as "retrieval of prior learning to working memory"; "providing learning guidance" has the meaning in terms of cognitive theory of "suggesting the semantic encoding of information."

While all nine of these events are considered to comprise instruction, they do not all have differential implications for media selection. For example, event number 2, "informing the learner of the objective" may be made to happen in a variety of ways depending on the medium being employed, but so far as is known these ways do not differentially influence learning effectiveness. In contrast, event number 7, "providing corrective feedback," requires that media possess certain characteristics if the event is to occur at all. Particular consideration must be given to some of these external events, but not to each one, as reflected in the characteristics of media.

Presenting the stimulus material is an event that must on some occasions be given attention in media selection. These instances arise when the learning objective requires the differentiation of features of the task situation. For example, teaching someone to read an electric meter requires instruction that includes a representation of the physical features of the material object, whether by means of a training aid, a simulated meter, or a

real meter. The instruction may be guided by other kinds of stimulation, including verbal directions, but it must include the perceptual learning that enables the learner to distinguish features of the task. Since many practically useful human performances involve visual perception, learning to selectively perceive the features of such tasks frequently requires the use of visual presentations. When the features to be distinguished are auditory, as in the learning of foreign languages, audio-based media become appropriate.

Learning guidance is provided in a number of ways designed to enhance the semantic encoding process which, according to theory, enables the storage of what is learned in long-term memory (Bower, 1975). Media often provide outstanding opportunities for multiple encoding, as well as for enormous variety in the presentation of associated ideas. Visual media, in particular, make possible the display of pictures to activate visual images and thus take advantage of the superior retentivity of multiple encoding (Paivio, 1971). In addition, visual media such as videodisc permit a varied mosaic of words, symbols, and pictures to be presented within a short time interval. The enhancement of semantic encoding is one of the most obviously supportive functions that can be accomplished by media. It occurs whenever media are able to supplement terse language communication with various forms of message elaboration.

The twin events of eliciting performance and providing corrective feedback are essential elements in cognitive learning theory, as they have been in virtually all theories of learning. The key concept governing the importance of these events is reinforcement, the feedback of information to the

learner concerning the probable rewarding or punishing outcomes of action (Estes, 1978b). Providing corrective feedback of this sort requires that the learner be able to respond to an instructional presentation, and that information then be given to the learner regarding the correctness (or degree of correctness) of his response. Media possessing these characteristics are called interactive.

The event described as enhancing retention and transfer is, in a sense, simply an extension of the idea of semantic encoding. Continuing to provide message elaboration improves the possibility of multiple encoding. Not only during original learning, but also in subsequent periods of spaced review (Gagne, 1977), this event is likely to be readily accomplished by media, particularly those having visual displays. Of singular importance may be instruction which uses pictures to suggest images, since these can provide the learner with an added source of cues for retrieval of what has been learned.

Learner characteristics. Another set of factors underlying the development of the media selection model is the characteristics of learners. These factors have both theoretical and practical origins in their relation to the processes of learning.

Amount of experience as a learner is likely to determine the presence of accumulated knowledge, and also of cognitive strategies which enhance the processes of learning and remembering. Thus, more experienced learners may be expected to exercise greater control over the events of learning than is the case with learners of lesser experience. For more experienced learners, some of the events of instruction may be presented in abbreviated form or

omitted entirely. In the extreme, this trend leads to the employment of self-instruction, which requires the selection of appropriate media having features that make corrective feedback possible.

Ability to read, that is, to gain information from printed text, is an important individual ability from both the theoretical and practical point of view. A number of studies (Lumsdaine & May, 1965) have shown that pictorial presentation of instruction helps those learners who are poor readers. If facile reading of text cannot be accomplished by the intended students of a program of instruction, media displaying printed messages, (books, computers) would best be excluded as possibilities. The identification of intended students as readers or non-readers serves as one of the major divisions in the media selection model.

Using the Media Selection Flowchart

Determining media appropriateness, and thus narrowing the process of media selection, takes only a few minutes with the use of the flowchart. By working through the flow-diagram, the instructional designer can be assured that no important factor of potential aid to human learning has been neglected. The media selection process can then proceed with the confidence that such factors have been taken into account.

The flowchart presents an unfolding series of charts, six in all. Each chart represents a set of decisions within a general area of conditions of the training system, such as "C. Self-Instruction with Readers," or "F. Instructor with Non-Readers." The charts are arranged in sequence so that those decisions having the most important implications for the training system are made first. For example, the first chart ("Chart A. Job

Competence Decision") pertains to the choice of real equipment (either large or portable) or a simulator as a necessary medium of instruction; obviously, these items usually entail a large expense.

Choosing one of the six charts. The decisions governing the choice of which of the six charts will receive primary attention are actually training system decisions. In accordance with the ISD procedures, these decisions have already been made by the time the question of media selection comes to the fore. For example, ISD Block I.5 is Select Instructional Setting. The decisions made within this step, as to whether Self-Teaching Exportable Packages (STEPs) will be employed, whether formal OJT will be designed, whether an installation support school or a resident school will be utilized, will often pre-determine which of the six charts of the flowchart is to be chosen as the one to provide a framework for particular media choices. Still other pre-determining decisions of the training sytsem are incorporated in step III.1, Specify Learning Events/Activities. In using the flowchart these decisions about the training system will be brought to mind, and will normally result in a quick progression to whichever chart best reflects the training conditions that are to prevail.

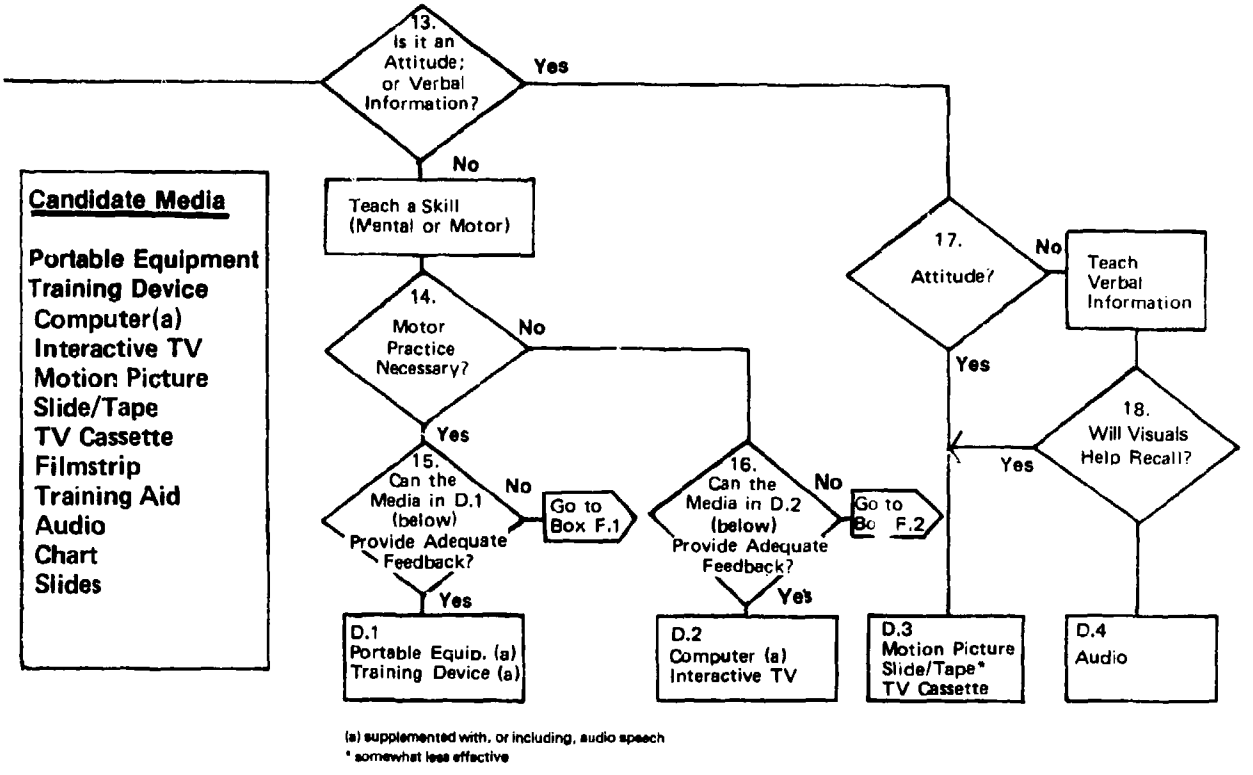
Still another set of determinations is previously made in following ISD procedures in Blocks II.1 and III.1.2.2, where objectives are developed and classified into learning categories. The procedure displayed in the flowchart begins with a box designated as "identify objective." Any particular course of Army training is likely to include many specific training objectives. The procedure of media selection may best be utilized when considering media requirements for a clustered set of objectives, all of which belong to the same domain of learning outcomes (mental skills, verbal infor-

mation, motor skills, attitudes). For example, the course as a whole may include objectives which pertain to the operation of three different pieces of equipment. For each piece of equipment, there are likely to be objectives which fall into the category of mental skills. The decision whether to cluster the total set of training objectives in this fashion should be made by the training designer, based upon his experience with the job for which training is being planned.

It should be noted also, that dealing with groups of objectives falling into a single domain of learning outcome should not lead to a neglect of other domains. For instance, three different pieces of equipment are likely to have in common, besides mental skills, some aspects of safety belonging to the domain of attitudes. The existence of several types of learning outcomes needs to be constantly borne in mind by the training designer as he proceeds to identify appropriate media within the confines of each chart.

Procedure within a chart. The prior decisions of the ISD procedure will make possible the rapid progression, for example, to a chart such as "D. Self-Instruction with Non-Readers." In this progression, certain media have been successively eliminated from consideration, so that each chart begins with a somewhat different set of Candidate Media. Chart D. for example, omits such media as printed text and programmed text from the list of Candidate Media, since these depend upon reading by the trainee. Figure 1 reproduces Chart D.

The decision process within each chart begins with a question contained in a numbered diamond-shaped box. The question shown within the diamond is actually an abbreviated form of the question having the same number, listed at the bottom of the chart. Thus, Chart D begins with the question "13. Is



Explanation of Questions - Chart D

13. Is it an Attitude; or Verbal Information? Is the aim to influence the trainee's values (attitudes); or to have the trainee learn to 'state' (rather than 'do') something?
14. Motor Practice Necessary? Does the skill to be learned require smooth timing of muscular movements (a "motor skill")?
15. Can the Media in D.1 Provide Adequate Feedback? Can the Media in D.1 accept and evaluate the desired student responses and provide the type of feedback planned?
16. Can the Media in D.2 Provide Adequate Feedback? Can the Media in D.2 accept and evaluate the desired student responses and provide the type of feedback required?
17. Attitude? Does training aim to influence the trainee's values or opinions?
18. Will Visuals Help Recall? Is it likely that the use of visuals will help the learner establish images that will aid recall of verbal information?

Figure 1. Chart D. Self-Instruction with Non-Readers

it an attitude; or verbal information?" which in its expanded form at the bottom of the chart is "13. Is the aim to influence the trainee's values (attitudes), or to have the trainee learn to 'state' (rather than 'do') something?" Answering the question "yes" sends the designer to another diamond-shaped box, 17, which asks "Attitude?" Should the answer here be "no," the following box indicates that verbal information has been identified as needing to be taught. ("Teach verbal information.")

Returning to a consideration of decision 13, should the answer here be "no," the designer has chosen to proceed to "Teach a skill (mental or motor"), and must now proceed to distinguish these two kinds of skill. Diamond-shaped box 14 asks "Motor practice necessary?" This is the case, of course, if a motor skill is the objective. If the answer to 14 is "yes," a rectangular box indicating the appropriate action is pointed to. This bottom-line box shows that appropriate media may now be reduced to two: portable equipment and training device (either with audio presentation capability). However, a re-check question is placed in an intervening diamond (15), in order to remind the designer to ask, "Can the media in D.1 provide adequate feedback?" Assuming this question has a "yes" answer, the designer reconfirms his decision to proceed to D.1 with its two candidate media. If the answer to the "motor practice necessary" question (14) is "no," then the skill is a mental skill, and a similar re-check question (16) leads to box D.2, with its two candidate media, computer and interactive TV. When either of these re-check questions (15 or 16) is answered "no," this means that consideration is to be given to the use of an instructor, and the appropriate media are located in box F1 or F2.

The process is continued until a decision leads to the identification of a set of media each of which is capable of aiding the learning of the task or tasks to be trained. In the charts, this set of media is brought down to a rectangular box which is the "bottom-line" box. Sometimes, as many as ten media may be in this box, or as few as one. For example, in Chart D applying to Non-Readers, three media are listed in the bottom-line box following a "yes" answer to question 18, "Will visuals help recall?" In contrast, in Chart C applying to Readers, a "yes" answer to the same question leads to a bottom-line box listing six media. Quite evidently, what have been excluded in going from Chart C to Chart D are media utilizing printed messages.

In general, the media in each bottom-line box are considered to be about equally appropriate for support of the type of learning outcome which has been identified by the decisions leading up to that box. Obviously, they differ in other respects, such as cost or availability, and considerations of this sort must now be applied in order to arrive at a final media choice.

The Model as Part of ISD Procedure

The media selection flowchart model is designed to replace the media selection procedures currently described in the Interservice Procedures for Instructional Systems Development (ISD), Block III.2. If the procedures described in the ISD model are followed, ten major steps will have been carried out prior to media selection. The actions taken in performing these steps will affect decisions made when media selection is undertaken. In addition, the decisions that result from the use of the present media selection model will affect decisions made during later stages of the ISD Process.

Effects of Prior ISD Decisions

Eight major inputs from six different ISD Blocks may be applied in using the flowchart. Those inputs are listed below:

1. The course objectives, i.e., the terminal learning objectives (TLOs) and learning objectives (LOs) (from Block II.1.)
2. The classification of each objective into a category of learning (from Blocks II.1 and III.1).
3. The instructional setting (from Block I.5 and/or administrative decisions).
4. Whether or not the students can be considered readers (from Block II.3).
5. The learning guidelines and activities (from Block III.1).
6. Information on the "consequences of inadequate performance" (from Block I.2).
7. The job performance measures (JPMs) that relate to each TLO (from Block I.3).
8. Constraints in the instructional situation (from Block I.3).

The User's Guide accompanying the flowchart describes in specific terms how these ISD items can aid the developer of instruction in arriving at the various decisions of the flowchart. This explanation is contained in the User's Guide section entitled "Explanation of Flowchart Questions."

Effects of Media Choice on Subsequent ISD Decisions

Three kinds of outputs from the media selection process are necessary for further use in later blocks of the ISD model:

1. the final medium or combination of media chosen for use with the objectives;
2. a list of the media in the bottom-line boxes selected; and
3. the reasons for final choices of media from the given alternatives.

The final media choice is needed in ISD Block III.3 to review existing materials, and again in III.4 to begin production planning. Reasons for the final choice may also be needed in III.4 to aid in identifying specific production constraints.

Documentation of media selection decisions may also be needed when planning course revisions (Block V.3). Internal and external evaluation (Blocks V.1 and V.2) could reveal needs for changes in the course, including media to be used. Another consideration is that jobs may change over time, requiring a new job analysis (Block I.1) and revisions of subsequent ISD steps. The entry skills of students may also change, leading to restructuring of course objectives. These changes would require the reapplication of media selection procedures. In these instances, prior documentation is likely to be helpful in making new decisions about media selection.

Characteristics of the Learning-Based Model for Media Selection

This report describes a model which takes a concrete form as a flowchart for use in the job of training design, as an aid to the task of selecting media. The flowchart enables the designer, within the framework of ISD procedures, to engage in a process of progressive exclusion of media, and thus to arrive at a relatively small set of "final candidate" media which are appropriate for the particular instruction being planned. This small set can then be further tested against practical criteria of cost, availability, and convenience.

According to the present model, the primary set of factors to be given consideration in making initial media choices is that set which influences learning effectiveness. The identification of these factors has been based

upon modern theory and research in human learning. The following set of learning factors are among those which have been accorded prominence in deriving the model:

(1) the instructional setting, whether classroom with instructor, student self-instruction, or other;

(2) the scope of the segment of instruction for which media are to be chosen;

(3) the objectives of the instruction;

(4) the domains of outcome intended to be accomplished by the learning; and

(5) certain critical events of instruction.

In use, the flowchart provides a convenient and relatively rapid way of reducing decisions about media to a manageable number. The designer is encouraged to employ a natural sequential mode of thinking, as opposed to one which requires the simultaneous judging and weighting of a number of features of differing degrees of importance. It is expected, therefore, that training designers will find the flowchart a job aid which they are well prepared to use, and which they welcome as a distinct help to the task of media selection. By employing the flowchart, designers will be able to arrive at decisions about media which carry the insurance that factors favorable to learning have been taken into account. With this kind of presumption, the designer can proceed to select media on the basis of such practical factors as cost and availability, unimpeded by doubts about the effectiveness of training design.

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