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ABSTRACT

This manual is designed to help Army training personnel select and implement a specific approach to achieving specific training goals. Following a general learning model, general training principles are summarized. The rest of the manual shows how specific learning principles are associated with groups of learner performances. Training goals include recall of facts and procedures, acquisition of motor skills and reactive skills, concept acquisitions, problem solving, decision making, and putting attitudes into practice. (CH)

HumRRO

Selecting Methods and Media to Achieve Training Objectives: A Preliminary Manual

by

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Division No. 2
Fort Knox, Kentucky

HUMAN RESOURCES RESEARCH ORGANIZATION

CONTENTS

INTRODUCTION

Purpose and Scope

This manual is designed to help personnel engaged in the development and management of Army training to select and implement a specific approach to achieving a desired training goal. For each approach, the instructional devices that can lead to the most effective achievement of the desired learner performance are listed. Increased effectiveness of training programs should result from using the suggested guidelines.

This manual is not a handbook on the development of military training courses, nor is it a handbook on the technical characteristics of instructional devices. This manual is prepared on the assumption that the user already has background in these matters, and has access to official Army guidance documents[1] and media references[2] The objective of this manual is to suggest alternative approaches toward achieving training goals which will effectively provide the same level of learner performance.

Within the overall process of designing training systems as specified in CONARC Regulation 350-100-1 (see Chapter 1), this manual describes a systematic procedure for use during the process of developing training materials. A general learner model (Chapter 1) is used as a device by which the conclusions derived from analyzing the appropriate research literature are organized and presented. This model makes explicit the assumptions used in selecting materials for the manual. General principles, many pertaining to human perception, are summarized in three chapters concerning information availability and general learning; these materials are based on the general assumption that learner performance is controlled by varying the information available to the learner. In the remainder of the manual, specific learning principles are associated systematically with groups of learner performances to derive specific approaches to a training program goal, and the instructional devices which would facilitate these training approaches are listed.

[1] In particular, CONARC Regulation 350-100-1, *Training Systems Engineering of Training (Course Design)*, and Army Field Manual 21-6, *Techniques of Military Instruction.*

[2] For example: James W. Brown, Richard B. Lewis, and Fred F. Harcleroad, *A-V Instructional Media and Methods*, (3d ed.) McGraw-Hill Book Company, New York, 1969; Edgar Dale. *Audio-Visual Methods in Teaching*, (rev. ed.) Holt, Rinehart and Winston, New York.

How to Use This Manual

The information in this manual may be systematically used to select training approaches and appropriate instructional devices. To achieve a specific training goal, the learner must be provided with three *functional kinds* of information: goal awareness information, content or related information, and feedback information. Each of these three kinds of information may be composed of different *presentational types* of information, such as written words, spoken words, or pictures. *The critical factor in designing learning programs is to provide the appropriate kinds and types of information to the learner.*

Throughout the manual; each discussion about a particular family of training goals concludes with a matrix indicating alternative instructional devices for presenting the different functional kinds of information. Training managers and developers must consider other factors, such as cost, available facilities and instructors, numbers and abilities of learners, stability of the selected training goals, and time available along with such managerial contingencies as would be required in the event of rapid, mass mobilization. Therefore, only inappropriate instructional devices are ruled out and all reasonable options are retained in the matrix.

The type of information that will most effectively present the desired functional information must be selected. For example, goal awareness information in a discrete motor skill would probably require some kind of demonstration or picturing of the desired behavior; words, spoken or written, would probably not be as efficient. However, if a learner is expected to memorize five simple facts, written or spoken instructions providing this goal awareness information would probably be the simplest and most efficient. Further, a lecture would provide exactly the same information when presented live, on a tape recorder, on a motion picture screen, or on a television screen. The learning results should also be the same. Media selection, therefore, should be based upon the ability of an instructional device to present the desired type of information.

Probably over 90% of learning will use the picture, the written word, or the spoken word. However, other options which would be required under special circumatances are provided in Chapter 3. The trainer, developing his own approach, determines the type (or types) of information that will most effectively provide each of the three functional

kinds of information. He determines his available options on instructional devices from the matrix.

The instructional devices listed in the matrix tables are grouped in six convenient categories: live human, recorded motion or sound, graphic, simulator or actual equipment, computer-administered instruction (CAI) or programed instruction (PI), and small group methods. Representative exemplars of each of the sorts of specific instructional devices are indicated in each category. The list of instructional devices is arbitrarily limited rather than exhaustive. The examples used were chosen to cover a broad range of instructional device potentials and characteristics and will provide a basis for the knowledgeable training develper to consider alternatives that are not shown on the list for a particular category.

Within the listed categories, the live human may function as a lecturer, a demonstrator, or a tutor or coach; other roles are possible although not indicated. Instructional devices that record motion or sound or both are grouped, and some examples of the various combinations of characteristics are provided. Graphic information mediating devices are also grouped; in general, devices in this category use either film or print. Simulators and actual equipment are considered within a category, as are computer-administered instruction and programed instruction; no further examples are listed in these categories because of the great diversity that is possible. Small group methods comprise the final category and two of the many possible specific choices are shown.[3]

The user can see immediately that many media combinations can theoretically provide the desired functional kind of information. With the specific objective providing guidance, the alternatives can be reduced to those instructional devices able to (a) provide the desired type or types of information (Chapter 3), and (b) provide the special characteristics which the manager may use to implement his learning program (Chapters 4 and 5). With inappropriate instructional devices eliminated, the final list derived from this procedure is based solely upon learner performance factors. The manager must also weigh in his choices the necessary administrative factors, such as cost, priority, and availability of men, equipment, and material which are not specifically considered in this manual.

[3]Small group methods are reviewed in HumRRO Technical Report 70-3, *Theory and State of the Art of Small-Group Methods of Instruction.*

In designing a learning program, this manual presents some research-based guidelines[4] which enable the manager to: (a) select an appropriate approach to achieving a specific training goal, (b) select instructional devices that will provide both the appropriate kind of information and type of information, (c) use principles that should induce learner attention to the selected information, and (d) emphasize the critical information. These factors must be simultaneously considered in the context of the specific learning goals which have been selected.

An example of how to use this manual follows.

> Learning Goal: The learner should be able to field strip the M16 rifle under daylight conditions within five minutes.

Analysis of the goal indicates that it is a form of procedure learning, which is covered in Chapter 7). The model approach for learning of procedures emphasizes meaningful context, practice, and immediate feedback. The matrix in Chapter 7 indicates that only the small group methods are inappropriate.

Feedback for this task would typically consist of some form of immediate correction of erroneous operations or an affirmation to move on to the next step. A tutor or coach using a simulator or the actual equipment has this capability. The learner may be able to adequately diagnose that he has not performed an operation correctly, so instructional devices that permit ease of repetition can also be considered. Tutor or coach, film cassette, book, printed handouts, simulator or actual equipment, and CAI or PI are instructional devices with this capability. (If motion were also desired, only a demonstrator with a simulator or the actual equipment, either live or on a film cassette, would remain from the list.)

To meet the training need for feedback information the prime training approach choices are:

First, a coach with the learner operating a simulator or the actual equipment. [NOTE: While this does not consider cost figures, it appears that in this instance, the actual equipment would be adequately available and less expensive than a simulator model; therefore, the discussion will assume an actual M16 rifle in the hands of the learner.]

[4] Specific citations are not included for the many research studies reviewed as part of the preparatory work for this manual. These citations are included in a HumRRO Technical Report now in preparation, dealing with the development of the manual.

Second, a demonstration on film cassette (since a live demonstration has a low/medium ease of repetition).

Both of these procedures for providing feedback appear to permit adequate *practice.*

The other critical factor indicated by the model approach is to provide a *meaningful context.* This means that the learner should receive an overview of the entire procedure along with an indication of its job relevance. Typically, a dramatization on motion film or TV could be used to indicate job relevance, while a demonstrator (live or recorded motion) would provide an overview of the entire procedure, along with each of the specific operations. Goal awareness information may be split into the two functions. Job relevance would be presented either by a lecturer or by a motion film or TV dramatization. A model of the correct procedure could be provided by a demonstrator either live or on motion film or TV.

Spoken words to point out possible difficulties would provide related information. This information could be integrated into the demonstration of the procedure. The matrix would retain the following options:

Goal awareness and related information—lecturer, demonstrator, recorded motion and sound, actual equipment.

Feedback—coach, film cassette, actual equipment.

These options should provide equivalent learner performances when correctly used.

The final decision on approaches to be used for achieving this objective would be based upon such factors as availability of men and materials, cost, number of learners and the like, as well as its integration with other related objectives in the training program.

A second example:

Learning Goal: The learner should apply the problem-solving concepts of military leadership (as stated in FM 22-100 to the tactical problems of a tank/reconnaissance platoon leader. Requisites would be a using knowledge of tank platoon tactics, armored cavalry platoon tactics, and the concepts of military leadership along with the previous knowledges and skills implied by this level of functioning.

Analysis of the goal indicates that it is typically a form of reactive decision making, which is covered in Chapter 12. The model approach for training in reactive decision

making emphasizes learner awareness of required performance (and its relationship to previous decisions), learner recollection of relevant concepts and principles, and practice with analytic feedback to provide organized experience. The matrix in Chapter 12 indicates that all instructional devices are potentially usable.

The initial assumption in the design of this learning program is that the practice opportunity would most economically be provided using some form of simulation (including games), guided-discovery approach, or case study. It is assumed that the computer is able to provide or be used in conjunction with a simulation or case study.

Analytic feedback showing why methods are erroneous, incorrectly applied, or probably effective would most frequently require either a tutor or coach or a small group method. In some cases a special computer program may be used effectively with a given game, simulation, or case study. Somewhat less effective would be the vicarious feedback gained from a dramatization (live or recorded) or the lecturer, the printed handout, or the book discussing the pros and cons of the various alternatives.

Goal awareness information would typically be provided by a clear verbal statement, either printed or spoken. This could be by lecturer, tape recorder, or graphic device. Recorded motion would be used only if the goal awareness information would be provided with another functional type of information.

Related information would present the relevant concepts and principles. However, the actual job would require that the learner have these concepts and principles available from memory. While, therefore, ability to use the concepts and principles should be requisite, it is also true that the actual use of the concepts and principles will aid in their recall during job performance. The learner's recollection of the relevant concepts and principles should be assisted using pictured, printed, or dramatized illustrations. Recorded motion or sound and a lecturer with graphic aids provide this information effectively.

The matrix would retain the following options:

Goal awareness information—lecturer, tape recorder or graphics.

Related information—lecturer, recorded motion or sound, or graphics.

Feedback information—tutor or coach, small group method, or computer in conjunction with games, simulation, or case study.

These options should provide equivalent learner performances when correctly used.

The final decision on approach to be used for achieving this objective would be based upon time, cost, availability of men and materials, number of learners, and the like, as well as its integration with other related objectives in the training program.

Chapter 1

TRAINING MATERIALS DEVELOPMENT

The process of developing training materials, with which this manual is concerned, is a part of the systems approach to the design of training that is outlined in CONARC Regulation 350-100-1.[1] The training manager or specialist in designing specific training materials works within an overall framework of training development structured in terms of seven processes:

(1) Job Analysis

(2) Selection of Tasks for School Training

(3) Training Analysis

(4) Development of Training Materials (Instructional and Administrative)

(5) Development of Testing Materials

(6) Conduct of Training

(7) Quality Control

Within this systems approach to training development, the present chapter specifies preconditions and necessary activities in the form of 12 steps that provide the context for the process of developing training materials. This process is the framework within which approaches to achieving desired learner performances are selected and facilitated. The present manual is designed to assist personnel developing training materials to select and facilitate approaches that will be effective in reaching these goals.

The process of developing training materials, as outlined in Appendix D of CONARC Regulation 350-100-1, consists of the following major activities: analysis of training objectives, identification of lessons, design of a lesson plan, and development of the

[1] U.S. Continental Army Command. *Training: Systems Engineering of Training (Course Design)*, CONARC Regulation 350-100-1, Fort Monroe, Virginia, February 1968. This regulation specifies the context within which this manual may be used and should be carefully studied in connection with this chapter.

Program of Instruction (POI) and training schedule. Preconditions to these activities include training analysis, study of student characteristics, and determination of available resources. Not stated as part of the process, but considered essential in modern training technology, is the pretesting of training materials, and them making appropriate revisions; this recommended pretesting is distinguished from normal student testing and quality control testing.

Figure 1 is a flow chart that illustrates the sequencing and the interactions of the procedures that are involved in the overall development and construction of training materials (this manual helps the manager perform steps 5 and 6). The activities may be summarized as follows:

Insert Figure 1

(1) Perform or obtain a training analysis (as outlined in Appendix C, CONRC Regulation 350-100-1) on the basis of the job analysis.

(2) Analyze the learner(s). Specify the initial skills and abilities, and the final performances desired. Become familiar with the previous knowledges and understanding levels of the learner.

(3) See what resources are available. Check manpower, equipment, training priority, and other related factors.

(4) Look at the learner performances specified by the training analysis and see whether these performances are actually necessary on the job. Determine why apparently unrelated performances have been included; eliminate unnecessary performances. Do the training analyses clearly identify the learner subskills that will be needed for adequate final performance? Is the analysis broken down to a simple enough level for the immediate learning of tasks? Identify the learning experiences (teaching points) needed for the learner to accomplish the desired final performance. Relate the selected learning experiences to the appropriate military reference or manual. Program the learning experiences so that the learner acquires the appropriate prerequisite subskills before proceeding to the next level.

(5) Select training approaches. The learner performances that are desired will suggest approaches that will be effective in achieving training goals. A motor skill

Twelve-Step Procedure for Developing Training Materials

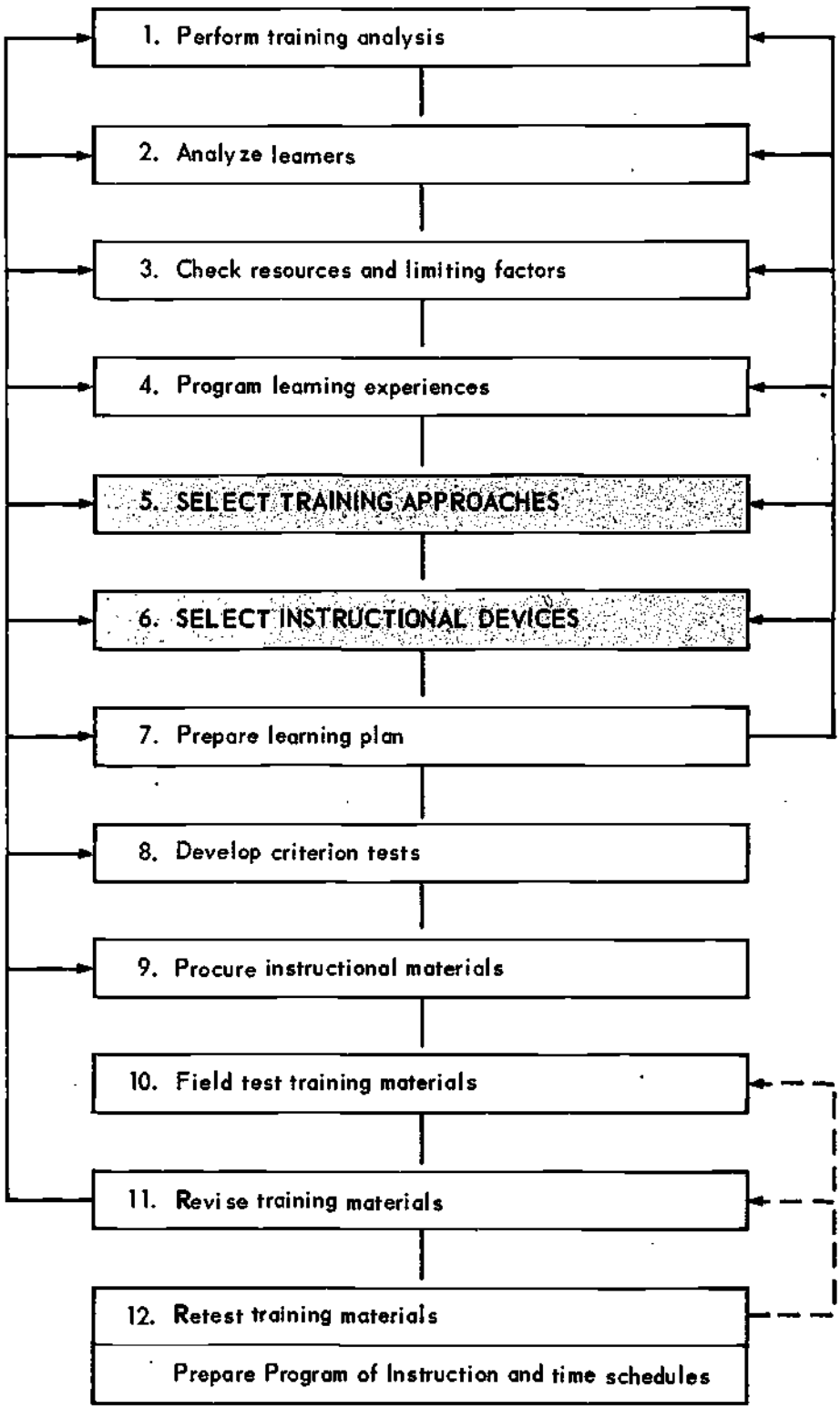


Figure 1

(muscular performance) would be taught differently than a leadership skill (management performance). *This manual suggests model approaches for the different types of learner performances.*

(6) Determine how the selected approach may be efficiently implemented, using appropriate instructional devices. The success of the approach to achieving the desired learner performances will depend, in part, on the effectiveness of the instructional devices that are chosen. *This manual provides guidelines for selecting instructional devices.*

(7) Prepare a plan of learning (refer to CONARC Regulation 350-100-1, Appendix D, Section III). Identify lessons, plan lessons, and apply the appropriate training resources using a learner performance approach. Note that, in this step, reference will be made to all previous steps; decisions made in these earlier steps will be modified, as needed, to improve the materials being developed.

(8) Develop criterion tests. Determine whether the test results represent the desired quality of job performance. At various points in the training program the performance of the learner should be assessed to (a) determine the feasibility of continuing his training, (b) provide additional (remedial) preparation, or (c) provide information for the commander or the training manager, indicating the adequacy of the learning program. The test should be designed to fulfill its primary function; that is, either (a), (b), or (c) above.

(9) Procure instructional materials through appropriate channels.

(10) Field test the training materials. Prior to full-scale use, the instructional devices and materials should be pretested; since even the best judgment can not replace actual testing.

(11) Revise and refine the training materials. On the basis of the pretest results, determine where the instructional materials, sequences, and instructional devices require changes, and make the appropriate revisions. Note that in this step, review and possible modification of the first seven steps and Step 9 may occur.

(12) Retest the training materials and revise as needed. If major modifications are needed, Steps 10 and 11 should be repeated. (To maintain continually effective training materials, review and revision should be scheduled on a regular basis after a program is in use.) Finally, prepare the POI and time schedules, following CONARC

Regulation 350-1 (Annex Q), CONARC Regulation 350-16, and other appropriate regulatory guidance.

This 12-step procedure shows the overall context of the process of developing training materials. The various steps of the procedure interact with one another, often in such a way that decisions at a later step may require review and revision of tentative decisions at earlier steps. This manual only provides assistance in accomplishing Steps 5 and 6.

The need to pretest training materials must be emphasized. Research has shown that pretesting and revising training materials results in a better product, to the later benefit of the learner. The judgment of even an experienced instructor is not as efficient as actual testing. Testing by the person developing the training materials should be included as part of the design of the program.

Chapter 2

GENERAL LEARNER MODEL

A general learner model designed to help the training developer construct a specific training program, is presented in this chapter. Training is understood as the process by which individuals learn the knowledges, skills, and attitudes which will fit them for adequate job performance. The principle which underlies this model is that learning is done by the learner; *teaching* does not guarantee *learning.* The emphasis in the general learner model will be on the input information and on the conditions that promote learning.

The model (Figure 2) includes and interrelates the factors reported to be involved in learning. In general, it suggests that the success of a training program depends on providing the learner with conditions under which he may learn, not just on how well material may be presented.

Insert Figure 2

Information *inputs* in the model are summarized as goal awareness information, task-related information, and feedback. The learner must know what is expected of him, he must be given the information needed to provide the appropriate performance, and he must be given the opportunity to evaluate his performance or have it evaluated. *Throughput* consists of the appropriate mental operations that are related to performance. The *outputs*, expressed as learner performances, are typified as recall of facts, recall of procedures, acquisition of discrete motor skills, acquisition of reactive skills, use of concepts, reactive decision making, and putting attitudes into practice. Since the focus of the entire training process is learner performance, the following description of the model will begin with discussion of the output.

General Learner Model

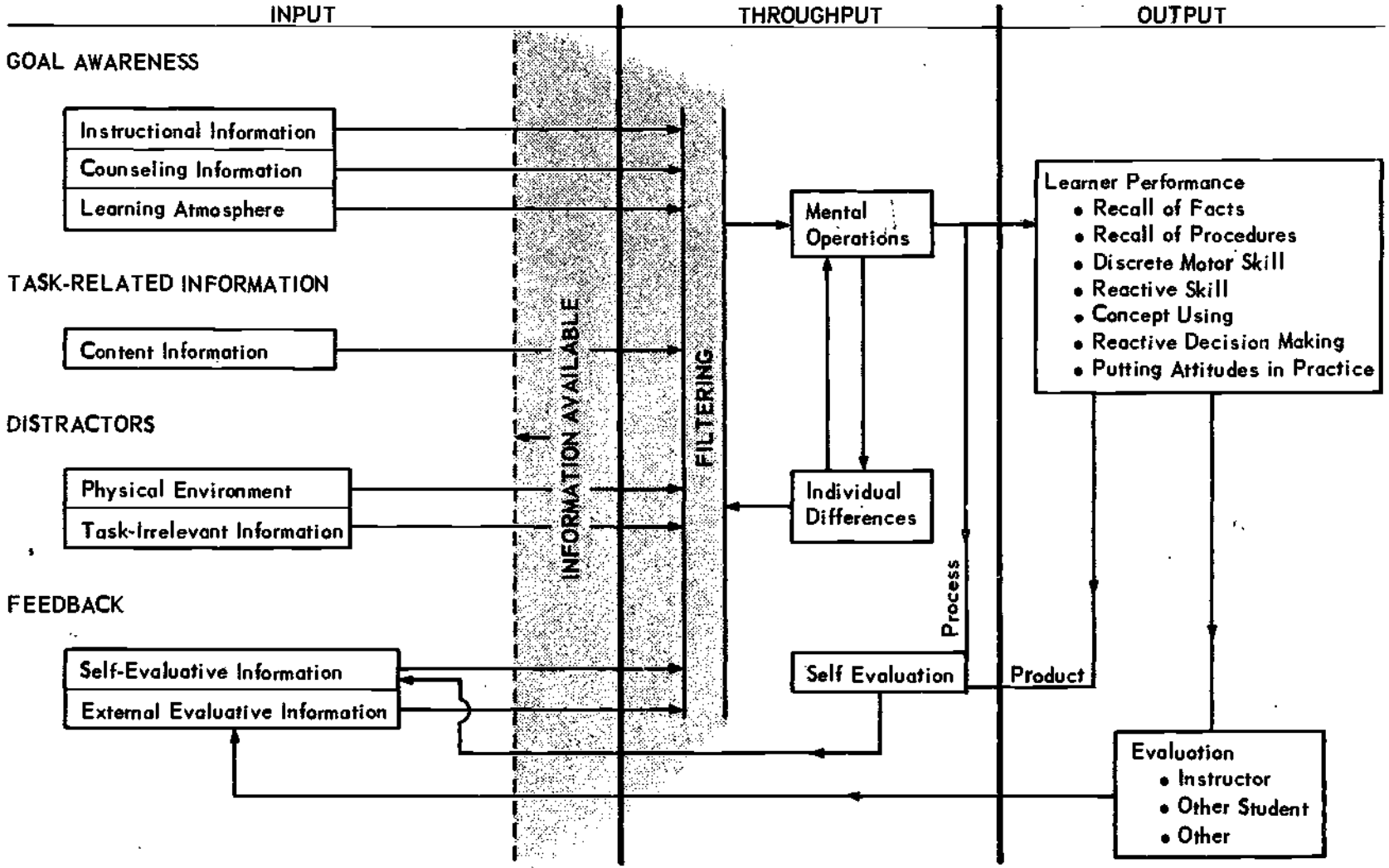


Figure 2

Output

The output of the model is an information-based performance by the learner. For our purposes these performances are equated with the stated training objectives; other outputs (performances) are not considered in this model. Tasks that may be accomplished by a normal adult given simple instructions are also omitted.

Seven groups of learning tasks comprise the learner performances or outputs of this model. These basic groups are:

(1) Recall of facts (e.g., general orders).

(2) Recall of procedures (e.g., assembly of a weapon).

(3) Acquisition of discrete motor skills (e.g., firing a weapon).

(4) Acquisition of reactive skills (e.g., typing from copy).

(5) Using concepts, including acquisition of concepts and problem solving (e.g., planning a tactical operation).

(6) Reactive decision making (e.g., troubleshooting).

(7) Putting attitudes into practice (e.g., the set of behaviors, all oriented to achieve cleanliness).

The seven groups of learner performances will be used as a basis for organizing the discussion of the approaches and principles involved in different kinds of learning, and hence in the development of training materials for different performance goals.

Throughput

The throughput of the general learner model consists of the mental operations which enable the learner to act in the desired manner. Each of the seven learner performances would require similar mental operations by the learners. Not all the available information is perceived, used, or learned by the individual. What aspects of the environment the learner will perceive are selective. Also, many other factors, such as reinforcement, repression, and set will interact with learning.

A function called "filtering" is assumed to account for the difference between the total information available and the information that the learner appears to use. It can not be assumed that available information will be used by the learner solely on the basis of

its existence. The fact that a learner is told something does not guarantee that he hears or understands it. Evidence other than that of exposure is necessary to indicate what information is used by the learner. The filter function may not be assumed to be fixed for a learner over time. What he may use in one instance of learning apparently may be ignored in another situation.

Input

The input in the general learner model consists of information. According to the educational literature, several kinds of information are available to a learner:

(1) Content information—the information required to accomplish a task. (Given the task of adding two and two, the content information would be a pair of two's.)

(2) Instructional information—directions as to the performance to be learned, and such rules or models as may be required. (The explicit statement of the task to be accomplished would be instructional information.)

(3) Counseling information—the influence of the advice of other people (including the instructor) on the learning process. "In this mapusing course, 80% of your grade will depend on a practical test in which you follow a route using map and compass," represents counseling information input.

(4) Learning atmosphere—the attitudinal dimension of the learning environment. It consists of generalized attitudes toward the instructor, toward the learning context, and toward other learners. (Perceptions such as "The instructor is a nice guy," "The instructor likes math," "John gets away with sleeping," would represent effects of this kind of input. Learning atmosphere also includes information intended to create or enhance learner motivation.

(5) Environmental information—features affecting the learner's physiological reactions to the physical environment. Temperature, humidity, barometric pressure, and similar factors, when beyond normal ranges, interfere with the learning process. ("It's too hot to think" is a statement of an effect stemming from the physical environment.' Environmental features include lighting, time of day, noise, and visual distraction. The test of whether distracting conditions are present in the environment is impairment of learning.

(6) Evaluative information—two types, externally and internally generated. Externally generated evaluative information, which is based on previous performances, is subdivided into student evaluation, instructor evaluation, or evaluation from other sources (such as answer booklets).[1] The information the learner receives represents the evaluation of previous performance as it affects present performance. However, the learner may also be continually evaluating, not only the result of his work, but also the process involved. This internal evaluative information associates not only previous performance, but also previous mental operations with present performance. All evaluative information will be termed feedback, and represents a critical information input to the learner.

Some simplified groupings of these kinds of information are used in this manual. First, however, under the general title of "Information Availability," three chapters (3, 4, 5) will summarize *general* principles related to using and receiving information that apply to most learner performances.

Information related to learning *particular* kinds of performances will then be presented in separate chapters (Chapters 6-13) titled according to the names of the seven basic groups of learner performances (output). Within these chapters, information will be grouped according to function, as shown in the Input section of the learner model (Figure 2). The three functional groupings for information (input) are goal awareness, task-related, and feedback:

(1) Goal-awareness information combines the inputs characterized earlier as instructional information, counseling information, and learning-atmosphere information. The functional use of goal-awareness information—that is, the purpose of the particular bit of training—would normally be stated in the "introduction" section of a lesson plan (as outlined in FM 21-6.[2] Since goal awareness and motivation are often closely related, the techniques used in gaining and maintaining attention and motivation also will normally be included in the introductory section of the lesson.

[1] The concept of reinforcement (defined as anything that increases the likelihood of the recurrence of a specified behavior) is part of the attitudinal dimension of evaluative information and will not be considered independently.

[2] Department of the Army. *Techniques of Military Instruction.* Field Manual 21-6, Washington, January 1967.

(2) Task-related information consists of specific subject matter information. The function of such information usually is found in the "Explanation/Demonstration" section of a lesson plan. Material is commonly presented mainly in words, as explanation; the basic function of a demonstration is to present information when discrete motor skills and reactive skills are being acquired.

(3) Feedback refers to the evaluative information available to the learner after performing a task (e.g., a practice trial). Such information is usually presented in the "Application" section of the lesson plan. As indicated in the general learner model, feedback may have many origins—self, instructor, other students, or other sources.

All other information is pooled in the model as "distractive information." It is recognized that environmental information usually becomes distracting only under extreme conditions.

The control of information input constitutes the major portion of a training program, so this manual is primarily concerned with information input. The chapters that follow deal first with general information availability and then with input information specifically related to a learner performance.

Chapter 3

INFORMATION AVAILABILITY: TYPE OF INFORMATION

This chapter and the two following chapters (under the general topic of "Information Availability") deal with the fundamental principles involved in the receiving of information by learners. In order for the learner to perform as desired, he must receive information. Input information is at the heart of learning. In these three chapters, principles related to the general process of the learner receiving information are grouped into three sets of factors: type of information, information exposure, and display design.

This chapter considers the relationships between sensory channels and types of information to be presented. Decisions concerning the type of information presentation needed in the particular learning situation must precede selection of instructional devices. Principles related to selecting the type of information best suited to particular cases are summarized.

Types of Information

Sensory channels and type of information provide important distinctions. The normally used sensory channels are sight, hearing, and touching. The two basic types of information are distinguished as: those *symbols* which are arbitrary, discrete, and bear no resemblance to what is represented, such as words, and those non-discrete *signs* which resemble in certain ways that for which they stand, such as pictures.

Type of information and the sensory channel are important factors in instructional device selection. Words (written and spoken) and pictures probably account for over 90% of the information the learner receives. The training developer must rely chiefly on the written word, the spoken word, and the picture.

Two major types of information, typified by words and pictures, can be subdivided on the basis of the sense to which they appeal. Figure 3 shows the subdivisions of these

Types of Information in Relation to Sensory Channels

Information Type	Eye				Ear	Tactual-Kinesthetic
	Graphic	Motion or Simultaneous Events	Color	Gesture		
Symbols Arbitrary, discrete information symbols that bear no resemblance to what they represent	Written Symbols (Words, numbers)	Not applicable	Color Symbols (Color-coded wire, signal flag)	Gestural Symbols (Finger spelling of the deaf)	Heard Symbols (Words, numbers, telegraph messages)	"Felt" Symbols (Braille printing)
Signs Information signs that resemble what they represent in a nondiscrete manner	Pictured Signs (Pictures, schematic diagrams, road maps)	Dynamic Pictured Signs (Drawings of a moving 4-stroke cycle engine)	Color Signs (Paint chart, color key)	Gestural Signs (Hand signals)	Heard Signs (Phonograph records, auditory pattern of ground surveillance radar)	"Felt" Signs (Control of a model airplane by wires, control of anti-tank guided missiles such as SS11 or ENTAC)

Figure 3

two major information types, symbols and signs.

(Insert Figure 3)

Subdivisions of symbols (arbitrary, discrete information hearing no resemblance to that which it represents) are: written symbols, heard symbols, color codes, gesture codes, and felt codes. Words and numbers may be written or spoken, depending upon the sensory channel which is used.

Subdivisions of signs (information which resembles that which it represents in a non-discrete manner) are: pictured signs, dynamic pictured signs, heard signs, color signs, gestural signs, and felt signs. The picture is a pictured sign as are road maps and schematic disgrams. Dynamic pictured signs show simultaneous movements or events, and may demonstrate the changing relationships between parts of a display. Normally, color signs are used along with pictured signs.

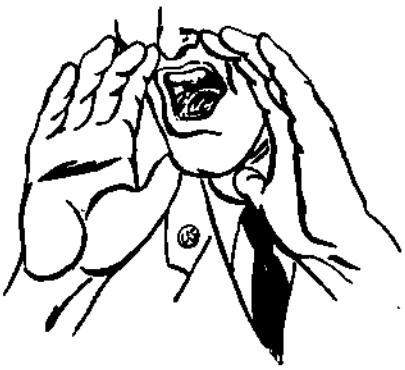
Examples of the various subdivisions are shown in Figure 3.

Principles

(1) *The perceptual conditions for learning through one sensory channel (such as sight) differ importantly from those for another sensory channel (such as hearing), and the conditions that employ one type of information (such as words or numbers) differ importantly from those that employ another type of information (such as pictures).* For example, an air hammer operating outside a classroom may not affect the learning of a repair chart, but will disrupt a lecture.

(2) Messages presented in terms of words or numbers normally can be perceived through eyes or ears, or both. Picture-type messages are received through the eye. *The relative usability of each type of information is in part determined by (a) the time duration of availability and (b) the learner's available performance capability.* Words and numbers have distinct advantages for performance by the learner (not everyone is an adequate artist). Written words and numbers and pictorial presentations have an advantage in that they are usually available to the senses longer than words that are heard once.

(3) A valuable aspect of pictures is that they can be (usually are) converted into words, and in that form can readily be produced. The recoding of pictures into words is so important that the designer of training should arrange to facilitate it for two



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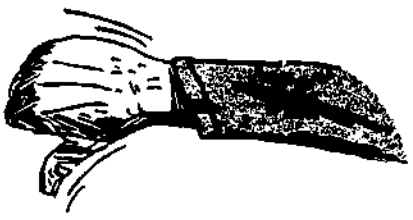

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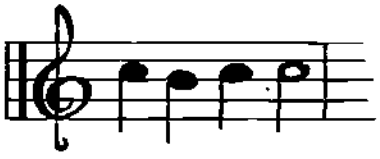
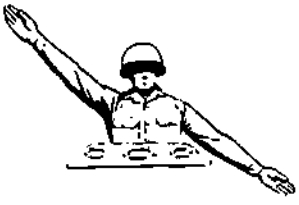
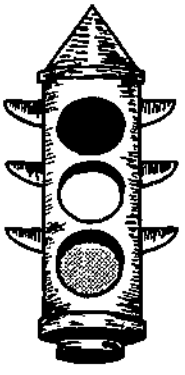
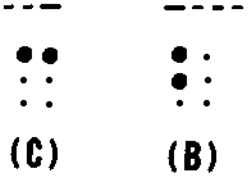
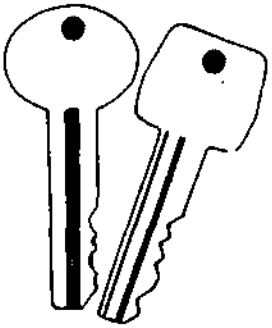










Both signs and symbols are common in the several sensory channels.

reasons: (a) Long-term recall of pictures and objects is aided when the learner repeats their labels, and (b) providing names or descriptions of pictures and objects increases the probability that the learner is seeing and interpreting them as desired. *Words direct attention to pictures and objects, and are a help in categorizing them.*

(4) *Where it is desirable in instruction to substitute a photograph or drawing for an actual object, it is important to know how to represent that reality adequately for the learner.*

(5) *Sight is a superb channel for representing spatial distinctions, but relatively poor for showing temporal distinctions.*

(6) *Hearing is superb for representing temporal distinctions, but relatively poor for spatial distinctions.* Supportive evidence is provided by the fact that auditory tracking is much less accurate than visual tracking.

(7) *In general, the sensory channel used in the final testing or application situation—that is, in the desired performance—should be employed during instruction and practice.*

(8) *For words using a single sensory channel in a learning situation, the written message appears to have greater information-carrying capacity than the spoken message; the more difficult or complex the level of the message, the greater the advantage of the written over the spoken.*

(9) *However, there is considerable evidence that objects and pictures of objects (line drawings) are better remembered than names of objects, other things being equal.* These results have been found for a wide variety of learning conditions. Combinations of words and pictures may be extremely useful. In general, the most effective combination of pictures and words or numbers is a pictorial stimulus and a word or number response label or description.

Type of Information and Instructional Device

Certain types of information pertain to specific kinds of performance. The specification of the type of information required is based upon the congruence of the information input with the specifiable performance. Type of input and sensory channel should be selected on the basis of the performance required. The principle that the input information should match the performance output pertains most directly to the goal-awareness category of information.

The training objective will often suggest the most useful types of information. Some examples would be: (a) aircraft identification would usually require written or heard symbols associated with pictured signs; (b) the golfer modifying his swing would require either heard symbols or dynamic-pictured signs (or both); (c) the interpretation of ground surveillance radar would require heard signs, and possibly heard symbols; (d) the person taking a written test would generally perform better when he had been provided similar written study materials.

No single instructional device provides such inherent superiority as to be most suitable for all learning experiences. When a particular series of performance requirements has been programmed, the most effective means (i.e., instructional devices) for presenting the necessary information input should be selected. However, since knowledge of the learning process is far from complete, a great deal of the effectiveness of any instructional program will depend on its operational testing, revision, and retesting. Comparisons of results using different instructional devices would be a useful step in designing an effective instructional program.

The term, instructional devices, refers to information-mediating equipment, methods, and materials. This definition is flexible enough to include the lecturer and the book and such equipment as the 16mm sound projector. When characteristics of the "software" (the page, the film, the lecture script) can be varied in such significant areas as sound or color, this fact is noted in describing the characteristics of the particular instructional device. Since information is what instructional devices provide, some previously stated distinctions are reemphasized: (a) The sensory channel through which the learner receives information may be seeing, hearing, or "feeling"; (b) the information itself may be arbitrary in form and bear no similarity to that which it represents (such as words or numbers), or it may resemble in certain ways that which it represents (such as pictures).

Before choosing the instructional device, one must clearly specify the performance required of the learner. No instructional device in itself directly assures mastering of performance, although use of the most appropriate device(s) often may lead to greatly improved performance. Essentially, an instructional device provides the vehicle for the learner to receive the information required to produce the performance. Instructional devices actually do little more than deliver information through the selected sensory channel.

In this analysis, six groupings of instructional devices are treated as representative:

(1) Live Human (e.g., lecturer, tutor).

(2) Recorded Motion or Sound (e.g., tape recorder, 16mm film with sound and color).

(3) Graphic (e.g., overhead projector, book with color plates).

(4) Simulator or Actual Equipment.

(5) Computer-assisted Instruction or Programed Instruction.

(6) Small Group (e.g., role playing, discussion group).

Table 1 represents the results of examining the characteristics of instructional devices and charts their capability to present a specific type of information through a given sensory channel.

Insert Table 1

Table 1

Information Type and Instructional Devices

Instructional Device	Symbols					Signs					
	Written	Color	Gestural	Heard	Tactual-Kinesthetic	Pictured	Dynamic Pictured	Color	Gestural	Heard	Tactual-Kinesthetic
1. Live Human											
Lecturer	No	No	Yes	Yes	No	Limited	Limited	Limited	Yes	Limited	No
Demonstrator	No	No	Yes	Yes	No	Limited	Limited	Limited	Yes	Limited	No
Tutor or Coach	No	No	Yes	Yes	No	Limited	Limited	Limited	Yes	Limited	No
2. Recorded Motion or Sound											
Tape Recorder	No	No	No	Yes	No	No	No	No	No	Yes	No
Film Cassette (super 8, silent, color)	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	No
Film (16mm, sound, color)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No
TV (B/W)	Yes	Limited	Yes	Yes	No	Yes	Yes	Limited	Yes	Yes	No
TV (B/W, record and playback function)	Yes	Limited	Yes	Yes	No	Yes	Yes	Limited	Yes	Yes	No
3. Graphic											
Overhead Projector	Yes	Yes	Limited	No	No	Yes	Limited	Yes	Limited	No	No
Film Strip (silent, color)	Yes	Yes	Limited	No	No	Yes	Limited	Yes	Limited	No	No
Film Slides (35mm, color)	Yes	Yes	Limited	No	No	Yes	Limited	Yes	Limited	No	No
Blackboard	Yes	Limited	Limited	No	No	Yes	Limited	Limited	Limited	No	No
Book (color plates)	Yes	Yes	Limited	No	No	Yes	Limited	Yes	Limited	No	No
Printed Handouts	Yes	Limited	Limited	No	No	Yes	Limited	Limited	Limited	No	No
4. Simulator or Actual Equipment											
Simulator	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Possible
Actual Equipment	Possible	Possible	No	Possible	Possible	Possible	Possible	Possible	No	Possible	Possible
5. CAI or PI											
Computer (words and numbers)	Yes	No	No	No	No	No	No	No	No	No	No
PI (including pictures)	Yes	Limited	No	No	No	Yes	Limited	No	Limited	No	No
6. Small Group											
Role Playing	No	No	Yes	Yes	No	Limited	Limited	Limited	Yes	Limited	No
Discussion Group	No	No	Yes	Yes	No	Limited	Limited	Limited	Yes	Limited	No

Chapter 4

INFORMATION AVAILABILITY: EXPOSURE

This chapter focuses on the fundamental exposure aspects of presenting information to the learner. All performances, as shown in the general learner model, depend on the availability of appropriate information. In general, perceptual principles are fundamental to further mental operations (whose outcome is a desired learner performance) because they influence what information is available to the learner. Some of the principles and research studies applicable to receiving available information are summarized in this chapter.

Principles

One of the most important facets in teaching is to insure that the appropriate cue (the information necessary to learn a performance) is effectively available to the learner. Fundamental to all other work is the simple fact that a learner who is not exposed to information can not use it; also, unless the information is apparent to him, he may not select it.

Attention

The attention the learner gives to the available information is an important element in the learning process. Generally, a person's attention is drawn to what is novel, to whatever stands in contrast to immediate past experience or to life-long experience. For example, wind is noticeable on a quiet day, a lull on a windy day; record rainfalls and heat waves attract attention, normal weather does not.

Further, one's attention is drawn and held by complexity. Given a choice, people have been shown to spend more time looking at:

(1) Figures having more numerous elements rather than fewer.

(2) Displays having an irregular arrangement of elements.

(3) Elements in a group that are different in structure rather than homogeneous.

A learner often will pay little attention to material that is too simple for him in content, pace, or treatment. When pacing is slow enough for slower learners, faster learners often become bored and inattentive.

When designing learning programs it is wise to recall these three principles:

(1) *Attention (and increased learning) can be developed through a controlled arousal of moderate anxiety.* Telling students that a test is to follow a phase of training is one example of this arousal.

(2) *Attention comes from success in learning, while persistent failure will extinguish motivation to learn.* Unpleasant experiences related to specific learning activities reduce interest. Pain, fear, frustration, humiliation, embarrassment, boredom, and physical discomfort also will reduce or extinguish learning motivation, although some short-term learning activities may occur.

(3) *Attention is a learned response.* Students must be rewarded for attentive behavior.

Selective Perception

(1) *Each person does not see or hear the same information*—a phenomenon called selective perception or set (i.e., readiness to attend to a particular thing). In general, the better a learner sees or hears an object or person, event or relationship, the better he can remember it. Further, a learner can see and hear information better and learn it better if it is consistent with his own values than if it is inconsistent.

Several other principles should be considered in designing a learning program:

(2) *People influence people; a person's attitudes are influenced by his instructors and peers.* Activity and productivity depend upon the characteristics of the instructional leadership provided. However, there is no clear superiority of one kind of instructional leadership over another for all purposes (although enthusiastic instructors are preferred over unenthusiastic ones).

(3) *Understanding of the overall objectives, nature, and purpose of a task will usually help an individual's motivation to learn.*

(4) *The purpose or goals of the learner determine the focus of his attention.* The learning experience must appear to him to be related to his own long or short term goals. The learner will "filter out" what he may assume is irrelevant information. Information is not simply transferred intact from the environment or from other humans to the learner. It is always subject to the learner's filtering processes.

Exposure to Material

At the most fundamental level, simple physical exposure to the information is necessary to provide an opportunity to learn it. In some Army training programs, up to one-sixth of a learner's scheduled training hours are given to medical/administrative/housekeeping activities, often leaving the individual learners with no way of learning the information they missed. If the information input of any class period is nonessential for performance, it should be eliminated; when the input is critical, measures should be taken to insure that the learner is given the opportunity to receive it. For example, tape recordings of missed lecture material might be provided (some studies have shown that learning lecture material is equally effective live and tape recorded).

Learner Involvement

The learner's involvement in the learning process also affects the *receiving* of available information.

(1) *Active participation in learning and active acquisition by the learner are often superior to seemingly passive reception of information.*

(2) *Human beings tend to be more productive when they work in groups rather than in isolation, even when no interaction is apparent between the members of a group.*

(3) Within a training context, however, the individual will perform more effectively when motivated as an individual rather than as a part of a group. *Motivation increases where there is personal involvement. The individual may be motivated to exert himself when he is ego-involved (i.e., personally identified with the results of the task).*

Research Studies

There have been many studies of instructional devices. Often the critical learning variables have not been defined adequately and the resulting information has not been useful in selecting instructional devices, but some guidelines based on research studies are summarized in this section.

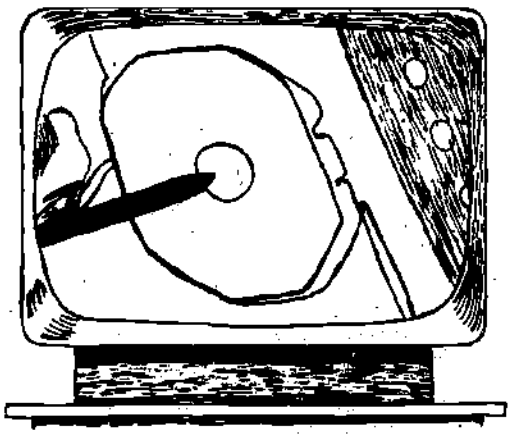
In general, it can be said that visual aids make a lecture more effective; a lecture with visual aids is often superior to an identical lecture without visual aids. Visual aids may provide critical information not available from the spoken words of a lecture.

Since it often is not known which information is essential, it is generally necessary to pretest and revise all instructional sequences. A revision based on samples of learner performance has been shown to be preferable to a revision made by subject matter experts because it results in better performance.

In general, the same learning results can be obtained from a well-designed motion picture film, TV program, programed instruction booklet, or lecture with visual aids (for instructional purposes, film and TV often may be considered substantially the same). When the necessary information is available to the learner, he is able to perform adequately. In studies in which still pictures (filmstrips or slides) were compared with motion films, for example, equivalent learning has generally occurred unless motion-related information was necessary for performance.

In one study in which TV was shown to be superior to classroom lectures, the results were interpreted as being due to special characteristics of information available only to the TV group: the use of extreme close-ups providing detailed information, and the use of pop-ons providing printed labels next to appropriate items. Another study found that visual continuity, derived from the motion depicted in a film, enhanced learning. When film or TV has been shown to produce better learning, the material being taught generally has involved concrete objects or processes not readily perceived when only the spoken word is used in a lecture.

In general, studies have shown that learners who are given more information show more learning, whatever the experimental condition. The "slickness" (degree of technical sophistication) of a film has not proved to be important to learning; if the essential information was available, the learning results were equivalent.



Each student has a front-row seat when instructional devices are used to provide extreme close-ups or special labeling of parts.

When a clear view of visually presented information is necessary for learning, the angle and distance from the visual display are important. The optimal viewing area has been described as within a 30° cone which is four to six screen widths deep, in which the learner looks up less than 15° or down less than 24°. For film projection, an acceptable viewing area is within a 50° cone (60° for matte screen) from two to six (under special conditions, eight) screen widths deep. For TV viewing, an acceptable viewing area is within a 90° cone from four to ten (under special conditions, 14) screen widths deep.

The size of letters or numbers used and the detail that needs to be portrayed are the limiting factors in planning distance and angle conditions for viewers. For fine detail or small letters, maximum acceptable viewing distances may need to be reduced. When little detail and no letters or numbers are used in the instruction, viewing distance can be increased to the special conditions maximum.

Feedback information following practice or drill is an important factor in learning. Experimental studies have indicated that practice at different times (distributed practice) is generally more effective than a single extended practice period (massed practice). Rest intervals help learning, providing each period of practice is long enough to permit the completion of the learning task; the practice period should not be allowed to break the tasks into such short segments that the overall integration of the task is decreased. The classical study showing the benefit of distributed practice involves aerial gunnery training, in which the percentage of hits on the final mission was directly related to the distribution of practice in the training program. Rest intervals appropriately spaced will help learning.

Drill (repetition) has been shown to help the learner produce a rapid correct response. Numerous studies further suggest that learning is helped when the material is placed in a meaningful framework; understanding therefore should precede repetition. When the information load is too great for immediate assimilation by the learner (as it often is in a training film), repetition is extremely useful for improving learner performance.

In programed instruction (PI), the optimal size of learning steps appears to be an unresolved issue. The question can be related to the amount of material presented before giving knowledge of results, the amount of useful information provided before performance (as related to the difficulty of material), or the time used in a single learning

sequence. These three senses in which step size can be understood summarize earlier studies, but do not provide explicit guidelines.

In general, research studies have not verified the proposition that learning might be increased if the learner could "self-pace" the rate at which he receives information. One study has shown that low aptitude learners require from two to four times as much training time as high aptitude learners to acquire given amounts of information.

Instructional Device Characteristics

Two special instructional device characteristics related explicitly to information exposure factors are referability and ease of repetition. These characteristics are related to some instructional devices in Table 2.

Insert Table 2

Referability can be defined as how long and how often the learner can refer to a given bit of information. For example, once a word is spoken it can be retained in memory or it can be repeated. A spoken word cannot, however, provide the learner a long exposure time since a characteristic of spoken language is its rapid fading. A book provides a high degree of referability because a given word can be scanned any length of time or number of times. Thus, the written word is superior when more complex information is being learned.

Closely related to referability is ease of repetition. For example, a lecturer may repeat a statement, but he would be unlikely to repeat an entire lecture for the benefit of an absentee. The lecture could, however, be recorded on magnetic tape and repeated as needed. A high level of ease of repetition is built into a simulator, and the major advantage of using film loops lies in ease of repetition. Some 16mm single topic films available for Army training permit some ease of repetition. Ease of repetition is especially valuable when the learner cannot readily assimilate the information during one exposure; for instance, training films typically provide more information than can be learned in a single showing.

Table 2

Information Exposure and Instructional Devices

Instructional Device	Display Permits Referability by Learner	Device Permits Ease of Repetition for Learner's Benefit
1. Live Human		
Lecturer	Low	Low
Demonstrator	Low	Low/Medium
Tutor or Coach	Low	Medium/High
2. Recorded Motion or Sound		
Tape Recorder	Low	Medium
Film Cassette (super 8, silent, color	Medium	High
Film (16mm, cound, color)	Low	Medium
TV (B/W)	Low	Low
TV (B/W, record and playback function)	Medium	Medium
3. Graphic		
Overhead Projector	Medium	Low
Film Strip (silent, color)	Medium	Medium
Film Slides (35mm, color)	Medium	Medium
Blackboard	Medium	Low
Book (color plates)	High	High
Printed Handouts	High	High
4. Simulator or Actual Equipment		
Simulator	Varies	Varies/High
Actual Equipment	Varies	Varies/High
5. CAI or PI		
Computer (words and numbers)	High	High
PI (including pictures)	High	High
6. Small Group		
Role Playing	Low	Low
Discussion Group	Low	Low

Chapter 5

INFDRMATIDN AVAILABILITY: DISPLAY DESIGN

This chapter deals with principles of designing learning displays and with research studies related to the effect of display design on the receiving of information by learners. Instructional device characteristics potentially related to the design of learning programs are discussed.

Principles

Any part of the information display which occurs prior to a specific learner performance may become associated with this performance in the learner's mind. He does not immediately distingulsh critical from incidental information. The critical information must, therefore, be made both visible and emphatic.

(1) *The organization of an informational display markedly influences the speed and accuracy of perception.* The better organized or patterned a message or display, the more information the observer can receive (and process) at one time, and/or the better he will retain what he sees or hears. Further, the more familiar or meaningful the message to the learner, the more readily he receives and learns it. Message familiarity or meaningfulness increases both the receiving and the learning capacity of the individual.

(2) *The perceptual system of the human being is limited to its capacity for handling information. In general, an individual can visually detect at a glance only about seven items.*

(3) If there is a full-capacity load of information in one sensory channel, the perceptual system will not be able to handle information fron another channel. For example, if a person must listen very intently, he will not be aware of visual information.

(4) There is considerable evidence that *concrete or specific words are better remembered than abstract or general words.* Concrete ideas may be remembered better than abstract ideas, although this has not been demonstrated.

(5) *In general, instruction for the new learner in a subject should begin with more concrete messages and move to more abstract ones as the learner moves to more advanced levels of subject matter.* This holds true for learners of all ages.

Research Studies

The use of introductions or preview questions preceding a film or TV presentation alerts the learner to attend to the information related to the performance that will be desired from him.

Questions, preferably at the end of the presentation, permitting silent, oral, or written answers, should be followed with the correct answer. This procedure helps learning by correcting *mis*-learning.

Other attention directing devices shown as useful in film have been narration, pop-ons, animation, and color. Irrelevant attention-gaining devices function as distractors and have not helped learning. It has been shown that taking notes interferes with learning from a film, and probably also would distract from an information-packed lecture. When films were loosely organized, learning has been helped by providing an outline of the organization.

No consistently reliable differences have been found between learning when the learner gives answers that are overt (written or spoken), or covert (mental). Generally, covert answers appear the more efficient because of time saved. It has been suggested that overt answers are most useful where new or novel answers are being learned, and that the more meaningful the context of the answer the less useful overt answers will be. Covert responses are superior when difficult material is presented under conditions of distraction or fatigue. Overt responses are not a requirement for learning verbal materials.

Vanishing cues (in which progressively less additional information is provided to assist the learner in providing the right performance) or prompts (where additional information is provided to assist the learner in providing the appropriate performance) have not been shown to be an essential factor in learning. There is some evidence that

they may be useful in particular tasks. In one study of verbal learning, vanishing cues helped the learner in delayed recall, but not in immediate learning.

Using a programmed instruction format, several studies have involved comparisons of multiple choice answers with constructed answers (i.e., written). Constructed answers have been shown to be superior for learning complex technical terminology, and for criterion tests that use program frames. The constructed answers typically require more learning time. When terminology not previously asked for in constructed responses (such as synonyms) is used in the criterion tests, the multiple choice format has been shown to be superior for large segments of reading material.

The importance of presenting subject matter in a logical sequence has been emphasized by many theoreticians, but, as yet, experimental results have not justified this emphasis. The best guidelines, at present, are suggested by the functional context method of organizing instruction—a sequence which provides a job-oriented atmosphere. The order of presentation goes from "whole" to "part" (as the learner focuses upon the component parts), from concrete to abstract, and from operational to theoretical.

Several studies have involved examining various kinds of interaction between prompting (providing additional information designed to elicit the correct performance) and feedback (providing confirmation or knowledge of results). For simple learning tasks, prompting is generally more efficient for initially exhibiting the desired behavior. Other studies in which prompting and feedback were mixed have achieved best results from a 75% prompting - 25% feedback combination. Some experiments suggest that feedback is superior to prompting for delayed recall and transfer tasks.

Retention of written material has been made more effective by placing questions in the printed text, and providing the answers. Questions appeared to be most effective when placed after passages of moderate length.

Learning and retention have also been helped by the use of introductory material at a high level of abstraction, generality, and inclusiveness. This organizing technique, used before the main material is presented, is assumed to provide the learner with a conceptual framework within which the specific details can be fitted appropriately.

Instructional Device Characteristics

While an instructional device may be eliminated from consideration because it cannot present the desired instructional information type, there are numerous other factors to be considered in choosing among devices that do meet this criterion. Some of these factors are recorded in Table 3 and discussed in the following paragraphs.

Insert Table 3

Motion provides many useful cues, information that may be helpful in attaining a great variety of behavioral goals. Television and motion film generally provide these motion cues most effectively. Also, the overhead projector, with a polarizing wheel, is useful for simulating some types of motion. Motion film is generally most effective for speeding up or slowing down the perception of various phenomena. Simulators often are used to provide a variety of experiences in a short time.

These devices also provide effective magnification and reduction. The need for magnification and reduction lies in emphasizing critical cues.

Either a fixed or a variable sequence for the presentation of material to the learner is usually determined by the software material used. A lecturer is able to vary his sequence but many film devices (except for separate slides) do not provide this flexibility. Simulators and computers can be designed for use with either a fixed or a variable sequence. Emphasis can be shifted by changing a sequence.

Most film devices make it possible to manipulate illustrations. Normally, overlays and disclosures are suited for an overhead projector. Motion films are particularly suited for implosions, superimposures, animation, zoon, and camera angle effects. These techniques have all been shown to improve learner performances under certain conditions.

Cue summation, simultaneously providing two or more types of information, appears to be a powerful (and efficient) strategy in presenting information. While complete duplication of information through two channels (simultaneous written and spoken word) has not been shown to be effective (for good readers), other information types may be combined to improve learning. In general, it is efficient to combine pictures with words that emphasize, point out, interpret, or label significant information. Instructional devices that give information through two channels at once provide opportunities for cue summation, which is generally most effective when the picture is used with the spoken

Table 3

Display Characteristics and Instructional Devices

Instructional Device	Display Represents Motion	Display Speeds Up or Slows Down	Display Magnifies or Reduces	Display Has Fixed or Variable Sequence	Display Manipulations Possible	Level of Display Fidelity	Display Provides Cue Summation	Feedback Possible	Ease of Student Operation of Device	Three-Dimensional Display	Group Size Appropriate	Special Environs Required
1. Live Human												
Lecturer	Low	Low	N/A	V	No	N/A	No	Typically Vicarious	N/A	N/A	Small/Medium/ Large	No
Demonstrator	Low	Low	N/A	Task Specific	No	N/A	Yes	N/A	N/A	N/A	Small/Medium	No
Tutor or Coach	Low	Low	N/A	V	No	N/A	No	Yes	N/A	N/A	Individual	No
2. Recorded Motion or Sound												
Tape Recorder	N/A	Low	N/A	F	No	Varies	No	Not Typical	Medium	N/A	Small/Medium	No
Film Cassette (super 8, silent, color)	High	High	High	F	Yes	Medium	No	Not Typical	High	N/A	Small/Medium	Dark
Film (16mm, sound, color)	High	High	High	F	Yes	High	Yes	Typically Vicarious	Low	N/A	Small/Medium/ Large	Dark
TV (B/W)	High	High	High	F	Yes	Medium	Yes	Typically Vicarious	Low	N/A	Small/Medium/ Large	Screen Access
TV (B/W, record and playback function)	High	Low	Low	F	N/A	Medium	Yes	Yes	Low	N/A	Individual	No
3. Graphic												
Overhead Projector	Medium	Low	High	V	Yes	High	No	Not Typical	N/A	N/A	Small/Medium/ Large	No
Film Strip (silent, color)	Low	N/A	High	F	Yes	High	No	Not Typical	Medium	N/A	Small/Medium/ Large	Dark
Film Slides (35mm, color)	Low	N/A	High	V	Yes	High	No	Not Typical	High	N/A	Small/Medium/ Large	Dark
Blackboard	Low	N/A	Medium	V	Low	Medium	No	Not Typical	N/A	N/A	Small/Medium	No
Book (color plates)	Low	N/A	High	F	Low	High	No	Limited	High	N/A	Individual	No
Printed Handouts	Low	N/A	Medium	F	Low	Low	No	Limited	High	N/A	Individual	No
4. Simulator or Actual Equipment												
Simulator	Varies	Varies/Low	Varies/Low	V/F	Varies	Varies	Possible	Yes	High	Varies	Small	As Specified
Actual Equipment	Varies	Varies/Low	Varies/Low	V/F	Varies	Identity N/A	Possible	Varies	High	Yes	Individual/ Small	As Specified
5. CAI or PI												
Computer (words and numbers)	N/A	N/A	N/A	V/F	No	Low	No	Yes	High	N/A	Individual	Individual Console
PI (including pictures)	Low	N/A	Medium	V/F	Low	High	No	Yes	High	N/A	Individual	No
6. Small Group												
Role Playing	Low	Low	N/A	V	No	N/A	Limited	Limited	N/A	Limited	Small	No
Discussion Group	Low	Low	N/A	V	No	N/A	Limited	Limited	N/A	Limited	Small	No

word (TV and 16mm sound motion picture are two instances). However, many other combinations are possible (e.g., an overhead projector with a lecture, or the filmstrip with a tape recorder).

Fidelity of sight or sound indicates the faithfulness of a reproduction to the original. Film reproduction is superior to available electronic reproduction. However, when a crude pencil sketch story board of a film was compared with a finished color version, no reliable difference in performance resulted. Fidelity may not be a critical factor, although it has been studied extensively in connection with simulators. As long as the essential information or cues are presented, adequate performance (and transfer) is generally possible. Realism appears to have no inherent superiority in providing adequate transfer to job performance. Testing is usually necessary to determine whether training is transferred to performance.

Ease of operation refers to the complexity of using an instructional device by learners. While training practice does not usually provide individualized instruction and thus require student operation, such Army-initiated concepts as the single topic film loop (now mostly on 8mm) are particularly suited to individual learning. Holograms, mock-ups, and some simulators provide 3-D cues. Well-designed film usually gives adequate information for learning most 3-D tasks.

Group size and special conditions are included in the tabulation of characteristics so that the adequacy of facilities for the particular instructional device may be evaluated. In over 200 studies of lectures, no differences have been shown that could be attributed to group size, but one fairly carefully controlled study showed that a small group performed better than a large group (both groups received essentially the same lecture, no questions and no discussion). The significant difference between the groups was attributed to the fact that the smaller group paid closer attention. A TV study in which individuals at home learned better than a classroom group may also be related to this attentiveness factor.

Chapter 6

RECALL OF FACTS

In the remaining chapters of this manual, the factors involved in selecting various types of instructional devices will be discussed in relation to the various groups of learner performances that make up the output portion of the learner model.

The purposes of this chapter are to examine principles related to the recall of facts, to suggest an approach to learning facts, and to relate the use of instructional devices to this approach.

The recall of facts is a learning task suggested by such behavioral objectives as to recall, to recognize, to read (aloud), to identify, to state, to listen, to label, or to discriminate. These are learner performances that imply the formation of an association or set of associations. Receiving adequate information is assumed as a requisite.

Principles Applicable to Recall of Facts

A review of the literature suggests the following five principles:

(1) The task must be defined for the learner in such a way that the appropriate performance may occur.

(2) Frequent repetition (this includes the concept of practice) aids retention.

(3) Organized material is learned more readily than disorganized material. When material does not possess an internal structure, the learner must impose one. One function of frequent repetition is to allow the learner an opportunity to develop a structure if one is needed.

(4) Prompt correction is necessary to prevent fixation of errors by the learner.

(5) Repetition (practice) should be carried on under arrangements in which correct responses are rewarded. It has generally been found that rewards and successes are more effective than punishments or failures in promoting learning.

An Approach to Recall of Facts

A large part of Army training time is invested in meeting behavioral objectives that can be typified as the recall of facts. Typical of such objectives are the learning of nomenclature and the learning of codes or symbols.

Training in the recall of facts may also include facets of what may be called concept acquisition and rule-and-principle learning, when the training program permits reducing these higher-order mental operations to this simpler level. The distinction between training in the recall of facts and the acquisition of concepts is based upon the selected approach rather than any clearcut inherent characteristic of the material.

When job performance requires the same output from all performers after they are provided with the relevant cues or information, the recall-of-facts approach may be used in training. Note, however, that when some higher-order mental operations are taught at this level (as facts), there may be two negative consequences: First, retention is reduced, and therefore more over-learning may be required to ensure adequate performance. Second, transfer to new job performances may be reduced since the learner is not able to deviate greatly from the job conditions for which he was specifically trained.

Three phases are important in fact learning: a meaningful context, an opportunity for practice, and feedback as to the correctness of the answer. These phases may be expressed as conditions:

(1) Instructions that evoke the desired answers (identification, label, name) must be provided.

(2) The learner must be given an opportunity to respond.

(3) Immediate feedback as to whether his answer is right or wrong must be supplied.

A useful approach to implementing these conditions would include:

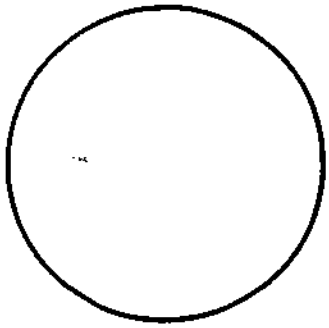
(1) Provide as meaningful a context as possible. Make explicit connections between a new fact and previously learned facts.

(2) If discrimination between items is involved, emphasize the differences between them.

(3) Make use of frequent repetition (practice). Plan for as much overlearning as is needed to ensure adequate performance of the particular job.

CIRCLE

A circle is a closed plane curve such that all of its points are equidistant from a point within called the *center.*



Pictures with labels have advantages over plain word descriptions in teaching nomenclature.

(4) Give the learner immediate feedback so that he knows whether his answer was right or wrong.

Facilitating the Approach

Context meaningfulness may be increased by (a) showing job relevance, (b) showing a relationship to other job information, or (c) relating to previously learned information. Giving the learner some kind of job orientation would supply one type of context. A film or TV demonstration of typical job performances may help provide a meaningful framework; a lecturer (deemed as expert) can provide verbal orientation.

As a fact is introduced, various means can be used to relate it to other facts. For example, use of a job simulation would place the learner within a context which, when the fact (the information) is introduced, would enable him to relate the fact to his own performance. Multi-image displays enable the learner to compare and contrast the related facts (the portrayed objects).

Repetition and immediate feedback are readily provided by such devices as flash-cards, programmed instruction (if it is designed for these purposes), and individual tutoring. Ways to provide over-learning are available with all these instructional devices. "Vicarious practice" means that the learner is provided opportunity to mentally rehearse appropriate answers.

Whether the fact is visual, verbal, auditory, or tactual will enter into the choice of the instructional device. In general, information type and sensory channel input should be matched with the desired information output type and sensory channel. If you want a written work output, use a written word input.

An overview of device capabilities in the teaching of recall of facts is presented in Table 4.

Insert Table 4

Table 4

Instructional Device Capability and Recall of Facts

Instructional Device	Goal Awareness Information	Related Information	Practice	Feedback
1. Live Human				
Lecturer	Yes	Yes	Typically Vicarious	Typically Vicarious
Demonstrator	N/A	Yes	N/A	N/A
Tutor or Coach	Yes	Yes	Yes	Yes
2. Recorded Motion or Sound	Yes	Yes	Typically Vicarious	Typically Vicarious
Tape Recorder				
Film Cassette (super 8, silent, color)				
Film (16mm, sound, color)				
TV (B/W)				
TV (B/W, record and playback function)				
3. Graphic	Yes	Yes	Possible	Possible
Overhead Projector				
Film Strip (silent, color)				
Film Slides (35mm, color)				
Blackboard				
Book (color plates)				
Printed Handouts				
4. Simulator or Actual Equipment	N/A	Yes	Yes	Yes
Simulator				
Actual Equipment				
5. CAI or PI	Yes	Yes	Yes	Yes
Computer (words and numbers)				
PI (including pictures)				
6. Small Group	N/A	Limited	Yes	Yes
Role Playing				
Discussion Group				

Chapter 7

RECALL OF PROCEDURES

The purposes of this chapter are to examine principles related to recall of procedures, to suggest an approach to training in this type of performance, and to relate specific instructional devices to this approach.

Recall of procedures is a learning task suggested by such behavioral objectives as to follow (a checklist), to start (a car), to tie (a knot), to assemble (a rifle), to apply (a given set of operations), to solve (by using a given set of operations).

Principles Applicable to Recall of Procedures

The principles listed as applicable to the recall of facts are applicable to recall of procedures:

(1) The task must be shown to the learner in such a way that the correct behavior may result.

(2) Frequent repetition aids retention.

(3) When material is not structured, the learner must impose a structure. One function of frequent repetition is to enable the learner to organize the material.

(4) Prompt correction is necessary to avoid learning incorrect responses.

(5) Repetition should be conducted under arrangements in which correct responses are rewarded. While there are questions over details, it has generally been found that rewards and successes are more effective than punishments or failures in promoting learning.

An Approach to Recall of Procedures

A significant amount of Army training time is invested in attaining behavioral performances that imply the recall of procedures. In addition to the assembly/disassembly

operations and tasks that require check lists, other possibly higher order behaviors may be included in this approach.

When only a limited number of problem solving or troubleshooting behaviors occur on a job, these performances may be reduced to a procedure which may be followed and possibly recalled. Special empbasis on the recognition of critical job-related cues designed to help a man to select the appropriate predefined and pretrained procedure would then be required with this type of procedure learning.

The two negative results associated with the teaching of concepts, principles, and rules as facts are also associated with the teaching of problem solving or troubleshooting as procedures. If the procedure must be remembered, over-learning will be necessary to compensate for poor retention (note, however, that job aids such as check lists may be used in reducing training time). Transfer to related job performances may also be reduced, in that the training program results in maximum transfer only to the specific job for which it was designed.

The three basic principles involved in procedure recall, stated as conditions, are:

(1) Instructions that evoke the desired responses at the appropriate times during the procedural sequence must be provided.

(2) The learner must have a chance to respond.

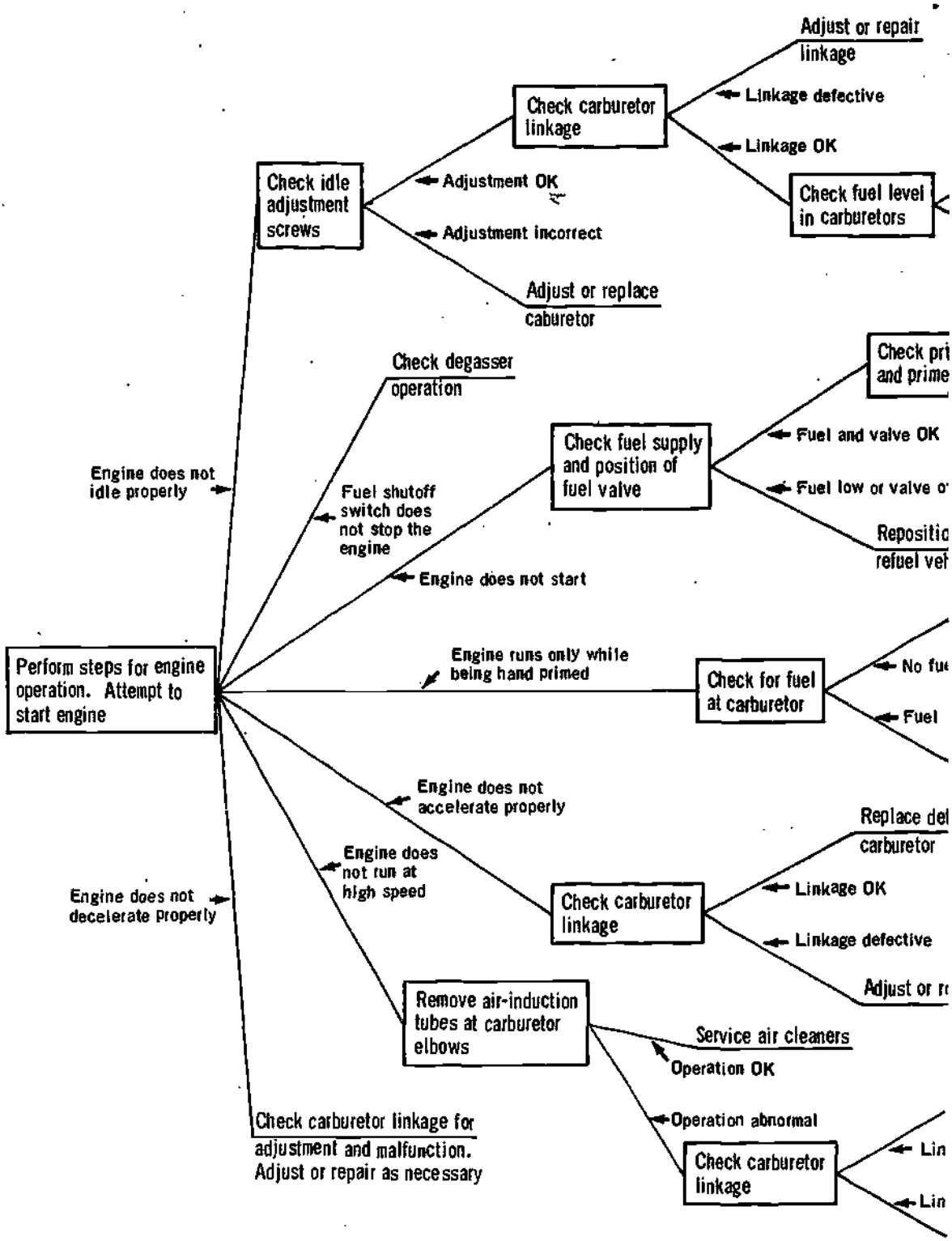
(3) Immediate feedback as to whether or not his answer is right must be available.

A useful approach in implementing these conditions includes:

(1) Provide as meaningful a context as possible. If the procedure is inherently well organized, a whole-task procedure should be used. If the procedure is not inherently well organized and certain portions provide exceptional difficulty, a part-task drill would be useful. When in doubt, use a whole-task procedure first. Make explicit the relations between different procedural steps.

(2) Provide opportunity for practice. Prompting may be quite useful. Provide as much over-learning as required for adequate job performance.

(3) Provide immediate feedback as to correctness of responses to the learner.



A procedure chart reduces trouble-shooting to a specified procedure.

Facilitating the Approach

Meaningfulness of the context may be increased by (a) showing job relevance of the material, (b) showing its relationship to other job information, or (c) relating the material to previously learned information. Giving the learner some kind of job orientation may supply one type of context. A film or TV demonstration of typical job performances may be meaningful; a lecturer (considered as expert) may provide verbal orientation.

The events in the procedural sequence should be related to one another within the context of the entire task. Motion cues are one means of showing such relationships. One recent study showed that motion helps a man learn a procedural sequence; for example, motion cues help in learning to tie knots or to assemble a weapon. Motion also may make the procedure seem more job related and so more meaningful to the learner.

Other studies have shown that procedure learning through film is facilitated by using a 0° camera angle—the camera shows the procedure as the learner would see it during his own performance. This would apply to both still and motion films and to TV.

A simulator (including procedure trainers) may be used to provide both feedback and repetition, as a tutor does. Job performance on the actual equipment, with such training aids as pictorial guides, film loops, and check lists, may be useful when the items in the sequence are so simple that elaborate feedback on performance is not required. However, feedback remains an essential information input.

An overview of device capabilities in the teaching of recall of procedures is shown in Table 5.

Insert Table 5

Table 5

Instructional Device Capability and Recall of Procedures

Instructional Device	Goal Awareness Information	Related Information	Practice	Feedback
1. Live Human				
Lecturer	Yes	Yes	N/A	N/A
Demonstrator	Yes	Yes	N/A	N/A
Tutor or Coach	Yes	Yes	Yes	Yes
2. Recorded Motion or Sound	Yes	Yes	Possible	Possible
Tape Recorder				
Film Cassette (super 8, silent, color)				
Film (16mm, sound, color)				
TV (B/W)				
TV (B/W, record and playback function)				
3. Graphic	Yes	Yes	Possible	Possible
Overhead Projector				
Film Strip (silent, color)				
Film Slides (35mm, color)				
Blackboard				
Book (color plates)				
Printed Handouts				
4. Simulator or Actual Equipment	Yes	Yes	Usually	Usually
Simulator				
Actual Equipment				
5. CAI or PI	Yes	Yes	Displaced	Yes
Computer (words and numbers)				
PI (including pictures)				
6. Small Group	N/A	N/A	N/A	N/A
Role Playing				
Discussion Group				

Chapter 8

ACQUISITION OF DISCRETE MOTOR SKILLS

The purposes of this chapter are to list the principles related to acquiring discrete motor skills, to suggest an approach to acquiring such skills, and to relate the use of instructional devices to this approach.

Acquisition of discrete motor skills is primarily related to gaining an acceptable level of proficiency in performing a complex physical act. Typical verbs describing behavioral outcomes of acquiring discrete motor skills are to hit (a target), to hit (a ball), to hammer (a nail), or to throw (a strike).

Principles Applicable to Discrete Motor Skills

Principles related to the acquisition of discrete motor skills are:

(1) The learner must be made aware of the behavior that he is expected to be able to perform.

(2) A learner's resolve to learn results in improved performance.

(3) Overt action is necessary for acquisition of physical skills. Mental practice also is helpful at some stages.

(4) Over-learning leads to better retention.

(5) Knowledge of results (feedback) is one of the most important variables governing skill acquisition. Improvement must be recognizable to the learner by qualitative or quantitative cues not usually provided at lower levels or early learning stages of performance.

(6) Feedback should be immediate or very nearly so.

(7) A limited amount of reflective discussion and explanation may direct the learner's attention to essential features of the skill, but this discussion must not be too detailed and must immediately be related to his efforts.

(8) Study of a model performance to observe relationships between actions and their results may help, although such insights may be difficult to acquire. It is usually helpful for a learner to make a mental review of essential elements of the performance.

(9) Normal progress enables the learner to change from an initial dependence on external cues to reliance on internal cues.

(10) Aptitudes involved in learning a skill may differ at different stages of mastering the skill.

An Approach to Acquiring Discrete Motor Skills

Discrete motor skills must be developed for tasks which require practice to perform some physical activity. Most individual athletic feats may be classed as discrete motor skills.

The essential factors in acquiring such skills are goal awareness, practice, and feedback. The relevant conditions are:

(1) Availability of an adequate conceptual model of the expected behavior.

(2) Opportunities to practice the response.

(3) Feedback as to relative adequacy of performance.

(4) Suggestions as to modifications that will improve performance.

The recommended approach for acquiring discrete motor skills includes:

(1) Give the learner an awareness of what constitutes the desired goal behavior by presenting a model, or by rewarding him for progressively better approximations of the task (shaping). Unfamiliar behavior can be acquired through imitation of models, through cuing, and through shaping.

(2) Provide the learner with opportunity to practice at an early stage of learning, and continue to provide it.

(3) Give (or let his performance give) immediate or nearly immediate feedback. This should, at first, be a rough guide to performance.

(4) Supply, through a model or through coaching, successively finer discriminations between learner actions and the desired responses. Thoughtful practice is most efficient.

Under fire, a man's life can depend on how well he has learned a new skill in movements

Facilitating the Approach

Normally, an adequate model is a very good way of inducing goal awareness. The model may be live, on film, or on video tape. For most discrete motor skills it should include the clearly shown motions involved in the particular skill. In one instance, showing the skills in slow motion was shown to improve learning. Cuing or shaping may be necessary to provide goal awareness; this would usually require a simulator, but individual coaching also may be used very effectively.

Skill-related information is usually provided to prevent the development of patterns which, in themselves, limit the final level of achievement, although the pattern may provide short-term appearances of improvement. However, it is noteworthy that some ways of learning the skill should be encouraged even if they deviate from the model. Only patterns of action that have been shown as harmful to acquiring the desired level of skill performance should be discouraged.

Feedback, most readily derived from practice, is of critical importance. Individual coaching requirements may be reduced by using film loops or TV playbacks at advanced stages in learning a discrete motor skill. Use of these techniques early in the learning process without expert assistance may slow acquisition of the skill. Mental practice has been shown to be helpful and probably indicates the need for thought and care during practice. Participation must not interfere with receiving the basic information; thus a slow rate of development is generally recommended.

An overview of the use of instructional devices in acquiring discrete motor skills appears in Table 6.

Insert Table 6

Table 6

Instructional Device Capability and Acquisition of Discrete Motor Skills

Instructional Device	Goal Awareness Information	Related Information	Practice	Feedback
1. Live Human				
Lecturer	Limited	Yes	N/A	N/A
Demonstrator	Yes	Yes	N/A	N/A
Tutor or Coach	Yes	Yes	Yes	Yes
2. Recorded Motion or Sound				
Tape Recorder	Yes	Yes	N/A	N/A
Film Cassette (super 8, silent, color)	Yes	Yes	Yes	Vicarious
Film (16mm, sound, color)	Yes	Yes	Typically Vicarious	Typically Vicarious
TV (B/W)	Yes	Yes	Typically Vicarious	Typically Vicarious
TV (B/W, record and playback function)	N/A	N/A	Yes	Yes
3. Graphic	Limited	Yes	Not Typical	Not Typical
Overhead Projector				
Film Strip (silent, color)				
Film Slides (35mm, color)				
Blackboard				
Book (color plates)				
Printed Handouts				
4. Simulator or Actual Equipment	N/A	N/A	Yes	Yes
Simulator				
Actual Equipment				
5. CAI or PI	Limited	Yes	N/A	N/A
Computer (words and numbers)				
PI (including pictures)				
6. Small Group	N/A	N/A	N/A	N/A
Role Playing				
Discussion Group				

Chapter 9

ACQUISITION OF REACTIVE SKILLS

The purposes of this chapter are to list the principles related to acquiring reactive skills, to derive an approach to learning these skills, and to suggest ways in which instructional devices may be used to facilitate this approach. The term "reactive" is used to emphasize the fact that the appropriate response is defined by unpredictable, sequentiall available cues.

The acquisition of reactive skills involves attaining a proficiency level in performing a series of related reactive acts. Typical verbs describing behavioral outcomes of acquisition of reactive skills are to track (a target), to type (a letter), to fly (an airplane), to function adequately (in system team performance).

Principles Applicable to Acquiring Reactive Skills

The principles listed as applicable to the acquisition of discrete motor skills are applicable to reactive skills. Briefly they are:

(1) The learner must develop an awareness of the expected behavior.

(2) A student's intention to learn results in improved performance.

(3) Overt action is necessary for acquiring physical skills (however, mental practice is helpful at some stages).

(4) Over-learning improves retention.

(5) Feedback is one of the most important variables governing acquisition of skills.

(6) Feedback should be immediate or very nearly so.

(7) A limited amount of reflective discussion and explanation may direct the learner's attention to the essential features of the skill, but must not be too detailed and must immediately be related to his efforts.

(8) It usually helps the learner to study a model, to note relationships between actions and their results, although these insights may be difficult to acquire.

(9) Normal progress in learning a skill enables the learner to change from a dependence on external cues to internal cues.

(10) Aptitudes involved in learning a skill may differ at different stages of progress in mastering the skill.

Approach to Acquiring Reactive Skills

Two types of reactive skills are distinguishable, but the same principles apply to both types. "Adjustive reactive" skills (commonly called tracking or adjusting) involve a varying, continuing input display that demands specific nulling responses for appropriate performance; "discrete reactive" skills involve selecting from a set of possible responses (as in typing a letter).

The primary factors involved in acquiring reactive skills appear to be goal awareness, practice, and feedback. The related required conditions are:

(1) Availability to the learner of an adequate conceptual model of the expected behavior.

(2) An opportunity to practice behaviors in sequence (or within task context).

(3) Feedback resulting from practice.

(4) Suggestions that will improve the performance.

The recommended approach would, therefore, be to:

(1) Give the learner an awareness of what constitutes the desired goal behavior by presenting a model, cuing, or shaping. Unfamiliar behavior can be acquired through imitation of models, through cuing, and through shaping.

(2) Provide the learner with an opportunity to practice at an early stage of learning, and continue to provide it. Demand thoughtful practice; do not permit patterns detrimental to overall performance to stabilize.

(3) Insure the acquisition of the discrete motor skills that may be components of the reactive skill. Focus attention on behaviors that are difficult to perform, maintaining the overall context whenever possible.

Gestural signs here form part of a reactive skill type of performance.

(4) Provide feedback in the performance of sub-elements. Do not focus on errors, but rather emphasize the positive aspects of the performance.

Facilitating the Approach

Reactive skills—either discrete (such as typing) or adjustive (such as tracking)—demand the acquisition of appropriate quantitative or qualitative responses. A visual model such as provided by film or TV may help give the learner an awareness of the desired performance. Cuing or shaping may often be necessary in giving the learner this awareness and may come from coaching on the actual equipment or a simulator.

Related information is useful in preventing the development of patterns that limit performance at higher levels. An example would be discouraging the use of a hunt-and-peck typing system.

Feedback is extremely important, and thus the most effective instructional devices must provide this capability. Simulators (or the relevant equipment) would most readily facilitate this approach.

An overview of instructional devices in relation to reactive skills appears in Table 7. Many of the reactive skills have been extensively studied, so that many critical factors in acquiring certain skills have been isolated. The training developer is advised to search out the studies involving the particular reactive skill with which he is concerned, to get information on the effects of task-dependent variables.

Insert Table 7

Table 7

Instructional Device Capability and Acquisition of Reactive Skills

Instructional Device	Goal Awareness Information	Related Information	Practice	Feedback
1. Live Human				
Lecturer	Limited	Yes	N/A	N/A
Demonstrator	Yes	Yes	N/A	N/A
Tutor or Coach	Yes	Yes	Yes	Yes
2. Recorded Motion or Sound				
Tape Recorder	Limited	Yes	N/A	N/A
Film Cassette (super 8, silent, color)	Yes	Yes	Vicarious	Vicarious
Film (16mm, sound, color)	Yes	Yes	Vicarious	Vicarious
TV (B/W)	Yes	Yes	Vicarious	Vicarious
TV (B/W, record and playback function)	N/A	N/A	Vicarious	Yes
3. Graphic	Limited	Yes	Not Typical	Not Typical
Overhead Projector				
Film Strip (silent, color)				
Film Slides (35mm, color)				
Blackboard				
Book (color plates)				
Printed Handouts				
4. Simulator or Actual Equipment	N/A	N/A	Yes	Yes
Simulator				
Actual Equipment				
5. CAI or PI	Limited	Yes	N/A	N/A
Computer (words and number				
PI (including pictures)				
6. Small Group	N/A	N/A	N/A	N/A
Role Playing				
Discussion Group				

Chapter 10

USE OF CONCEPTS: CONCEPT ACQUISITION

The purposes of this chapter are to list the principles pertaining to the use of concepts, to recommend an approach to achieving learner performances which use these new concepts, and to relate the use of instructional devices to the recommended approach. The following chapter will continue the discussion of concepts, as used in problem solving.

Learning to use concepts is a task suggested by such goals of performance as to solve (a problem), to state (a concept), to apply (a principle), to generate (a rule), to write (a staff study), or to identify (the interpretation of a signal in operating ground surveillance radar equipment). Performance goals which are called understanding also are included in concept using.

This type of learning involves two operations: analyzing (or differentiating) the elements and the relations between them, and synthesizing (or integrating) the elements and relations. The relative emphasis on each of these operations depends on the task. Stated in another way: Concept using involves gaining new information (or redefining previously available information), transforming or manipulating this information to make it fit a new task, and evaluating (or checking) to see whether the manipulation enables the learner to perform the task. Concept acquisition represents th lower level of concept-using learner performances.

Principles Applicable to Concept Using

The relevant principles are:

(1) Adequate performance depends on how fully aware the learner is of the goal. His ability to achieve various levels of goal awareness controls his performance.

(2) Selecting the relevant information is essential for task performance. Structuring and presenting a concept or learning problem so as to emphasize the essential features will help learning.

(3) To learn structure is to learn how various aspects of a concept or problem are related. To understand is to grasp the structure of a subject to such a degree that other concepts may be meaningfully related to it. Learning should be meaningful to the learner in terms of his specific goals, interests, previous knowledge, or intended application.

(4) The learner's responses are modified by feedback.

(5) Aptitudes involved in learning a task may differ at different stages of task achievement.

(6) Time spent in learning rules may increase the learner's likelihood of applying what he has learned to a new situation (more so than time spent in learning facts).

(7) Generalization and differentiation (or analysis and synthesis) of what is being learned suggest the importance of practice under varying conditions with corrective feedback.

Primary Conditions for Concept Using

Two approaches for applying the above principles will be related to concept using, for the mental operations involved in concept using are complex and diverse. The two approaches, representing two levels of complexity, will be termed the acquisition of concepts and problem solving (discussed in the next chapter). The factors involved in the use of concepts seem to be goal awareness, availability of relevant information, practice, and feedback. Conditions related to these factors are:

(1) Awareness by the learner of the desired performance.

(2) Meaningfulness of the goal (and the learning) to the learner in terms of his own goals, interests, previous knowledge, or intended application.

(3) Availability of the relevant information.

(4) Practice and feedback under varying conditions.

Approach to Concept Acquisition

Concepts are ideas that provide useful groupings of kinds of human experiences. As they develop in a learner, concepts generally move from concrete to abstract, from vague to clear, and from inexact to definite. Some children, for example, may for a time call all animals "dog." Concepts gradually change in their implications, relationships, ramifications, and transferability over a period of time. Since the development of a concept results from the learner's experience, concepts vary greatly in what they mean to different learners.

A useful approach to concept acquisition is presented under two sets of factors.

(1) Goal awareness and relevant information

This aspect of the approach involves the following:

(a) Describe the performance expected of the learner after he has learned the concept. Therefore, the operational level of concept acquisition needed for satisfactory job performance must be determined beforehand.

(b) Reduce the number of features to be learned in acquiring complex concepts. Stress the features important for acquisition of the concept.

(c) Give the learner an opportunity to perceive the relations between the concept to be learned and other concepts. The order in which the concepts are to be learned should be determined beforehand so that the learner may observe and use such relationships.

(d) Provide positive and negative examples of the concept. Negative instances are not efficiently used by most learners, but they play an important part in learning.

(3) Present examples of related concepts together, or nearly so, and show how they differ. This enables the learner to make finer discriminations between related concepts.

Correct concept formation partly depends on the diversity of materials used. The greater the variety of concrete information provided, the more easily and correctly the process of concept formation will proceed. The learner needs experience in order to acquire the concepts. Information should be introduced to enable him to extend the meaning of the concept under study (from his previously limited understanding), and

Concept using may involve concepts, principles, and laws

should deal with irrelevant characteristics of the informational display (this helps to stress the essential characteristics that the learner should abstract).

The learner can be aided in differentiating by showing together similar concepts, for instance, the concept of "tactics" and the concept of "strategy." Such comparison of related concepts makes differentiation more precise. The learner should also establish connections between related concepts, as they must be organized in his own understanding. When concepts are structurally related—for example, in a hierarchical structure where certain concepts can be learned only when other concepts are already known—learning is helped by using the implied structural sequence.

(2) Practice and feedback

This aspect of the approach involves the following:

(a) Present a new positive example of the concept and ask the learner to identify it.

(b) Verify the level of the learner's comprehension of the concept.

(c) Have the student verbally define the concept.

(d) Provide opportunities for student response and feedback to him.

The instructor analyzes the learner's mistakes and asks him to repeat the operation. The learner needs to state verbally what is essential and what is not. He should stress the essential features of the concept if he will be required to use it in performing his job.

The instructor has to identify the stage or level of meaning the learner has attained, then use this information as a basis for helping the learner find and take the next step forward. Guidance is the primary ingredient in the feedback the learner requires. The greatest benefit from feedback is derived when the learner is given time enough to integrate the new information before moving on to the next phase of learning. When the learner is just beginning to comprehend the dimensions of a concept, misleading feedback information confuses him and delays concept acquisition. A concept erroneously learned is difficult to relearn correctly.

Facilitating the Approach to Concept Acquisition

When a learner is made aware of what constitutes the objective of an instructional segment, through verbal descriptions and statements of minimum performance

requirements, he is enabled to evaluate, abstract, and relate what to him are the most important elements of the information presented. He reorganizes, in his own terms, the information presented to him. He then is able to direct his efforts more efficiently to achieving the appropriate performance, and has an adequate basis for noting his own progress and difficulties and seeking appropriate guidance. An instructor or tutor, PI booklet, or CAI program can effectively provide the required goal awareness.

Concepts are acquired through a variety of experiences; one study indicated six or seven as an optimal number of instances. The present approach suggests providing the learner with a wide variety of experiences in which the concept is appropriate (emphasizing the important features of the concept), and differentiating it from related concepts.

Multi-image displays often create an opportunity to compare and contrast visual information. Film and electronic instructional devices, such as the overhead projector, filmstrip, 8mm film loop, TV, CAI, 16mm sound film, and possibly some simulators can provide the recommended wide variety of experiences in a relatively short time.

Guided practice has been shown to be useful, but the need for learner responses and for feedback (in guidance or correction) of his responses would suggest a tutorial need (live, CAI, or PI). Programing of both the entry level (of personnel to be trained) and the output level of concept acquisition for performance of the job requires a training manager's careful attention. The training manager needs to program a series of vicarious experiences for the learner and give him guidance in his acquisition of essential concepts.

An overview of instructional devices in relation to concept acquisition factors appears in Table 8.

Insert Table 8

Four perceptual principles are related to concept acquisition:

(1) If a concept is basically spatial, like mountain, or mile, or cube, or anatomy, or leaf shape, then the eye is an effective sensory channel. Also, vision is appropriate when it is desirable to maintain a message in the learner's perceptual field for some time. Auditory sensations fade rapidly and must be presented again and again if the learner is to examine their interrelationships.

(2) If a concept is temporal, like rhythm, frequency, music or speech, the ear is an effective sensory channel.

Table 8

Instructional Device Capability and Acquisition of Concepts

Instructional Device	Goal Awareness Information	Related Information	Practice	Feedback
1. Live Human				
Lecturer	Yes	Yes	Typically Vicarious	Typically Vicarious
Demonstrator	Yes	Yes	N/A	N/A
Tutor or Coach	Yes	Yes	Yes	Yes
2. Recorded Motion or Sound	Yes	Yes	Typically Vicarious	Typically Vicarious
Tape Recorder				
Film Cassette (super 8, silent, color)				
Film (16mm, sound, color)				
TV (B/W)				
TV (B/W, record and playback function)				
3. Graphic	Yes	Yes	Possible	Possible
Overhead Projector				
Film Strip (silent, color)				
Film Slides (35mm, color)				
Blackboard				
Book (color plates)				
Printed Handouts				
4. Simulator or Actual Equipment	N/A	N/A	Yes	Yes
Simulator				
Actual Equipment				
5. CAI or PI	Yes	Yes	Yes	Yes
Computer (words and numbers)				
PI (including pictures)				
6. Small Group	Yes	Limited	Yes	Yes
Role Playing				
Discussion Group				

(3) If a concept involves both time and space, such as speed, or plant growth, or life cycles, or erosion, or city growth, or earth orbit, or the westward movement, then both eye and ear can be used as sensory channels. Words would be used in marking, describing, or calling attention to the visible changes.

(4) In general, the sensory channel used in testing the learner's achievement should be the one employed during instruction and practice.

Chapter 11

USE OF CONCEPTS: PROBLEM SOLVING

The purposes of this chapter are to recommend an approach to achieving complex concept-using learner performances as exemplified by problem solving, and to relate the use of instructional devices to the recommended approach.

In learner performances, concept acquisition represents a less complex level of concept using than problem solving. As previously stated, concept using involves gaining new information (or redefining previously available information), transforming or manipulating this information to make it fit a new task, and evaluating or checking to see whether the manipulation enables the performance of the task.

The principles and conditions for achieving concept-using performances are the same for both concept acquisition and problem solving; the distinction lies in the level of complexity of learner performance. The preceding chapter lists the principles and conditions for acquiring concept-using learner performances.

Approach to Problem Solving

Problem solving clarifies perplexing situations. The process involves restructuring the elements (or complexes of elements) of the problem, and applying previously learned rules or generalizations to generate a solution. To solve a problem, the elements (or complexes of elements) of the problem must be derived through analysis (differentiation) and synthesized (integration); that is, the right pieces must be selected and put together correctly.

Solving problems *whose structure is familiar* involves learner activity basically different from that used in solving problems whose structure is new to the learner. In solving problems of a familiar type, the learner comes to recognize common relationships

between elements as he isolates them in the problem situation. These relations, identified during his analysis, are repeatedly connected by a particular set of operations (a "rule") and these connections help him find the solution. The solution of problems whose structure is familiar rests, therefore, on *remaking* necessary associations or connections. The appropriate rule is determined and applied. In a training program a family of familiar problems, if limited in number in job performance, may be reduced to learning a specific procedure. This procedure *can* have adverse consequences, as noted in the chapter dealing with the learning of procedures.

Solving problems *whose structure is new* to the learner presupposes the formation of new connections or associations following precise anticipatory analysis. New associations arise on the basis of those formed previously. The learner's analysis may involve observing old connections through which new connections can be established. At first, the facts of a new problem may seem to the learner quite disconnected. To find the relationship between these new facts, concepts, or principles and a solution, the learner has to select a number of intermediate complexes of elements and analyze them. This analysis covers the elements, the result sought, and the potentially useful connections or relations between the elements. The purpose of the analysis of relationships is to enable the learner to discover other relations or connections between them which may lead to the problem solution.

Only problem solving operations that lead toward the solution (i.e., synthesis on the basis of analysis) are productive. When problem solving efforts do not lead to the answer, the learner is making an inadequate analysis of the elements or relations within the problem. When he selects the wrong combinations of elements or omits some critical elements, the learner's perception of the content of the problem has been distorted.

Analysis is never isolated from synthesis. The learner makes connections or associations between the elements he separates in the anticipatory analysis. The selection by the learner of certain complexes of information presupposes a future combination of these complexes. The basis for synthesis is established during anticipatory analysis, and synthesis is accomplished when the analysis is developed sufficiently. The new fact, concept, or principle (derived by the learner's synthesis) is subjected to analysis, establishing a new connection between it and the information already known. Consequently, dissociating analysis and synthesis in learning to solve problems is not useful.

It often happens that a learner cannot solve a problem because he is unable to use what he knows. Effective use of the necessary knowledge calls for special concentration on the problem itself—on analyzing it, finding the elements, facts, or rules that are appropriate.

As noted, the analytic-synthetic activity required of the learner for problem solving is complex. To solve simple problems, a learner needs, first, to divide the problem into parts; second, to subject these parts to special examination, tentatively related to a possible answer (examining the given facts and some of the possible relations between them); and finally, to synthesize the parts into the answer as he finds the relations between the given information and the answer. To solve composite problems, the learner must divide the given information into a number of simple problems, then select the combination of the given information which will lead him to the overall solution (i.e., synthesis on the basis of tentative analysis).

Several techniques of problem solving strategies have been isolated:

(1) Concretization—The learner gives a problem posed in abstract form a concrete meaning and solves it with the aid of specific mental images.

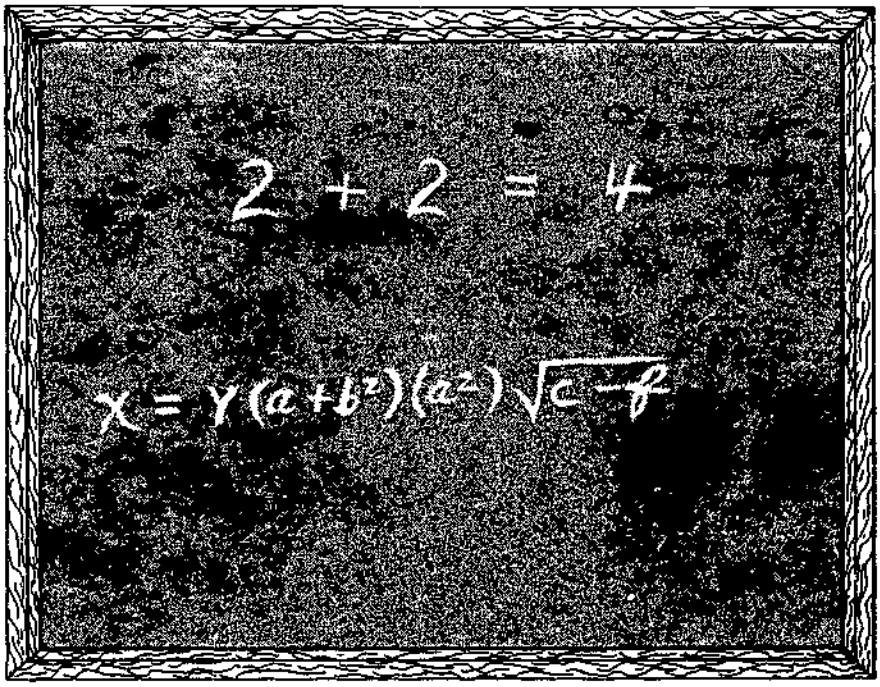
(2) Abstraction—The learner avoids the specific details of the problem and expresses the problem content in more abstract concepts (such as mathematical symbols) which may clearly show the connections between the various elements.

(3) Graphic analysis—The learner tries to portray the relations between facts, concepts, or principles in conventional forms (rectangles, straight lines, circles, Venn diagrams) and thus find the necessary relations.

(4) Modification—The learner modifies the problem by excluding certain facts and when interpreting the impact of these changes, finds the way to solve the problem.

(5) Analogy—The learner creates a simpler, similar problem.

(6) Analytic Questions—The learner's attention is directed by analytic questions to analysis of the facts, concepts, or principles, and the connections between the various elements. These questions help the learner to isolate the important connections and major elements of the problem, and to concentrate attention on these elements and their connections.



Use of mathematics plays a major part in some types of problem solving.

Guidance of the learner for a particular problem solving task may be helped by the following approach:

(1) Goal Awareness and related information factors

(a) Provide the learner with an awareness of the final performance which constitutes the solution of the problem. Help the learner to formulate the problem clearly, and see that he keeps the relevant information and goal continuously in mind.

(b) Assess the learner's present knowledge of facts, concepts, and principles needed to solve the problem. (It is not always feasible to try to supply learners with all the meanings and understandings that could be useful in solving the problem. Such information must be carefully developed through a wide variety of experiences.) There is reason to believe that the meanings and understandings most useful in problem solving are those that have been acquired by problem solving.

(c) Have the learner recall relevant facts, concepts, and principles. Teaching should start with techniques the learner already uses proficiently and should help him adopt and use more and more adequate approaches to problem solving. (Skill in problem solving is partly a matter of technique and partly a matter of meanings and understandings. Highly formal and abstract techniques should never be imposed on the learner, but should be viewed as the end-products of his development.)

(d) Verbally direct the learner's thinking, short of giving him the solution to the problem, by:

1 Encouraging him to make many suggestions, having him analyze the problem orally, recall similar cases and the rules or principles which applied, and then select a strategy.

2 Getting him to evaluate each suggestion (suspending judgment), anticipating objections and consequences, and verifying the conclusions by appeal to known facts, simple experiments, logic, or other valid authorities.

3 Having the learner organize the process of problem solution by making outlines, using diagrams and graphs, taking stock from time to time, and formulating statements of the implications of results of his activity.

(2) Practice and feedback factors

(a) Verify the learner's progress by requiring him to solve a problem (using other problems of the same type). The experience most valuable for solving problems is organized experience. This means that, to the limits desirable and possible, he would summarize the problem, state the solution, and generalize the successful approach to other similar problems.

(b) To be most fruitful, practice in problem solving should consist not in solving the same problems repeatedly with the same techniques, but in *solving different problems by the same technique* and in *applying different techniques to the same problems*. Tests of problem solving are whether the method or rule is or is not retained, and whether it can be employed subsequently in solving similar problems.

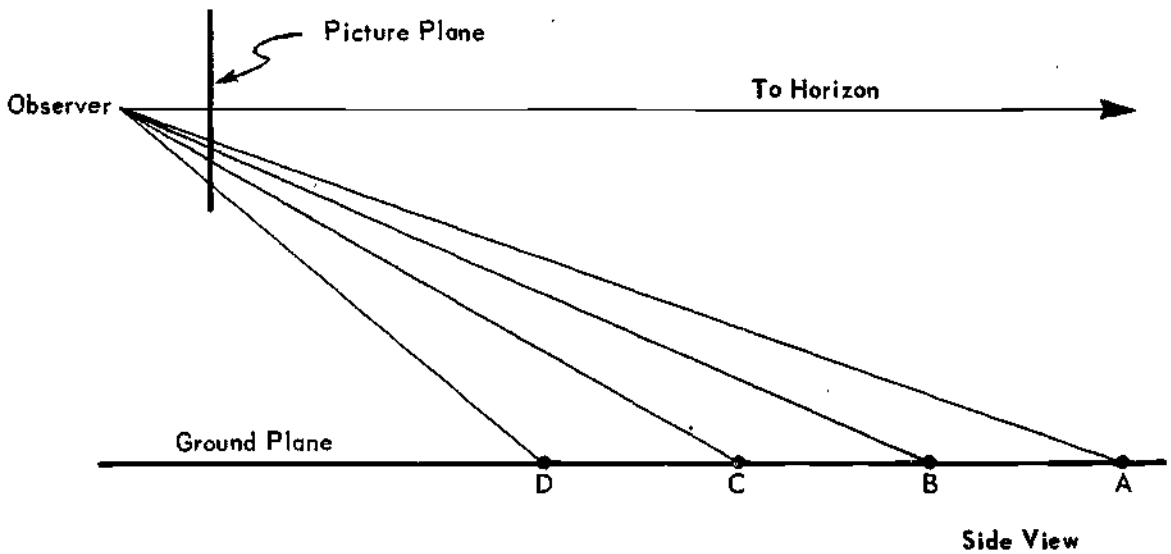
(c) Mistakes the learner makes when he is really trying to solve problems should not be corrected by giving him the solution. Mistakes in problem solving are corrected only when the weakness in technique has been exposed and replaced by a sounder attack, or when the needed meaning or understanding has been developed, or both. Instead of being protected from mistakes, the learner should be permitted to make them, and then encouraged to find and to show what is wrong, and why.

Facilitating the Approach to Problem Solving

The teaching of problem solving may have either of two primary goals—teaching *methods* or obtaining *results* (solutions). Mastery of problem solving demands the learner independently repeat his learned behavior with new material (or elements) to get a new (i.e., not previously learned) result, answer, or conclusion.

Teaching goal awareness usually involves words directing the learner's attention to the appropriate elements or factors. Clear indication of what behavior constitutes an adequate performance is also important. Placing the training effort within a job-like context would assist in providing goal awareness, as would verbal guidance by PI booklet, CAI program, instructor, or tutor.

An emphasis on *method* could (after the instructor is sure of the learner's awareness of the desired performance and of his retention of necessary facts, concepts, and principles) use a guided-discovery technique, applying various possible problem solving



Side View

Problem solving can take many forms, use many techniques.

techniques. Often a translation of the problem into visual signs (as suggested in the techniques) assists in problem solving. Use of visual aids may then be useful in providing related information.

Feedback would be provided the learners during their analyses, during association of the problem with similar problems, and during evaluation of specific strategies (not demanding a specific solution). Preferred instructional devices may consist of simulation and individual coaching. Small group methods may also be used, particularly in examining and evaluating alternative ways of solving problems.

When only a limited number of specifiable problems will be encountered on the job, learning to solve problems may be reduced to learning a procedure and the use of the relevant principles for that type of learning.

This manual, for example, provides a step in the reduction of the "problem" of lesson planning to a procedure. The training need would be to provide wide experience in recognizing the particular cues which suggest a specific procedure. This would be accomplished by exposing the learner to relevant cues and providing feedback as to correctness of the procedures he selects. Small group methods provide an opportunity for shared experience Simulation also would provide feedback.

An overview of use of instructional devices in relation to the teaching of problem solving is given in Table 9.

Insert Table 9

Table 9

Instructional Device Capability and Problem Solving

Instructional Device	Goal Awareness Information	Related Information	Practice	Feedback
1. Live Human				
Lecturer	Yes	Yes	Typically Vicarious	Typically Vicarious
Demonstrator	Yes	Yes	N/A	N/A
Tutor or Coach	Yes	Yes	Yes	Yes
2. Recorded Motion or Sound	Yes	Yes	Typically Vicarious	Typically Vicarious
Tape Recorder				
Film Cassette (super 8, silent, color)				
Film (16mm, sound, color)				
TV (B/W)				
TV (B/W, record and playback function)				
3. Graphic	Yes	Yes	Possible	Possible
Overhead Projector				
Film Strip (silent, color)				
Film Slides (35mm, color)				
Blackboard				
Book (color plates)				
Printed Handouts				
4. Simulator or Actual Equipment	N/A	N/A	Yes	Yes
Simulator				
Actual Equipment				
5. CAI or PI	Yes	Yes	Yes	Yes
Computer (words and numbers)				
PI (including pictures)				
6. Small Group	Limited	Limited	Yes	Yes
Role Playing				
Discussion Group				

Chapter 12

REACTIVE DECISION MAKING

The purposes of this chapter are to list principles related to reactive decision making, to suggest approaches for this type of learning, and to consider instructional devices useful in facilitating this approach.

Reactive decision making is described by such behavioral objectives as to troubleshoot (a radio), to react to a tactical situation (with appropriate orders in a battle). This type of learning may be seen as a complex form of problem solving.

Principles Related to Reactive Decision Making

There are several classes of reactive decision making: making a choice with alternatives specified, with alternatives unspecified, and with alternatives unknown. Troubleshooting is a specific reactive decision making task which is best performed through a series of decisions with specifiable alternatives (if not in fact specified).

The general principles that apply in using concepts also apply in reactive decision making:

(1) The adequacy of the learner's response depends on the adequacy of his goal awareness.

(2) The learner must select the information needed to perform the task. Structuring and presenting a problem to emphasize its essential features will help learning.

(3) To learn structure is to learn how various aspects of a concept, rule, or principle are related. To understand is to grasp the structure of a concept to such a degree that other concepts may be meaningfully related to it. Learning should be meaningful to the learner in terms of his goals, interests, previous knowledge, or anticipated application.

(4) The learner's responses are modified by feedback.

(5) Aptitudes involved in learning a task may differ at different stages of learning.

(6) Time spent in learning rules may increase the likelihood of the learner applying what he has learned to a new situation (more so than time spent in learning facts).

(7) The need to be able to generalize (synthesis) and to differentiate (analysis) suggests the importance of practice under varying conditions with corrective feedback.

(8) As information load on the person increases, perception narrows in scope. Increasing the information load first increases, then decreases, the effectiveness of communication in a complex network. There is an optimal level of information input for the individual making reactive decisions.

Approach to Reactive Decision Making

When the learner must make decisions, either in a changing environment or on the basis of the results of previous performed actions, the activity is termed reactive decision making. It includes such performances as troubleshooting and combat command decisions.

The factors that pertain to learning reactive decision making are goal awareness, availability of relevant information, practice, and feedback. The conditions related to these factors are:

(1) Awareness by the learner of the desired performance.

(2) Meaningfulness of the goal (and the learning) to the learner in terms of his own goals, interests, previous knowledge, or intended application.

(3) Availability of relevant information.

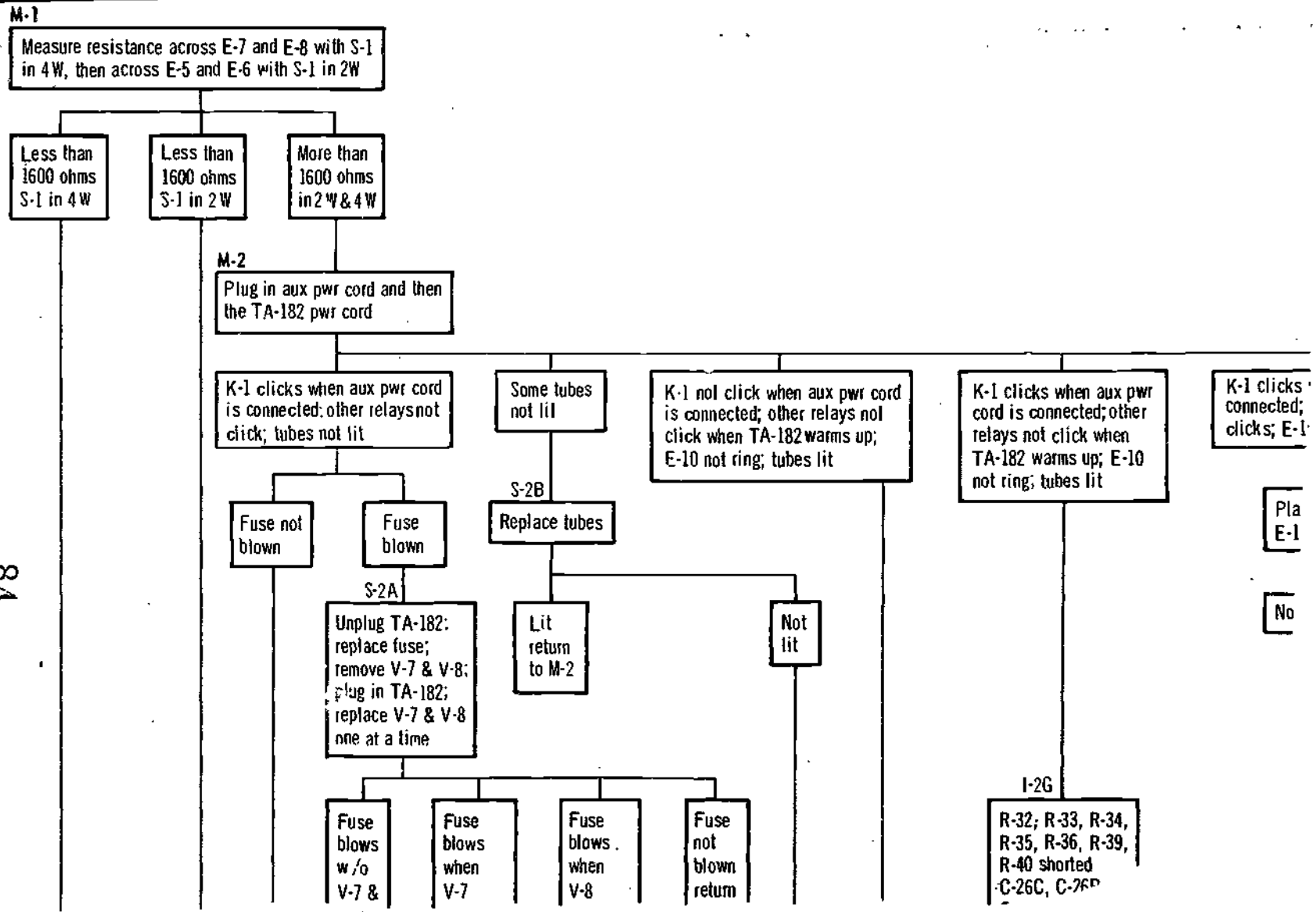
(4) Practice and feedback under varying conditions.

One approach would be to:

(1) Make the learner aware of the performance required and of the ways in which prior decisions are related to this performance.

(2) Have the learner recall the relevant concepts and principles.

(3) Provide practice and feedback used as guidance. Organized experience provides the framework for successful performance. After a performance the components of the reactive decision making process should be analyzed.



Complex troubleshooting behaviors may be partly proceduralized and partly reactive decision making.

Note the similarities between reactive decision making and problem solving and refer to the previous discussion of problem solving.

Facilitating Reactive Decision Making

Goal awareness is critical for reactive decision making, as often the decisions may only be able to provide successive approximation to the desired goal. Clear understanding and awareness of the desired goal is essential. This awareness may be provided by verbal or pictorial descriptions and a statement of minimal performance requirements. A CAI program, PI booklet, instructor, or tutor may provide this goal awareness.

Since reactive decision making often consists in selecting relevant information from a much larger body of information, the learner needs to generate guidelines as to what kinds of information will be important. The learner develops efficient strategies through a wide variety of experiences in actually making decisions. Games and other forms of simulation can provide an environment for making practice in reactive decisions; organized experience provides the framework for subsequent successful performance. Analysis of the critical components of the reactive decision making process should follow a practice session.

Factors in problem solving which were discussed in Chapter 11 are also useful in examining the training of reactive decision making and should be reviewed. Preferred instructional devices are small group methods and simulation games which provide either vicarious or condensed experience. Feedback is critical in training for this behavior.

When the task can be reduced to the learning of procedures, the problem becomes that of selecting correct procedures. Simulation or coaching provides an appropriate feedback for this type of training. Simulation is also an excellent means of providing the learner with the numerous experiences necessary for decision making proficiency in a great variety of situations in a short time.

An overview on use of various instructional devices for training in reactive decision making appears in Table 10.

Table 10 here

Table 10

Instructional Device Capability and Interactive Decision Making

Instructional Device	Goal Awareness Information	Related Information	Practice	Feedback
1. Live Human				
Lecturer	Yes	Yes	Typically Vicarious	Typically Vicarious
Demonstrator	Yes	Yes	N/A	N/A
Tutor or Coach	Yes	Yes	Yes	Yes
2. Recorded Motion or Sound	Yes	Yes	Typically Vicarious	Typically Vicarious
Tape Recorder				
Film Cassette (super 8, silent, color)				
Film (16mm, sound, color)				
TV (B/W)				
TV (B/W, record and playback function)				
3. Graphic	Yes	Yes	Possible	Possible
Overhead Projector				
Film Strip (silent, color)				
Film Slides (35mm, color)				
Blackboard				
Book (color plates)				
Printed Handouts				
4. Simulator or Actual Equipment	N/A	Yes	Yes	Yes
Simulator				
Actual Equipment				
5. CAI or PI	Yes	Yes	Yes	Yes
Computer (words and numbers)				
PI (including pictures)				
6. Small Group	Limited	Limited	Yes	Yes
Role Playing				
Discussion Group				

Chapter 13

PUTTING ATTITUDES INTO PRACTICE

The purposes of this chapter are to list principles related to the development of attitudes, to suggest an approach toward putting attitudes into practice, and to relate appropriate instructional devices to this approach.

Putting attitudes into practice usually is not defined as a single performance, but rather as groups of related behaviors such as are exemplified by job safety (in maintenance personnel), sanitary practices (in food service personnel), and other behaviors such as reliability or responsibility. The content of this group of objectives is the set of behaviors from which we infer the holding of a specifiable attitude, which remains loosely specified because the particular behaviors are frequently too numerous for listing.

Principles Related to Attitude Change

Some principles related to attitude change are:

(1) The learner's attitudes affect what he perceives and applies selectively.

(2) Attitude change is promoted by inducing a behavioral commitment. Under some conditions, actively role-playing a previously unacceptable behavior increases its acceptability.

(3) Easy persuasion of a learner is generally related to a low self-esteem. Such a person may be equally easily persuaded to reaccept his original position.

(4) Group norms and peer attitudes exert a powerful effect on attitudes and behavior. A communicator's effectiveness is increased if he initially expresses some views that are also held by the audience.

(5) A learner's belief in the integrity or knowledgeability of the information source plays an important part in his attitude toward a message. The initial positive attitude, however, does not necessarily persist over time.

(6) A communication may evoke a "boomerang" effect on attitudes, strengthening the reverse of the attitude intended by the communicator. If the audience feels that a communication has a manipulative intent, their resistance is increased.

(7) Typically, attitudes result from the learner's cumulative experience, rather than from any single message.

(8) The greatest attitude change usually results when explicit conclusions are drawn from a message.

(9) Attitudes expressed as opinions may be changed by use of rewards. These changes, however, are primarily related to a rational component of attitude, and may not persist.

(10) Permanent changes in attitude require permanent changes in the individual. The person's reason for holding an attitude must often be changed before the attitude can be changed.

(11) Behavior patterns are often acquired by imitation.

(12) The more extreme the requested change in behavior, the greater the actual change that is likely to occur.

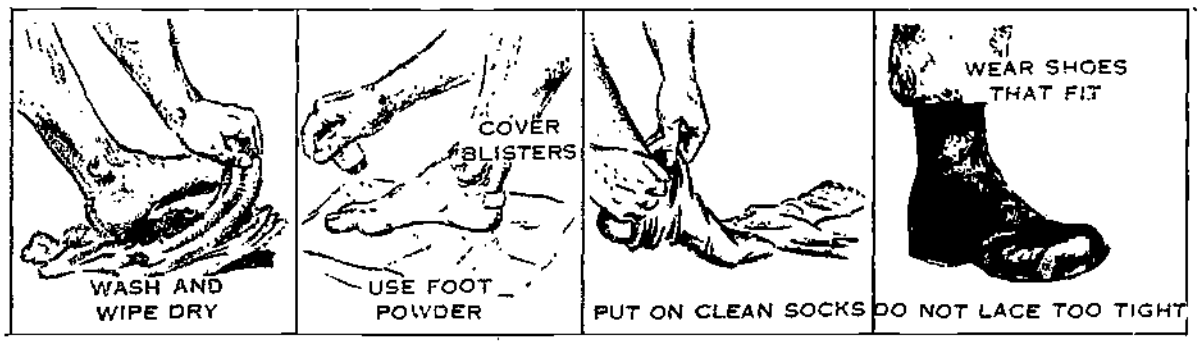
Approach for Putting Attitudes Into Practice

Attitudes are generally regarded as a disposition to act in certain consistent patterns which are learned rather than innate. An efficient way of changing many specific behaviors sometimes may be to change one or two underlying attitudes. The training developer must ask himself several questions, such as: How specific is the desired attitude change? How long must the attitude change last? Who or how many people are involved? What is the behavioral expression of the attitude change? Attitudes are difficult to modify, and ethical issues can readily be seen. The training developer is dealing with human beings whose integrity must be protected.

The conditions for putting attitudes into practice include:

(1) Availability of models showing the desired behaviors.

(2) An opportunity for the individual to make a behavioral commitment (such as a public statement of an attitude) to actions or opinions normally seen as an expression of the desirable attitude.



Men need not only to learn health safeguards but to put them into practice.

(3) Avallability of positive factual information related to the specific attitude.

(4) Rewarding and supporting the behaviors which indicate that the desired attitude is being put into practice.

The suggested approach for helping individuals put particular attitudes into practice includes:

(1) Providing appropriate prestige models of desired behaviors.

(2) Providing information pertaining to the desired behaviors, drawing explicit conclusions about the desirability of an opinion or action.

(3) Inducing a behavioral commitment by the learner of an opinion or action.

(4) Rewarding desired behaviors.

Helping Put Attitudes into Practice

In trying to put particular attitudes into practice, goal awareness may often be very difficult to provide. The working environment must provide continual support to behaviors representing the preferred attitude. In some cases, providing such support is a command function rather than a training function.

The difficulties are illustrated by one study in which inexperienced drivers exposed to driving safety films initially practiced the behaviors shown in the film, but their behavior changed as they encountered common road practices that did not conform with practices shown in the film. Models of desired behaviors can be provided by television, motion pictures, and live examples. If the attempt to modify attitudes is obvious, however, it may have the opposite effect.

To put new attitudes into practice the person must be changed, and should desire the change himself. Factual information, supportive of the desired attitude, should be available and the person should see the positive values (and rewards) of the actions attributed to the particular attitude. Dramatic appeals using film or TV (where identification with the proponent of the attitude is facilitated) may be helpful. Positive vicarious experience will help provide a responsiveness to change. However, the vicarious identification with the proponent of an attitude will not persist unless some individual need is met.

Some behaviors, such as in hygiene, may be enumerated and demanded: however, they may not persist when the coercive force is removed unless the new patterns of behavior have become habitual. The learner also must realize that the desired behaviors are to his advantage or they will not persist.

Role playing and other small group methods provide opportunities for learners to make a desired behavioral commitment, directly or vicariously, an action that may help change attitudes. Standing up before others and saying, "I believe . . . ," strengthens the stated attitude. In some cases it might be wise to reduce occasions where attitudes contrary to the desired attitudes would be expressed.

Feedback will occur after the training program is complete. The rewarding of desired behaviors should be continually related to the job and must therefore be integrated into the command structure.

Table 11 presents an overview of use of instructional devices in seeking to put attitudes into practice.

Table 11 here

Table 11

Instructional Device Capability and Putting Attitudes Into Practice

Instructional Device	Goal Awareness Information	Related Information	Practice	Feedback
1. Live Human				
Lecturer	Yes	Yes	Not Typical	Not Typical
Demonstrator	Yes	Yes	N/A	N/A
Tutor or Coach	Yes	Yes	Yes	Yes
2. Recorded Motion or Sound	Yes	Yes	Typically Vicarious	Typically Vicarious
Tape Recorder				
Film Cassette (super 8, silent, color)				
Film (16mm, sound, color)				
TV (B/W)				
TV (B/W, record and playback function)				
3. Graphic	Yes	Yes	Possible	Possible
Overhead Projector				
Film Strip (silent, color)				
Film Slides (35mm, color)				
Blackboard				
Book (color plates)				
Printed Handouts				
4. Simulator or Actual Equipment	N/A	N/A	Yes	Yes
Simulator				
Actual Equipment				
5. CAI or PI	Yes	Yes	Displaced	Yes
Computer (words and numbers)				
PI (including pictures)				
6. Small Group	Yes	Yes	Vicarious	Vicarious
Role Playing				
Discussion Group				

GLOSSARY

Acquisition of discrete motor skills	Learning to attain an acceptable level in performing a complex physical act.
Acquisition of reactive skills	Learning to attain a proficiency level in performing a series of related acts in response to cues in the environment.
Analyzing	Process of reducing a complex display or event to its elementary parts.
Approach	A selection of learning experiences designed to enable a learner to perform.
Aptitude	Potential ability.
Attitude	A relatively stable predisposition to behave in certain ways.
Behavioral objectives	Explicit statement of performance to be attained in learning in the form of an observable action.
Camera angle	The viewpoint given the learner by the angle from which an object is photographed.
Confirmation	Information used as equivalent to knowledge of correct results.
Covert	Not evident; activities that are not observable or noted by an observer.
Cue	Stimulus used in guiding or controlling performance.
Cue summation	Simultaneous availability of information through two or more sensory channels, such as words and pictures.
Discrete motor skills	Skills necessary to perform a complex physical act.
Discrimination	Distinguishing differences between items.
Distractive information	Information which is not goal related.
Ease of operation	The apparent complexity in using a piece of equipment by a learner.
Feedback	The evaluative information available to the learner following a performance, useful in regulating present or future performance; provides confirmation of knowledge of results.

Fidelity	Faithfulness of reproduction. Degree to which a device corresponds to an operation with regard to physical and operating characteristics.
Filtering	An inferred process to account for difference between the total information available and that which the learner appears to use.
Generalized behavior	Set of related specific behaviors.
Goal awareness	The end result, immediate or remote, which an organism is seeking.
Information available	All the information, of whatever category, that is potentially available to the learner.
Input	In system terms, that which is entered into a processing system; in the general learner model, information.
Instructional device	Information mediating equipment, methods, and materials.
Job aid	A device intended to assist in job performance, such as a handbook, procedural guide, or check list.
Job analysis	Identified on-the-job performance requirements in terms of individual tasks and job characteristics for the MOS.
Learner performance	A statement of what the learner may do as a result of training.
Learning atmosphere	Generalized attitudes towards the instructor, the learning context, and other learners within the learning context.
Learning experiences: (teaching points)	The information and experiences needed for the learner to achieve the appropriate performance.
Mental operations	The inferred process by which information is converted into a learner performance; the system that mediates between input and output.
Output	Something that is produced using input by mediating processes; in the general learner model, an information-based performance by the learner.
Overlays	A transparent sheet containing graphic matter to be superimposed on another sheet.
Overlearning	Learning in which practice is continued beyond the level of performance needed to insure retention.
Overt	Observable activities: something that can be detected by an observer.
Perception	Process of knowing objects and objective events by means of the senses.
Pop-ons	The sudden appearance of new information on a display.

Procedure	A series of steps followed in a regular, orderly, definite way.
Programed instruction (PI)	A method of self-instruction in which the student works through a carefully sequenced and pretested series of steps leading to the acquisition of knowledge or skills.
Prompting	Providing additional information intended to elicit the correct performance.
Putting attitudes into practice	A set of behaviors from which is inferred the holding of a value, remaining loosely specified since often the specific behaviors are too numerous for listing.
Reactive	Used in this manual to emphasize the fact that the appropriate response is defined by a cue that is immediately relevant to the environment.
Reactive decision making	Sequential series of problem solving behavior, with the nature of each step based on the outcome of the previous step.
Reactive skills	A series of activities in which each one is the outcome of a previous action.
Recall of facts	Learner performances which imply the formation of an association or set of associations.
Recall of procedures	Learner performances which imply the formation of a fixed sequence of associations.
Referability	Availability for access over a time period; the characteristic that enables sustained scanning or rescanning of information.
Reinforcement	That which increases the probability of a response.
Response	Reaction to a cue or other stimulus; an overt or covert behavior.
Retention	Capability of performing a learned act or experience during an interval of no practice.
Reward	That which produces satisfaction; occasionally a synonym for reinforcement.
Role playing	Technique in which specified roles are acted out; a method of studying the nature of a certain role by acting out its concrete details in a contrived situation that permits of better and more objective observation.
Selective perception	Perception of some types of objects and objective events better than others.
Sensory channel	The modality of sensation, such as seeing or hearing.
Set	Readiness to perceive in a certain way or according to a certain form of reference.

Shaping	Teaching a desired response by rewarding for acts progressively more like the act to be learned.
Sign	Information segments that resemble what they represent in a non-discrete manner.
Skill	A learned aptitude or ability.
Stimulus	A sign or signal for action.
Symbol	Arbitrary, discrete information segments that bear no resemblance to what they represent.
Synthesizing	Integrating discrete elements to form a whole.
Task-related information	The specific content information required to achieve a specific performance.
Training analysis	Bridges the gap between job requirements and training program. Most specifically relates to converting job requirements to training objectives and criteria.
Training management	Responsibility for the design of training.
Training materials	The specific information required to enable a learner performance; the means by which knowledges or skills are developed.
Tutoring	Method of individualized instruction; typically involves one instructor teaching one student.
Type of information	Term used in this manual to characterize presentational aspects of information; the two basic types are distinguished as signs and symbols.
Using concepts	Using meaningful groupings of experience for particular purposes.
Vanishing cues	Cues in which progressively less information is provided to assist the learner to provide the correct performance.
Variable	Factor able to vary in quantity or magnitude or in some qualitative aspect; subject to change.
Vicarious practice	The substitution of mental practice for overt performance.
Visual aid	Graphic portrayal assisting in a verbal presentation.